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ABSTRACT

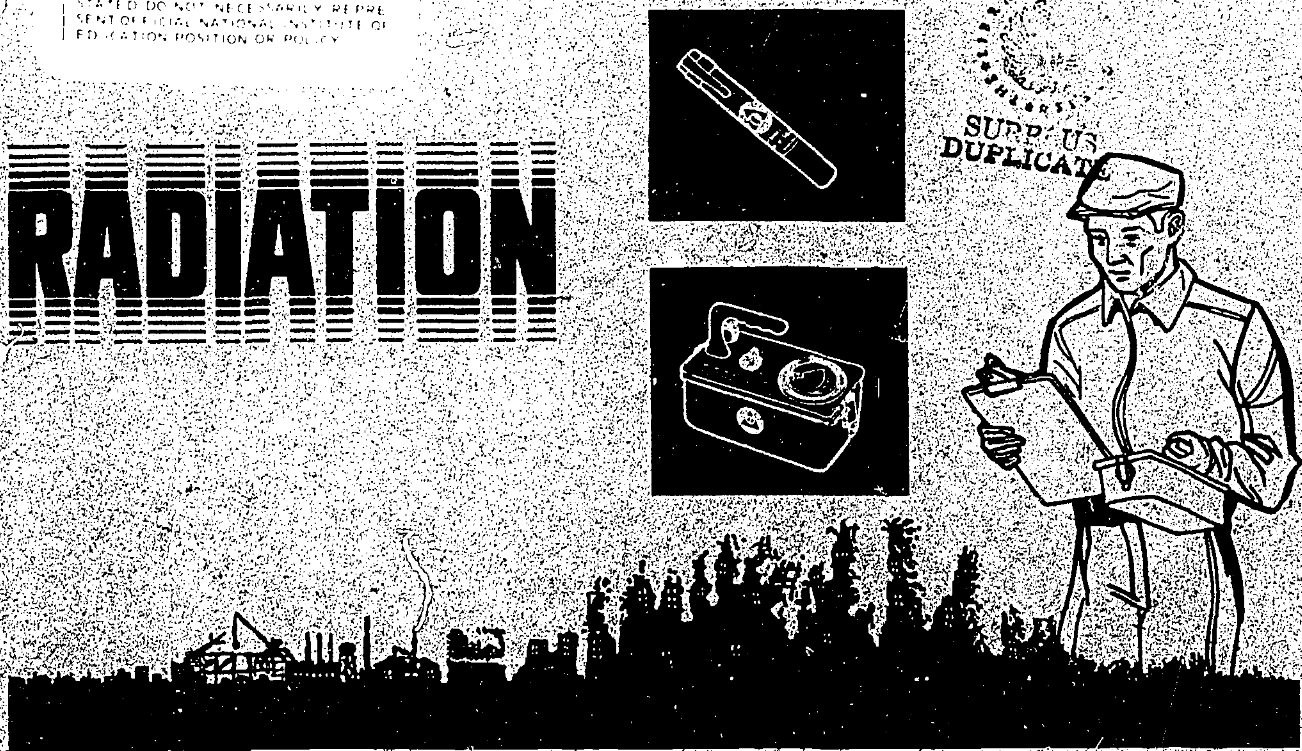
This progrmed course of study is designed to prepare local government officials and individual citizens to act in nuclear emergencies or disasters. Each of the four units has two lessons beginning with a brief overview and proceeding with self study frames. Line drawings are used to illustrate effects. Topics covered are the radiological monitor in civil defense, fallout effects, exposure guidance, RADEF instruments, protective measures, decontamination procedures, dose and dose rate calculations, and radiological monitor tasks, procedures, responsibilities, and reporting. An additional information appendix follows the same format but is not provided with tests; it covers nomograns and peacetime nuclear hazards. (MS)

JUNE 1972

Introduction To RADIOLOGICAL MONITORING

A Programmed Home Study Course

FOUR SELF-STUDY UNITS



STAFF COLLEGE DEFENSE CIVIL PREPAREDNESS AGENCY • BATTLE CREEK, MICHIGAN

Dear Participant: June 1972

On May 5, 1972, Secretary of Defense Melvin R. Laird announced the establishment of the Defense Civil Preparedness Agency (DCPA) in the Department of Defense. Simultaneously the Office of Civil Defense within the Department of the Army was disestablished and its functions transferred to the new Defense Agency. All references to the Office of Civil Defense (OCD) in this text should be changed to Defense Civil Preparedness Agency (DCPA).

The goals of the new agency are to provide an effective National Civil Defense Program and planning guidance to state and local governments in their achievement of total disaster preparedness. One step in achieving the goals is to train local government officials and individual citizens for emergency or disaster activity that will save lives and protect property. This home self-study course will introduce you to the knowledge and activity required for radiological monitoring, which is a vital skill for nuclear preparedness.

Sincerely,

John E. Davis
Director
Defense Civil Preparedness Agency

DEFENSE CIVIL PREPAREDNESS AGENCY
STAFF COLLEGE
FEDERAL CENTER
BATTLE CREEK, MICHIGAN 49016

TO HOME STUDY PARTICIPANTS:

Welcome to the Staff College home study course Introduction To Radiological Monitoring!

Through this self-teaching programmed instruction, you will receive an orientation to radiological monitoring. The study materials accompany this letter. These and a pencil are all you need to get started.

When you are ready to begin, read the "Table of Contents" and the "Introduction." They give background in the subject matter. Carefully study the section on "How to Use These Materials," in order to get off to a good start in the programmed instruction.

If you have any questions during study of this course, write to us here at Staff College. We will be glad to help you. The address is: Instructor, Introduction To Radiological Monitoring, HS-3, OCD Staff College, Federal Center, Battle Creek, Michigan 49016.

Good luck! We think you are going to enjoy this new method of learning.

ENROLLEES STUDENT NUMBERS

YOUR STUDENT NUMBER IS ON THE UPPER LEFT CORNER OF THE ADDRESS LABEL ON THE ENVELOPE IN WHICH YOU RECEIVED THESE COURSE MATERIALS.

EXAMPLE:

002199 0400 122368

DOE: MR. JOHN C.

11 MAIN STREET

ANYCITY, ANYSTATE 49016

THE STUDENT NUMBER IN THIS EXAMPLE IS 002199. PLEASE INCLUDE YOUR NAME AND STUDENT NUMBER ON ALL CORRESPONDENCE REGARDING THIS HOME STUDY COURSE. (IF YOU DESTROY THE MAILING ENVELOPE BEFORE GETTING YOUR STUDENT NUMBER, GO AHEAD WITH YOUR LESSONS AND SEND IN THE ANSWER CARD WITH YOUR NAME AND ADDRESS, OMITTING THE STUDENT NUMBER.)

NOTE: DUE TO THE MUCH MORE RESTRICTIVE REGULATIONS OF THE U. S. ATOMIC ENERGY COMMISSION ON THE MAXIMUM ALLOWABLE DOSE OF NUCLEAR RADIATION FOR YOUNG PEOPLE, HOME STUDY COURSE STUDENTS UNDER THE AGE OF 18 WILL NOT BE PERMITTED TO TAKE THE SPECIAL 8-HOUR CLASSROOM COURSE.

JUNE 1972

INTRODUCTION TO RADIOLOGICAL MONITORING

HOME STUDY COURSE

PAGE

INTRODUCTION TO RADIOLOGICAL MONITORING

HOME STUDY COURSE

GENERAL INFORMATION

In the event of a nuclear attack on the United States there would be millions of survivors, regardless of popular statements we often hear to the contrary. In order to do all that can be done to enhance their chances for continued survival, the U. S. Office of Civil Defense (OCD) must have a system for gathering, analyzing, and developing countermeasures against the threats to survival that will exist during postattack times.

One of the most significant parts of this system is the Radiological Defense Program (RADEF). An extremely important job in this program is that of Radiological Monitor. He must be well enough trained to be able to help protect the citizens in his community from the hazards of radioactive fallout.

To become a fully qualified Radiological Monitor, it has been necessary for students to be taught by and in the physical presence of an especially trained Radiological Monitor Instructor (RMI) for the full 16 hours of the established OCD radiological monitors course.

To make radiological monitor training available to many more citizens, who may be willing to serve their communities as monitors, but who cannot afford 16 full hours in class, this home study course has been developed.

The Course consists of 4 Units of programmed instruction and a final examination. All who successfully complete this course will be considered by OCD to have fulfilled the requirements of the equivalent of the first 8 hours of the standard OCD 16-hour course and will receive a Certificate of Completion. Then if a student is interested in being certified as a Radiological Monitor he must contact his local Civil Defense Director and arrange to take the additional 8 hours of practical training in the use of the instruments.

INTRODUCTION TO RADIOLOGICAL MONITORING

HOME STUDY COURSE

RADIOLOGICAL MONITORING QUALIFYING COURSE OUTLINE

This is a general description of the major subject matter of the Special 8-hour classroom course graduates of the INTRODUCTION TO RADIOLOGICAL MONITORING Home Study Course must successfully complete, in order to become fully qualified Radiological Monitors.

	Subject	Approximate Time
I.	RADIOLOGICAL MONITORING PRACTICAL EXERCISES	4 Hours
	OCD RADEF Instrument familiarization, and practice in monitoring techniques and procedures; taught by and in the physical presence of a qualified RMI. OCD Radioactive Training sources will be utilized.	
II.	RECAPITULATION AND REVIEW OF HOME STUDY COURSE UNITS 1 THROUGH 4.	2 Hours
	Amplification by the instructor of concepts which were unclear or difficult for the individual students of the particular class being taught at the time.	
III.	NATIONAL RADIOLOGICAL DEFENSE SYSTEM	1-1/2 Hours
	Description of nuclear postattack conditions; RADEF personnel requirements, i.e., how many monitors are required, where, and why, as well as other trained RADEF personnel; Federal Civil Defense Guide formula for establishing monitoring stations, i.e., how the location of monitoring stations is decided; how instruments are obtained; how qualified monitors contribute to preattack preparedness.	

IV. SUMMARY, AND PRESENTATION OF CERTIFICATES TO FULLY QUALIFIED MONITORS. 1/2 Hour

Written assignment to Monitoring Station or Shelter, signed by the Local Civil Defense Director or Coordinator, to accompany each graduation Certificate.

HOW TO USE THIS BOOK

This course is presented in a special format known as programmed instruction, a learning technique based on the concept that you learn better when you take an active part in studying. Since this is a home study course, you don't have the benefit of a personal instructor. Instead, you should regard the text itself as your instructor and follow all the instructions you find in it.

In programmed instruction, information is presented in small pieces called "frames." In a frame, you're given information, then asked to make a response based on what you've been told. You may be asked, for example, to fill in the blank, check a correct answer, or label a drawing. The correct answer is then provided so that you can check on your progress through the material.

The answers will appear to the right of the frames, as shown below. Cover the correct answers with a blank piece of paper, such as a 3 x 5 card or a mask torn from the next page of this book, until after you've answered the frame as you think you should. Then move the paper mask down and check your answer. Heavy lines between frames tell you how far to move your mask to reveal only one answer at a time. Here are a couple of sample frames. (If you have not yet obtained a mask, tear a strip of paper from the next page and cover the answers below.)

FRAME	ANSWER
FRAME 1 A person who collects radiological data and reports it performs a function called monitoring. It follows that this person is called a radiological ____________________.	monitor
FRAME 2 When a monitor has obtained radiological data, he should (CHECK THE CORRECT ANSWER): ____A. keep it hidden--it's confidential. ____B. report it as directed by his community's standing operating procedure.	B is correct.

Now, you may be thinking that it's awfully easy to "cheat" by looking at the answer before writing your own. It is. But you won't learn as well, or as easily, if you do so.

After you complete each unit you will find a Unit Test. This, also, is handled on the "honor system." The correct answers for all unit tests are found on page xxx in the back of the book. If you find some of your answers are incorrect you are to review the material until you understand it before beginning the next unit.

USE THESE STRIPS TO

MASK THE ANSWERS ON THE SIDE OF THE PAGES

AS YOU READ THROUGH THIS COURSE.

CUT ALONG THE DOTTED LINES

EXTRA MASK

EXTRA MASK

MASK

This isn't a test; it's a learning method. If you follow the instructions and pay attention, you'll be pleasantly surprised at how much you can learn in a relatively short time.

Ready? All right. Start with Unit 1, which begins on the page after next.

UNIT 1

THE RADIOLOGICAL MONITOR IN CIVIL DEFENSE

FALLOUT EFFECTS AND EXPOSURE GUIDANCE

LESSON ONE

THE RADIOLOGICAL MONITOR

IN

CIVIL DEFENSE

OVERVIEW

&

SELF-STUDY FRAMES FOLLOW

LESSON ONE

THE RADIOLOGICAL

MONITOR IN CIVIL DEFENSE

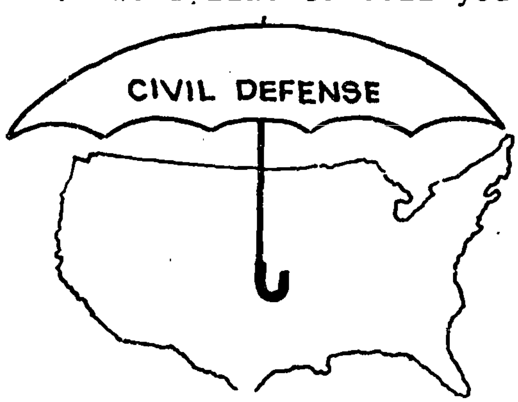
OVERVIEW

In this lesson, you'll learn what civil defense is and how radiological defense fits into the overall picture. You'll also learn what happens when a nuclear weapon is detonated--what blast and thermal effects are, and the types of radiation hazards that result.

Throughout the lesson, you'll see how the radiological monitor functions in a typical radiological defense (RADEF) system. All set? Go to frame 1 and begin.

CIVIL DEFENSE DEFINED

1. We'd like to tell you that civil defense can eliminate all danger from nuclear attack, like a huge umbrella over our nation. But we can't. Instead, our civil defense program is designed to minimize the effects of an ______________ on our nation.



Answer: attack

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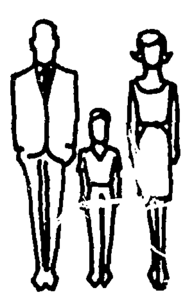
2. Since it's called civil defense, which of these two groups do you think civil defense is designed to protect?

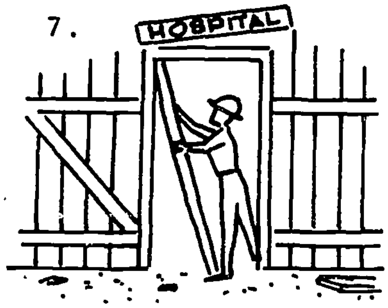


CIVILIAN POPULATION

MILITARY

Answer: civilian population

3. So, one part of the definition of civil defense is that it consists of those activities and measures designed to: A. minimize the effects upon our ______________ population.... B. caused by an __________ on our nation.	A. civilian B. attack
4. If an attack occurs, we'll be thrown into a state of emergency, to which civil defense must respond. That's another part of our civil defense definition: Those measures and activities designed to deal with (CHECK THE CORRECT ANSWER): ___A. immediate emergency conditions resulting from an attack. ___B. normal conditions just prior to attack.	A is correct.
5. In some phases of radiological monitoring, you'll be dealing with long-range activities. But in our definition of civil defense, we'll state that it involves conditions that are (immediate/long-range--which?) ____________________________.	immediate
6. The third part of the definition of civil defense deals with the emergency repair to, or restoration of, vital facilities and utilities. Check any items in the list that probably fall into the vital category. ___A. humane society facilities. ___B. hospitals. ___C. power plants. ___D. museums.	B & C are

7. 

Normally, civil defense operations don't include rebuilding our cities. Still, CD personnel may become involved in restoring to use or repairing facilities that are considered__________, such as hospitals.

vital (OR) essential

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8. Civil defense, then, is defined as all those activities and measures designed to (CHECK ANY CORRECT STATEMENTS):

___A. eliminate danger of attack.
___B. minimize the effects upon our civilian population caused by an attack.
___C. deal with immediate emergency conditions resulting from an attack.
___D. permanently rebuild our cities.
___E. provide for emergency repair to, or emergency restoration of, vital facilities and utilities.

B, C, & E are correct.

RADIOLOGICAL DEFENSE (RADEF)

9. We're concerned here with CD operations dealing with protection against nuclear radiation. Since our nation is so large, and because we already have local governmental units, CD responsibilities are considered a logical extension of the functions of these _______ governments.

local

10. Our RADEF system is an organized effort to minimize the effects of nuclear attack on people and their resources through: (1) detection of nuclear radiation; (2) warning of the presence of harmful radiation; and... (3) preventive and remedial (corrective) measures against harmful radiation. Place the numbers of the above statements beside the appropriate descriptions below. ____A. Shelters are prepared to protect against radiation. ____B. Using radiological instruments, monitors discover the presence of radiation after a nuclear attack. ____C. Presence of harmful radiation is reported to the proper authorities.	3 A. 1 B. 2 C.
11. Through these activities, RADEF is the organized effort to minimize the effects of nuclear radiation on both people and the things they must have or use to live. That is, RADEF is intended to protect both people and their __________________.	resources (or equivalent)
12. Radiological defense is performed through: A. determining if radiation is present, or radiation__________. B. warning the authorities when harmful __________is present. C. taking preventative and remedial ______against radiation hazards.	A. detection B. radiation C. measures (OR) action

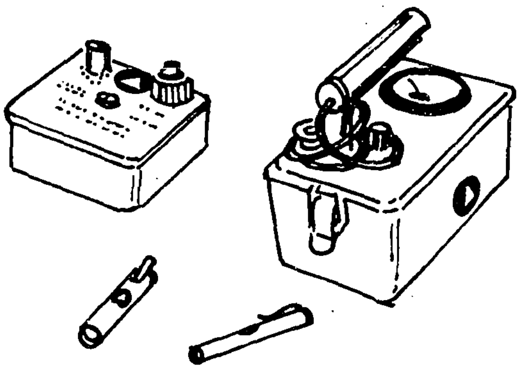
13. Radiological defense is (CHECK THE CORRECT ANSWER): ___A. the organized effort to eliminate all danger from radioactivity to people and their resources. ___B. the organized effort, through detection, warning, and preventive or remedial action, to minimize the effects of nuclear radiation on people and their resources.	B is correct.
RADEF RESPONSIBILITIES 14. Keep in mind that RADEF is just one part of CD. But RADEF is (CHECK THE CORRECT ANSWER): ___A. relatively unimportant, since nuclear attack is less and less likely. ___B. moderately important, but not essential. ___C. extremely important, because it deals with measures that will save lives.	C is correct.
15. Civil defense functions are a logical extension of normal government and community activities. With community involvement, costs are held down and lines of communication are more easily kept open. In short, this method of assigning CD functions is very (efficient/inefficient--which?) ______________________.	efficient

16. Civil defense functions are spread around in the most economical fashion. These functions are the responsibility of (CHECK THE CORRECT ANSWER): ___A. community governments. ___B. Federal agencies only. ___C. state governments alone.	A is correct.
17. Check any correct statements below about CD and RADEF operations. ___A. CD is set up under one non-governmental agency. ___B. RADEF is separate from CD. ___C. CD, including RADEF, is a responsibility of existing governmental bodies. ___D. The main responsibility is at the community level.	C & D are correct.
THE RADIOLOGICAL MONITOR 18. In RADEF, a key element to success is trained personnel. Community RADEF systems nationwide need thousands of people capable of detecting and reporting radiation. The nation, therefore, needs trained ___________ monitors.	radiological

19. We must maintain a vast network of monitors to report radiological data from shortly after an attack until such time as the radiological hazard diminishes to the point that daily activities essential to survival can be resumed. So, unless some special situation develops locally, the trained monitor will have no monitoring to do until (CHECK THE CORRECT ANSWER): ___A. after we have been attacked. ___B. we are ready to move out of the shelters.	A is correct.
20. Radioactive material (from which nuclear radiation comes) "decays" with time; -- that is, as time passes, the intensity of the radiation decreases, and therefore becomes less hazardous. After attack the monitor's services will be required until outside activities can be resumed. (CHECK ONLY ONE ANSWER): ___A. Because radiation intensities have decreased to acceptable limits. ___B. Because of the decay of radioactive material, which decreases the hazard; and any direct measures, such as decontamination, taken by local government. ___C. Both A and B are correct. ___D. Neither A nor B is correct.	C is correct.
21. The monitor's function will begin shortly after nuclear attack, but there's no specific limit beyond which his job is no longer necessary. Monitoring will have to continue until (FINISH THIS SENTENCE)________________ ____ ____ ____ ____.	radiation levels have dropped to the point that it is permissible to resume outside activities (OR EQUIVALENT ANSWER)

22. The monitor's primary function in the event of nuclear attack is to obtain and report information about local radiation that is essential to the analysis and evaluation of the radiological hazard. To do this, he must know: (1) local standing operating procedures (SOP) for radiological defense. (2) types, operation, and uses of all CD radiological instruments and equipment. (3) techniques for monitoring areas and in support of emergency operations. (4) protective measures necessary to keep personnel exposure to a minimum. Perhaps not all these terms mean a great deal to you just now. But you'll learn more about them later. NO RESPONSE REQUIRED: GO TO THE NEXT FRAME.	NO RESPONSE REQUIRED
23. As a part of his function, the monitor must know and follow his community's standing operating procedures, abbreviated ______________.	SOP

24. To obtain and report radiation information, the monitor will have to



be able to use what's pictured here--radiological_______________.

instruments

25. The monitor will also have to know what techniques to use in area monitoring, plus techniques to use when monitoring in support of (normal/emergency--which?)_________ operations.

emergency

26. Finally, the monitor must know protective measures to hold personnel exposures to a_________________.

minimum

27. The primary duty of the radiological monitor is to (CHECK THE CORRECT ANSWER):

___A. lead everyone to a place of safety.

___B. take over complete control of all CD functions in the area.

___C. obtain and report local radiation information essential to the analysis and evaluation of the radiological hazard.

C. is correct.

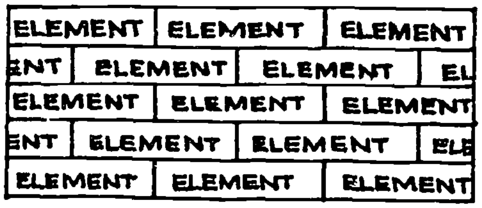
28. Monitors are named according to the function to which they're assigned. All are taught to perform the same functions and tasks, but: A. if a monitor is assigned the main function of monitoring shelter conditions for the protection of shelterees, he's called a ________ monitor. B. if he's assigned to a fallout station for the function of monitoring for emergency operations in a locality, he's called a ________ monitor.	A. shelter B. fallout station
29. Any monitor is operational--he can perform emergency operation monitoring if required. But assignments can vary. A. Some are assigned to monitor for the protection of shelterees in a ________. B. Others are assigned the function of obtaining and reporting information from a ________.	A. shelter B. fallout monitoring station
30. Even if you were assigned to the loneliest fallout station, in the RADEF system, you wouldn't be alone. You wouldn't have to make decisions by yourself--provided communications are kept open with your community emergency operations center (EOC). You'd report to, and obtain assistance from, your organizational radiological defense officer, abbreviated (also called) ________.	RADEF Officer (OR) RDO

31. Suppose you've been ordered to perform a mission outside your fallout station, but you know you've already been exposed to radiation, and the task may cause overexposure. You needn't make the final decision alone. A long as you can communicate with him, you can get help from your community__________ ______________________________.

RADEF Officer (OR) RDO

ELEMENTS AND ATOMS

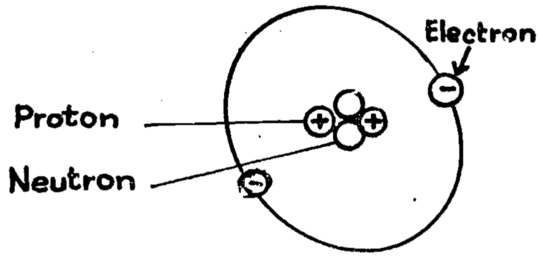
32. Let's discuss a few terms you'll run across in dealing with radiation. The first of these is "element". Elements are sometimes referred to as the "fundamental building blocks of nature".



Such things as hydrogen, nitrogen, iron and tin are ______________.

elements

33. Suppose you could take one of these elements--iron, for instance--and break it into tiny pieces. The tiniest piece you could break it into and still have a chunk of iron is called an atom of iron. Atoms



usually have all of the parts shown here. Neutrons are neutral in electrical charge, but, as indicated by the signs:

A. electrons have a __________ electrical charge.
B. protons have a __________ electrical charge.

A. negative
B. positive

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34. We've said that:

A. Nature's fundamental building blocks are called __________.
B. the smallest possible particle of such a material is called an __________.
C. the parts of the atom are __________, __________, and __________.

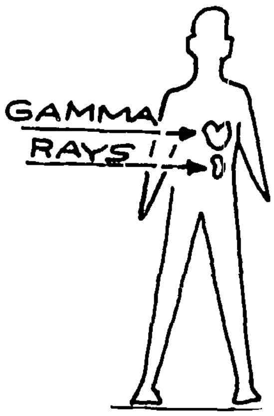
A. elements
B. atom
C. electrons, protons, neutrons (IN ANY ORDER)

35. Most materials--elements--hold together quite well. Therefore, we can state that the atoms of most elements are (stable/unstable--which?)____________________.	stable
36. Without going into further detail about elements and atoms, let's summarize by saying: A. elements are called Nature's fundamental________________. B. the smallest possible particle of an element is an____________. C. Most atoms are_____________.	A. building blocks B. atom C. stable

RADIOACTIVITY AND NUCLEAR RADIATION

37. Most atoms are stable. But some natural atoms, and several we've been able to create, simply don't hold together well. These atoms are (stable/unstable--which?) ____________________________.	unstable
38. Unstable atoms tend to break down. Parts of them can fly off into surrounding space in the form of energy. That's what radioactivity is...the spontaneous, uncontrollable breakdown of ______________atoms.	unstable
39. The spontaneous, uncontrollable breakdown of unstable atoms, with a resultant energy release, is called ___________________________.	radioactivity

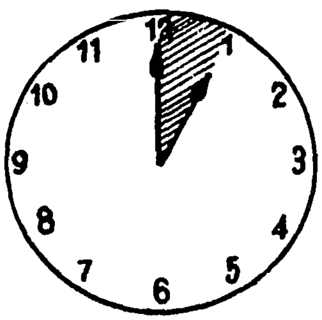
40. The particles of energy that go flying off unstable atoms have a name of their own. Since the energy is released from the nucleus, or center, of the atom, the energy particles are called ________ radiation.	nuclear
41. Once nuclear radiation starts, there's no way to stop it. It lives up to the definition of being (CHECK THE CORRECT ANSWER): ___A. controlled, gradual energy release. ___B. spontaneous, uncontrollable release of energy from an atom.	B is correct.
42. We've said that: A. radioactivity is the spontaneous, uncontrollable breakdown of ________. B. the energy particles thus released are called ________.	A. unstable atoms B. nuclear radiation
43. There are three types of nuclear radiation, and they're named after the first three letters of the Greek alphabet. The third one is gamma. Do you know the first two letters of the Greek alphabet?________.	alpha, beta (If these were "Greek" to you, don't worry--we asked you to guess).
44. Alpha and beta radiation consist of actual particles that are electrically charged. But the third type is pure energy, similar to X-rays. So gamma radiation is often referred to as gamma________.	rays

45. Alpha rays can't penetrate unbroken skin. However, if radioactive materials that emit alpha rays are taken into the body, the internal organs, which are not protected by skin, can be seriously damaged. Nevertheless, alpha radiation (rays) still (is/is not--which?) ________ as hazardous as beta and gamma radiation.	is not
46. When left on the skin for long periods, beta-emitting particles can cause skin burns similar to heat burns. If they're brushed off in time, beta-emitting fallout particles won't even cause serious burns. So, as with alpha-emitting particles, beta particles (are/are not--which?)__________ considered as dangerous as gamma radiation.	are not
47. Gamma rays resemble X-rays. They can penetrate most materials with ease. When they penetrate the body, gamma rays can damage vital organs. It's obvious, then, that gamma radiation is the most ________ of the three types of nuclear radiation. 	dangerous (OR) harmful
48. Alpha-and beta-emitting particles must either be in or on the body, respectively, before they are harmful. But gamma rays can harm an individual (CHECK ONLY ONE ANSWER): ___A. because of the damaging effects on vital organs. ___B. even when the gamma ray emitters are quite some distance from him. ___C. Both A and B are correct. ___D. Neither A nor B is correct.	C is correct

49. The radiological monitor will be required to measure only the most dangerous type of nuclear radiation--______________ radiation.	gamma

RADIATION MEASUREMENT TERMS

50. Since radiation affects people, we must be able to measure its presence and relate the measurement to its physiological effect. The total amount of gamma radiation to which a person is exposed is called the dose, and the unit of dose measurement is the roentgen or milliroentgen (one thousandth of a roentgen). If a man is exposed to 5 roentgens of gamma on one occasion, and 6 more on another: A. the total of the two figures is his cumulative gamma radiation exposure________________. B. his total dose is___________.	A. dose B. 11 roentgens
51. In gamma radiation exposure dose measurement: A. the unit of measurement is the ____________________. B. measurements can be made in thousandths of a unit, or ____________________________.	A. roentgen B. milli-roentgens
52. In writing exposure doses, roentgen is usually abbreviated with a capital "R", and it follows immediately after the number. A dose of 50 roentgens would be written__________________.	50 R

53. If John White has received a 15 R exposure to gamma radiation, his total exposure ____________ is 15 ______________________.	dose, roentgens
54. If the indicated dose is 15 mR, White has received a dose of 15 ________ ____________________.	milliroentgens
55. Another very important measurement of radiation is the rate at which an individual is exposed to gamma radiation. This is measured on a per-hour basis, and it's called the exposure dose __________________.	rate
56.  The roentgen or milliroentgen is used for expressing the dose <u>rate</u>, too, except that the time involved must be included in the measurement. As the clock shows, the time unit is always an hour, and dose rates are expressed in terms of roentgens or milliroentgens per ________________.	hour

57. In writing dose rates, "R" or "mR" stands for roentgen or milliroentgen: a "/" (slash) is used in place of "per"; and "hr" is used for the word "hour." A dose rate of sixty roentgens per hour would be written ______________.	60 R/hr
58. Write these doses and dose rates: A. dose of 12 milliroentgens, ________. B. dose rate of 100 roentgens per hour, __________. C. dose rate of 250 milliroentgens per hour, ____________. D. dose of 100 roentgens, _________.	A. 12 mR B. 100 R/hr C. 250 mR/hr D. 100 R
59. When exposure to radiation is being measured: A. the unit used to measure gamma radiation exposure dose is the ________ or the ________________. B. the unit used to measure gamma radiation exposure dose rate is the ______________________________.	A. roentgen, milli-roentgen B. roentgen, per hour or milli-roentgen per hour

NUCLEAR BLASTS

60. Because we are more familiar with TNT explosions, the power of a nuclear explosion is expressed in terms of its relationship to TNT. The relationship is stated with the prefix <u>kilo</u> or <u>mega</u> added to the word <u>ton</u> or <u>tons</u>. Since the prefix "kilo" means 1,000, an explosion of 1 kiloton of TNT is the same as one of a thousand ____________ of TNT.	tons

61. If a nuclear explosion releases as much energy as 5,000 tons of TNT, it's a 5-______________burst.

kiloton

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62. Today's weaponry makes possible nuclear weapons capable of releasing energy equivalent to <u>millions</u> of tons of TNT. Since the prefix "mega" means "million", we have bombs capable of releasing energy measured in ______________________-tons.

mega(tons)

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63. Write the correct descriptions for nuclear weapons equal to:

A. 100,000 tons of TNT--__________ ________________.

B. 5,000,000 tons of TNT--________ ________________.

C. 75,000,000 tons of TNT--_______ ________________.

A. 100 kilotons
B. 5 megatons
C. 75 megatons

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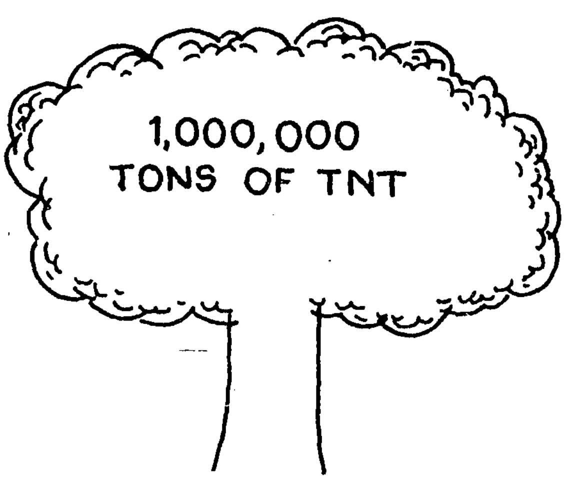
64. The amount of energy released by a nuclear weapon is called its yield. The weapon shown has a ______________ of one __________________.

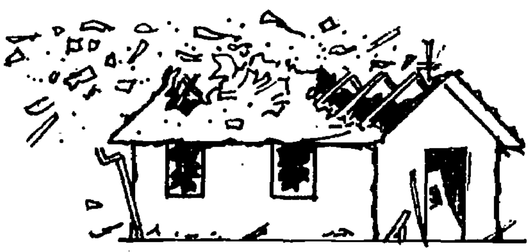


yield, megaton

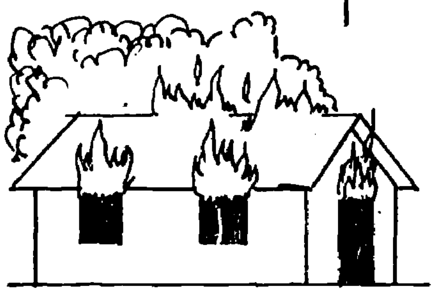
65. The yield, or energy release, of a nuclear explosion takes three forms. The first is called the blast effect. Based on your general knowledge, check the best answer below. ___A. Both conventional (TNT, for example) and nuclear weapons have blast effects, but the one from a nuclear weapon is always smaller. ___B. Only nuclear weapons produce a blast effect. ___C. Both types of weapons produce a blast effect, but the one from a nuclear weapon can be much greater.	C is correct
66. With even a relatively small nuclear weapon, buildings can be destroyed by the shock of the explosion for miles around. This is evidence of the tremendous __________________ of nuclear weapons.	blast effects
67. A nuclear weapon also releases vast amounts of energy in the form of thermal radiation. This energy has been known to set houses afire quite some distance from the blast itself. So thermal radiation is the release of energy in the form of ________.	heat
68. The release of energy in the form of heat is known as ______________ radiation.	thermal

69. The third form of energy released from a nuclear burst is the main subject of this course--________ radiation.	nuclear
70. A nuclear explosion produces unstable atoms that release vast amounts of energy. This form of energy, as you know, is called ________________.	nuclear radiation

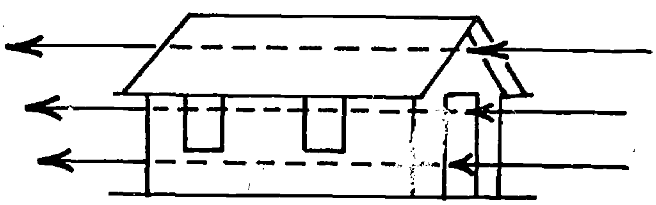
71. These three drawings illustrate the types of energy released by a nuclear weapon. Label each.



A.________________



B.________________



C.________________

A. blast effect
B. thermal radiation
C. nuclear radiation

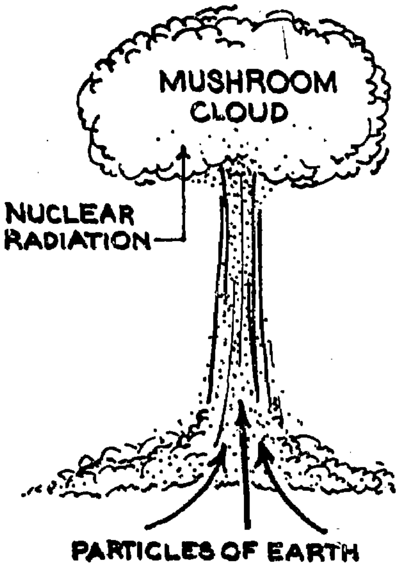
72. If a burst should occur, many people will be killed or injured. Depending upon where a person is in relation to the burst:

A. the initial explosion, or ________ effect, might kill or injure him...
B. the tremendous heat, or ________ ________, might cause injury or death...
C. or the resulting gamma ________ can result in injury or death.

A. blast
B. thermal radiation
C. radiation

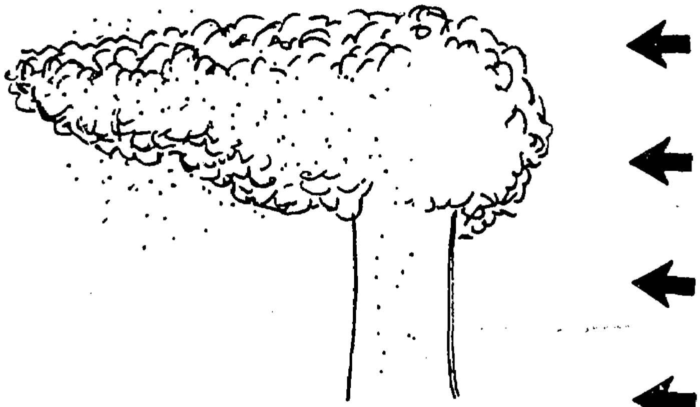
---

73. Even if you're not close enough to a ground burst nuclear detonation to be affected by the blast or thermal effects, you still may be in an extremely hazardous situation. The heat created by a surface burst causes an updraft of air into the mushroom cloud it forms. Millions of vaporized dirt particles are also drawn into the cloud. Then, as the heat diminishes, radioactive materials that have been vaporized condense on the drawn-up particles of earth, which are also condensing. Eventually, all these particles, many of which have combined with radioactive materials, fall back to earth. And that's where we get the name "radioactive ____________________."



fallout

74. All three types of nuclear radiation are present in fallout, but we've learned that alpha radiation (is/ is not--which?) ________________ as important to us in RADEF as the other types of nuclear radiation.	is not
75. Beta-emitting particles are harmful if taken into the body. And if fallout remains on the skin for prolonged periods, beta radiation can cause skin burns. Still, the beta radiation from fallout is much less harmful than ________________ radiation.	gamma
76. Radioactive fallout effects can be spread over a wide area due to the factor shown here--the__________.	wind



77. Remember these facts: A. When particles which have combined with radioactive materials return to the surface after a nuclear burst, they're called ________. B. A factor contributing to the widespread distribution of this fallout material is the ________.	A. fallout B. wind
78. This completes this lesson. We hope you have enjoyed this method of study. NO RESPONSE REQUIRED.	NO RESPONSE REQUIRED.

PLEASE CONTINUE WITH UNIT 1 ON THE FOLLOWING PAGES

LESSON TWO

FALLOUT EFFECTS

&

EXPOSURE GUIDANCE

LESSON TWO

FALLOUT EFFECTS AND EXPOSURE GUIDANCE

OVERVIEW

In this lesson, we'll discuss what happens to the human body when it's exposed to radiation. Much of what you're learning about fallout effects is presented as a general guideline only. For example, no two people necessarily react to an identical dose of radiation in exactly the same way. Still, you may need guidance in determining, with your shelter manager or RADEF officer, what effects are likely to occur. Therefore, the material in this section can be used if you need it. We expect you to be able to contact your RADEF officer for help in unusual cases.

The radiation exposure guidelines taught in this lesson are also intended as emergency rules. Certain situations may require, for instance, that you perform duties that will cause you to receive a greater dose than the limits described here. How valid these guidelines are depends upon emergency circumstances encountered.

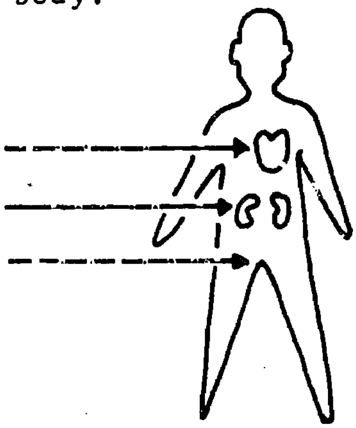
Ready? Go to frame 1 and begin this lesson.

IMMEDIATE HAZARDS

1. The three types of nuclear radiation are represented by the drawings below. Label each type.

A. ________________radiation must be ingested, which is unlikely, to harm the body.

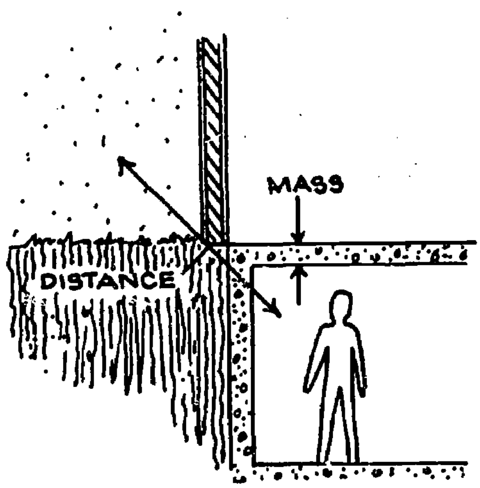
B. ______________ radiation can cause skin burns.



C. _______radiation can seriously damage vital internal organs due to its ability to penetrate so deeply.

A. alpha
B. beta
C. gamma

2. Due to radioactive decay, to be discussed later, time is a factor in the effects of gamma radiation. In addition to time, however, the only real protection against gamma radiation consists of the two factors provided by adequate shelter: ________________ and ________________.



mass, distance

3. The least important type of radiation to us in radiological monitoring is alpha. So the two more important types are ________________ and ________________ radiation.

beta, gamma (IN EITHER ORDER)

EXPOSURE OVER SHORT AND LONG PERIODS

4. To better understand radiation effects on the body, you should know the difference between short-term exposure and exposure over extended periods of time. For our purposes, we'll define a short-term dose as the dose received during a 4-day period. A dose, of course, is (CHECK THE CORRECT ANSWER):

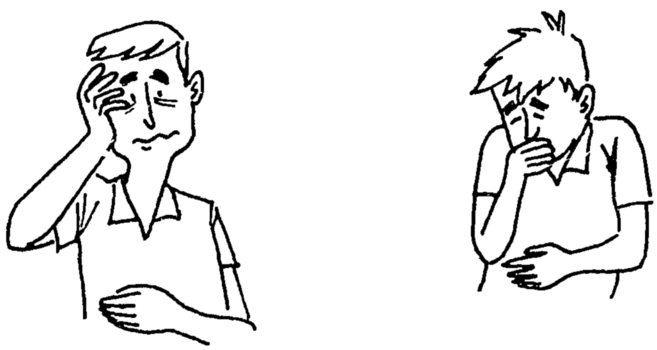
   ____A. the total exposure to radiation.
   ____B. the rate of exposure per hour.
   ____C. the amount of radiation the human body can withstand.

A is correct.

5. The human body can at least partially recover from radiation injury. If a person receives a serious dose, but makes it to shelter before being fatally injured, his body can begin repairing damage tissues even if a certain amount of exposure continues over extended periods--provided he's not exposed to a lethal dose. In other words, the body can repair damage (CHECK THE CORRECT ANSWER):

   ____A. only if no further radiation dose is received.
   ____B. even when further exposure occurs, as long as a lethal dose isn't received.
   ____C. when an additional massive short-term dose is received.

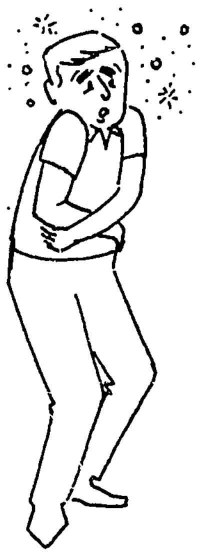
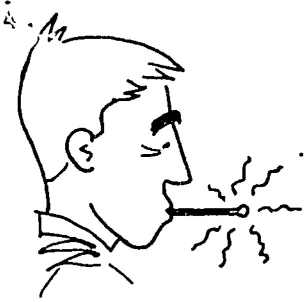
B is correct.

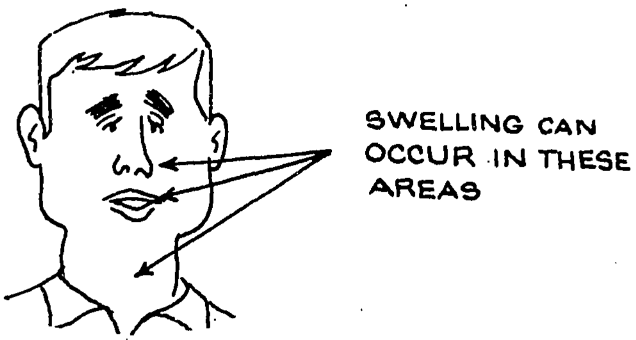
6. Depending upon the size of the dose and the way an individual reacts to radiation exposure, a large short-term dose can mean serious illness or death. For example, a dose of 450 R can kill about 50% of a large group of people so exposed. This same dose, however, received over an extended period of time, would kill far fewer people. This tells us that (CHECK THE CORRECT ANSWER): ___A. a massive short-term dose is less dangerous than an equal dose received over an extended period. ___B. extended exposures can't be tolerated as well as short-term doses. ___C. small doses, received daily over an extended period of time, can be much better tolerated than the sum total of all such daily doses received in one short-term exposure.	C is correct.
7. Assume both of these persons have been exposed to the same dose.  MAN A: feels slightly ill the day of exposure, then begins recovering. MAN B: is quite ill for several days after exposure. As these situations indicate, all people (do/do not--which?)_________react the same to identical radiation exposures.	do not

8. The greatest danger exists during the first few days to two weeks after the arrival of fallout. Therefore, people who survive the initial blast and thermal effects of the burst (CHECK THE CORRECT ANSWER): ___A. can begin resuming normal outside activities almost immediately. ___B. must remain in adequate shelter, especially during this period of high short-term exposure hazard.	B is correct
9. As long as the subsequent short-term dose isn't too high (lethal) the body (can/cannot -- which?) ____________ repair some of the damage caused by radiation.	can

RADIATION SICKNESS SYMPTOMS

10. The symptoms to be discussed are those caused by short-term doses of gamma radiation from fallout. We'll relate some general symptoms to specified doses. These classifications must be general because people don't all react the same to an identical __________ of radiation.	dose
11. The symptoms we'll discuss are those that can be seen or readily measured--the (visible/invisible--which?) ____________ signs of radiation sickness.	visible

12.  Two visible signs of radiation sickness are nausea and vomiting. But shock, or just pain, can cause a similar reaction. So, are nausea and vomiting necessarily an indication of radiation sickness? ________	no
13. You'll have to weigh the symptoms against the exposure received to determine whether they indicate radiation sickness. The symptoms we've discussed are ________ and ________.	nausea, vomiting (IN EITHER ORDER)
14.  This drawing illustrates the best way to detect a third radiation sickness symptom--a high ________ ________.	temperature (OR) fever
15. We've discussed three radiation sickness symptoms. List them. A. ________ B. ________ C. ________	nausea, vomiting, fever (IN ANY ORDER)

16. These symptoms resemble those of many common illnesses, including the "flu" and the common cold. You must judge them in terms of the amount of radiation exposure the person has had--his radiation exposure ________________.	dose
17. Radiation sickness symptoms may appear shortly after exposure, then disappear for a few days--only to reappear in a week or so in much more serious form.  When they recur, the symptoms are sometimes accompanied by swelling in the passages of the ________, __________, and _________________.	nose, mouth throat (IN ANY ORDER)
18. Once radiation sickness symptoms appear (CHECK THE CORRECT ANSWER): ___A. they may disappear, then reappear in a week or so, sometimes accompanied by nose, mouth, and throat passage swelling. ___B. they usually persist until death occurs. ___C. there is little or no hope for the individual, since the body cannot repair radiation-caused injuries.	A is correct

DOSE-VISIBLE EFFECT RELATIONSHIPS	
19. Now, let's relate these visible effects to radiation exposure doses. These points are discussed as general rules only, since different people react (the same/ differently--which?) ____________ to an identical dose.	differently
20. On the next page, you'll find a chart depicting dose-visible effect relationships. Look the chart over at this time, reading it carefully; then return to the next frame on this page. NO WRITTEN RESPONSE REQUIRED.	NO WRITTEN RESPONSE REQUIRED
21. As the chart indicates, we're discussing the visible effects of (CHECK THE CORRECT ANSWER): ____A. short-term doses. ____B. doses received over extended periods.	A is correct
22. Look closely at the chart. See the Note on the term "group." A. There are usually no visible effects with doses up to about ____________. B. Brief periods of illness may begin on the day of exposure in about 10% of a group, exposed to around ____________. C. When doses exceed 450 R, ranging upward toward 600 R, you can expect (FINISH THIS SENTENCE). ____________ ____________	A. 50 R B. 75-100 R C. all to be ill, and most to die, in 1-3 weeks. (OR EQUIVALENT ANSWER)

DOSE -- VISIBLE EFFECT RELATIONSHIPS

Short-term dose	Visible effect
50 R	No visible effects
75-100 R	Brief periods of nausea on day of exposure in about 10% of the group.
200 R	As many as 50% of this group may experience some of the symptoms of radiation sickness. Although only 5% to 10% may require medical attention, no deaths are expected.
450 R	Serious radiation sickness in most members of the group followed by death to about 50% within two to four weeks.
600 R	Serious radiation sickness in all members of the group followed by death to almost all members within one to three weeks.

NOTE: As we have learned, all people do not react the same to identical radiation exposures. That is, some are more sensitive to radiation damage, while some may be less sensitive to such damage.

The term "group" as used in this chart refers to a number of people large enough that it would include individuals from the most sensitive to the least sensitive of all, to any dose or dose range.

23. So at least some brief illnesses in the group may be expected when the short-term dose is between _______ and _______.	75 R, 100 R
24. If doses exceed 200 R--moving up toward 450 - 600 R -- real problems develop. Death can occur, and serious illness is quite likely. So, while these guidelines are very general, you should try to avoid exposures that cause illness--those that exceed _______.	100 R
25. Keep this chart, if you wish. It provides you with (general/ specific--which?) _______ indications of dose-visible effect relationships.	general

CARING FOR RADIATION CASUALTIES

26. Radiation casualties may be suffering from a full range of injuries--from superficial beta burns, to serious radiation sickness. Whatever the injury, if at all possible, the fellow pictured here should treat them--a ________________.

doctor

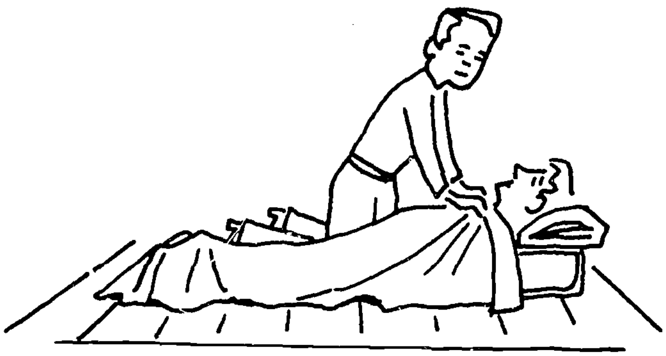
27. If a doctor isn't available, treatment depends upon the nature and seriousness of the injury. Beta burns can be treated just like any other burns, after all fallout is removed. You can bandage, if necessary, and use salves or jellies to lubricate and protect the wound. Beta burns (CHECK ONLY ONE ANSWER):

___A. must always be treated by a physician, even if they appear minor.
___B. can be treated similar to heat burns.
___C. Both A and B are correct.
___D. Neither A nor B is correct.

B is correct.

28. If a beta burn breaks the skin, it can become infected. Don't ignore it. Treat it as you would a heat __________.	burn
29. More serious problems arise with radiation sickness due to gamma ray exposure. If professional help is available, the victim should be treated by a __________.	physician (OR) doctor
30. If a doctor isn't available, there are some steps you can take. First, the injured person has probably lost body fluids due to vomiting and fever. These fluids must be replaced, so the injured party (should/should not--which?) __________ be given water or other liquids, if possible.	should
31. His illness has made him weak, too. He must regain his strength, if he is to survive. Therefore, a radiation casualty should be given nourishing __________, when it is available.	food
32. While his stomach is upset, it may be difficult for the radiation casualty to keep anything down. But as soon as he can take it, he should be given __________ and __________, when they are available.	food, water (OR) liquids (IN EITHER ORDER)

33. In addition to being given food and liquids,



the radiation casualty should, if possible, be (CHECK THE CORRECT ANSWER):

___A. kept quiet and made as comfortable as possible.

___B. allowed to keep up normal activities.

A is correct.

---

34. A radiation casualty is often very weak due to excessive vomiting, diarrhea, and the destruction of his red blood cells by gamma rays. These are other reasons why he should, if possible, be kept ______________ and made ________________________.

quiet, comfortable.

---

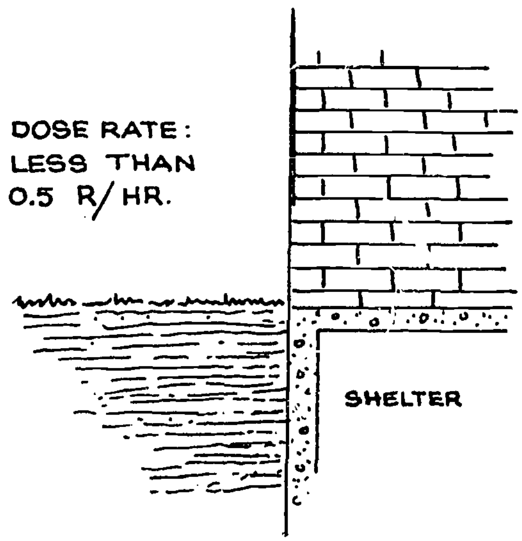
35. Gamma radiation can also destroy white blood cells--our defenders against infection. Even a small cold can become disastrous. Since others may have colds or other illnesses, a radiation casualty (should/should not--which?) ____________________be separated from the rest of the group, if possible.

should

36. There isn't much you can do for a gamma radiation casualty. But you can, if possible, (CHECK ONLY ONE ANSWER): ___A. keep him quiet and as comfortable as possible. ___B. isolate him from infectious diseases. ___C. Both A and B are correct. ___D. Neither A nor B is correct.	C is correct.
RADIATION EXPOSURE CRITERIA 37. Here are some guidelines for controlling exposure to gamma radiation. You may not be able to stay within the limits suggested, depending upon local conditions. Knowing what you do about the effects of gamma radiation, you know that every effort should be made to keep exposure doses (high/low--which?)__________________.	low
38. Unless communications have been disrupted, you'll be given guidance as to what activities are permissible from the individual to whom you report--your_______________officer.	RADEF
39. When communications lines are open, the person who decides what outside activities are permissible is the (CHECK THE CORRECT ANSWER): ___A. head of government or his designated representative, based on advice from his RADEF Officer. ___B. man in charge of the shelter. ___C. radiological monitor.	A is correct.

40. In case communications with the RADEF officer is cut off, and there is no one available who is better qualified than you, you can use the guidance contained in this frame and frames 41 and 42. (These guidelines must be modified, too, depending upon specific situations--the in-shelter dose, for instance.) If the total dose inside the shelter has exceeded 75 R, activities outside the shelter will add very dangerously to this dose and should be even (more/less--which?) ________________ restricted than detailed below.	more
41. A dose of 75 R to 100 R may cause nausea in some people. If you already have received an in-shelter dose of around 75 R, then you should (CHECK THE CORRECT ANSWER OR ANSWERS). ___A. remember that your dose will continue to increase, even though you do not leave shelter. ___B. go ahead with outside activities, since you're already sick anyway. ___C. severely limit outside activities to keep from increasing your dose to much more dangerous levels.	A and C are correct.
42. In discussing thses guidelines for radiation exposure, remember that they should be even further limited if the in-shelter dose has reached __________________ or more.	75 R

43. No special precautions are necessary as long as the outside dose rate is below that shown here. Outside activity for essential tasks--up to a few hours per day, at least--can be performed without special precautions when the unsheltered dose rate is below ________________.

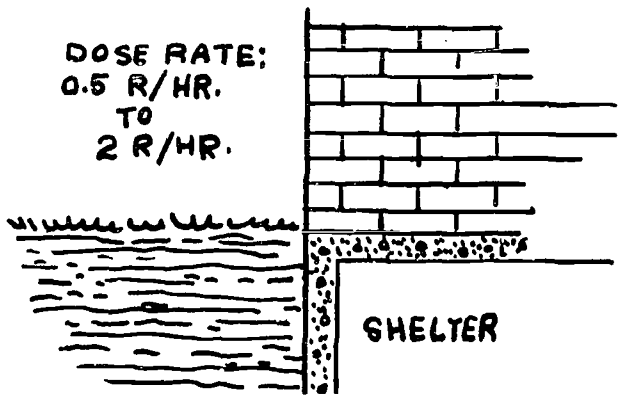


0.5 R/hr

44. Don't spend any more time outside than necessary. But with an unsheltered dose rate of less than 0.5 R/hr, you can perform essential operational activities, up to a few hours per day (CHECK THE CORRECT ANSWER):

___A. only with RADEF officer's permission.
___B. as long as you take special precautions.
___C. without taking special precautions.

C is correct.

45. You must restrict outside activities to essential duties only--fire-fighting, rescue, obtaining medical supplies, etc.--when unsheltered dose rates reach these levels--___________to ______________________________. 	0.5 R/hr (to) 2 R/hr
46. In terms of outside dose rates: A. activities needn't be very restricted when the dose rate is below____________________. B. they should be restricted to more essential duties when the outside dose rate is between____________ and __________________________.	A. 0.5 R/hr B. 0.5 R/hr (and) 2 R/hr
47. When the outside dose rate reaches 2-10 R/hr, hold time outside the shelter to a few minutes per day. Outside activities should be (CHECK THE CORRECT ANSWER): ___A. limited to those important activities that cannot possibly be postponed. ___B. carried on as usual. ___C. extended to give shelterees more exercise.	A is correct.
48. Perform only those activities that cannot possibly be postponed when the outside dose rate has reached the ____________to______________level.	2 R/hr (to) 10 R/hr

49. Once the outside dose rate reaches 10-100 R/hr, outside activities should be strictly limited. Everyone should (CHECK THE CORRECT ANSWER): ___A. get outside while they still can. ___B. move outside the shelter only when it's uncomfortable. ___C. remain in the best available shelter, no matter how uncomfortable it may be.	C is correct.
50. When the dose rate exceeds 100 R/hr, radiation sickness and/or death can result from even a short exposure. Therefore, (CHECK THE CORRECT ANSWER): ___A. outside activities of only a few hours are permitted. ___B. no outside activities should be permitted. ___C. no precautions are necessary.	B is correct.
51. If the shelter were on fire, or if it were under a collapsing building, it may be necessary to go outside, regardless of the dose rate. Or if the shelter is totally inadequate and you know of another one within a few minutes travel, it might be advisable to make the trip. Usually, however, you should remain inside the shelter when the outside dose rate is ______ or greater.	100 R/hr

52. Write the dose rate beside each description. ____________A. No precautions are necessary, but you should sleep in the shelter. ____________B. Outside activities are allowed, up to a few minutes a day, for absolutely essential purposes. ____________C. No outside activities permitted.	A. below 0.5 R/hr B. 2 to 10 R/hr C. over 100 R/hr
53. The exposure guidelines we've been discussing are to be utilized (CHECK ONLY ONE ANSWER): ___A. standard procedure, even when all communication lines are open. ___B. more accurate than any local exposure limits your RADEF officer may set. ___C. Both A and B are correct. ___D. only when competent guidance is not available.	D is correct.
54. Unless other local limits have been established, exposures of personnel on emergency missions should be kept below 200 R during the first month, and below 25 R per week for the next five months. These persons would probably be exposed to more radiation than most shelterees. If they are to be used in unsheltered activity, they must hold down their total __________ ______________________.	doses (OR) exposures

55. If local conditions cause your RADEF officer to set other limitations, follow them. Normally emergency mission personnel's exposures should be limited to: A. 200 R during the first ________; and, B. 25 R per week during the next five ________________.	A. month B. months
56. If exposures are likely to exceed the prescribed limits, there are some protective measures (to be discussed later) you can take. Whenever possible, report to your RADEF officer, if exposures are likely to exceed__________ the first month, or ______________per week during the next 5 months.	200 R, 25 R
57. This completes Unit 1. You should have no trouble with the test for this unit. If you do, don't hesitate to go back and review those sections or frames you may have misunderstood. NO RESPONSE REQUIRED.	NO RESPONSE REQUIRED

PLEASE COMPLETE TEST ON NEXT PAGE

INTRODUCTION TO RADIOLOGICAL MONITORING

HOME STUDY COURSE

NOTE: DO NOT LOOK AT THE TEST BELOW UNTIL YOU HAVE COMPLETED UNIT 1.

UNIT 1 TEST

(Check the best answers)

1. Civil defense is defined as all those activities and measures designed to:

   ___a. rebuild cities, if not eliminate the danger of nuclear attack.

   ___b. minimize the effects of an attack on our army, permanently restore all facilities.

   ___c. minimize the effects of an attack on our civilian population, temporarily repair or restore vital facilities, deal with immediate emergency conditions.

2. Civil defense functions are:

   ___a. assigned to Federal agencies only.

   ___b. completely run by state governments.

   ___c. a logical extension of the duties of local community governments.

3. Those activities that add up to the organized effort to minimize effects of nuclear radiation on people and their resources are called:

   ___a. radiological defense (RADEF).

   ___b. civil defense.

   ___c. the Armed Forces.

4. A monitor's primary duty is to:

   ___a. lead people to safety in times of emergency.

   ___b. collect and report radiological data.

   ___c. take over emergency operations in his community.

5. The type of nuclear radiation with which the monitor need be least concerned is:

____a. alpha.

____b. beta.

____c. gamma.

6. The total amount of exposure to radiation is known as the:

____a. dose rate.

____b. dose.

____c. biological effect.

7. The amount of radiation per hour is the:

____a. dose.

____b. exposure.

____c. dose rate.

8. Radiation is measured in:

____a. roentgens only.

____b. BTU's.

____c. roentgens or milliroentgens.

9. Three forms of energy released by a nuclear weapon are:

____a. kilotons, megatons, yield.

____b. blast, thermal, nuclear radiation.

____c. roentgens, milliroentgens, dose.

10. Dirt drawn into the mushroom cloud of a nuclear detonation often returns to the surface as:

____a. rain.

____b. pure radioisotopes.

____c. radioactive fallout.

11. Under the best recovery conditions, what part of an injury received from radiation will the body repair?

___a. Some of it.

___b. Most of it.

___c. All of it.

12. Some visible or measurable signs of radiation sickness are:

___a. nausea, vomiting, fever.

___b. diarrhea, jaundice, nervousness.

___c. nausea, backache, headache.

13. As a general guideline, you should avoid exposure that will cause your dose to exceed:

___a. 0.25 R.

___b. 10 R.

___c. 75 R - 100 R.

14. If the radiation exposure dose greatly exceeds 450 R:

___a. most people will be able to continue with normal activities.

___b. everyone will probably be ill, most will probably die.

___c. everyone is certain to die immediately.

15. If possible, a radiation casualty should be:

___a. treated by a doctor.

___b. left alone, since no one can help him.

___c. left outside the shelter area for the protection of others.

16. A radiation casualty:

____a. shouldn't be given food or water, since it may be wasted on him.

____b. can be given food, but no water.

____c. should have food and water to help him gain strength, replace lost fluids.

17. A person suffering from radiation sickness:

____a. should be allowed to mingle with others.

____b. must be kept away from others so he won't infect them.

____c. should be kept away from others so he won't catch any colds or other illnesses they might have.

18. Unless communications have been disrupted:

____a. the monitor receives exposure guidance from his RADEF officer.

____b. decisions as to allowable exposures are always made by the monitor himself.

____c. the monitor won't need any exposure guidance, since radiation levels probably won't become dangerous.

19. If an in-shelter dose of 75 R or more has been received, outside activities:

____a. needn't be restricted at all.

____b. should be somewhat restricted, but not severely.

____c. must be severely limited.

20. Outside activities should be strictly limited when the outside dose rate is:

___a. 0.5 R/hr or less.

___b. 100 R/hr or more.

___c. 2-10 R/hr.

WHEN YOU HAVE FINISHED THIS TEST, CHECK YOUR ANSWERS USING THE ANSWER KEY ON PAGE xxx IN THE BACK OF THIS BOOK.

UNIT 2

RADEF INSTRUMENTS I

RADEF INSTRUMENTS II

LESSON ONE

RADEF INSTRUMENTS I

OVERVIEW,

CHARACTERISTICS/CAPABILITIES

&

HOW TO USE INSTRUMENTS

FOLLOW

LESSON ONE: RADEF INSTRUMENTS I

OVERVIEW

Both this lesson and the next deal with radiological instruments you'll use in monitoring. First we'll discuss civil defense instrumentation in general; then we'll talk about such instruments as dosimeters, survey meters, etc., and how to use them.

You won't be able to practice with the instruments as a part of this home study course because of the difficulty of shipping them to you. We'll go into enough detail, however, that you'll be able to recognize each of the major instruments and know the job each is designed to perform. Begin now with frame 1.

CIVIL DEFENSE INSTRUMENTATION

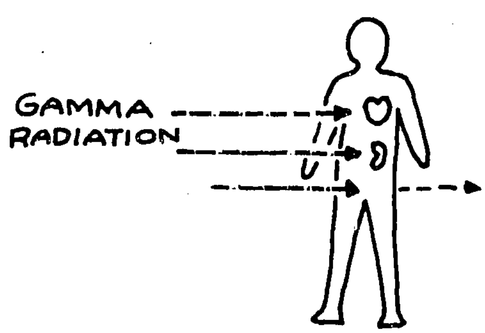
1. Radiological instruments are obtained by the Office of Civil Defense (OCD) on a national scale and are distributed to local CD organizations. Civil defense requires the best possible instruments, so as better instruments are developed, the OCD (CHECK THE CORRECT ANSWER):

   ___A. sticks to the old ones to avoid training problems.
   ___B. obtains the new instruments (if funds permit) or "modernizes" (retrofits) older instruments.
   ___C. makes no changes.

   B is correct.

2. More recent RADEF instruments are normally just improvements on the older models. The principles remain the same. So, if a monitor is used to the old instruments, he probably (can/cannot--which?) ______________ use the new ones without much difficulty.

   can

3. If you learn in this course and subsequent in-class instruction how to use the latest pieces of equipment, but find that older models are being used in the field, you should (CHECK THE CORRECT ANSWER): ___A. use the instruments that are available, because later instruments are basically refinements of these. ___B. throw the old instruments away, since they're obsolete. ___C. report that you're unable to take readings due to obsolete equipment.	A is correct.
<u>TYPES OF RADEF INSTRUMENTS</u> 4. The most dangerous type of nuclear radiation can penetrate (enter) the flesh and vital organs of an individual, doing great damage, and that person won't feel it.  That is, you wouldn't even feel ____________________ radiation.	gamma

5. Since gamma radiation can penetrate humans without being felt, we must have some means of determining how much radiation we're being exposed to. To detect and measure radiation we use radiological ____________.	instruments
6. We must have instruments to measure both factors of radiation exposure: A. the total amount of exposure to radiation, or the exposure ________. B. the amount of exposure received per hour, or the ____________.	A. dose B. dose rate
7. The instrument for measuring dose is the dosimeter (dōs - ĭḿ - etêr), and the dose rate is measured by the survey meter. Both measure in roentgens or ______________.	milliroentgens
8. To remember which instrument measures dose, just keep in mind that it begins with a part of the word itself. So the instrument that measures the total exposure dose to radiation is the (CHECK THE CORRECT ANSWER): ____A. survey meter. ____B. dosimeter.	B is correct.
9. A dosimeter reacts to an increase in dose. If you're close to the maximum acceptable dose, you need to know immediately what your total ________ is.	dose

10. Survey meters require a minute or two to "warm up" before accurate readings can be obtained. These instruments react reasonably quickly once they're warmed up. They'll register a change in about 15 seconds from the moment they're turned on. Survey meters measure the rate at which you're being exposed to radiation, or the ________.	dose rate
11. Once a survey meter is warmed up, it will react fairly quickly. If you move from one area to another, the change in dose rate can be read (CHECK THE CORRECT ANSWER): ___A. after about a 15-second wait. ___B. instantaneously. ___C. in about 15 minutes.	A is correct.
12. A survey meter is so named because it's used to scan, or __________, an area or surface to determine the exposure dose rate.	survey
13. Label these instrument descriptions with their names. ______________A. measures dose rate in R/hr or mR/hr. ______________B. measures accumulated exposure dose in R or mR.	A. survey meter B. dosimeter

14. The dosimeter measures in roentgens or milliroentgens. The survey meter, since it measures dose <u>rate</u>, measures in these units per ______________.	hour
15. The unit of measurement, while basically the same, varies in this respect: A. Since the dosimeter measures dose, the unit is the ______________ or ______________. B. Since survey meters measure dose rates, they measure in ______________ ______________.	A. roentgen, milliroentgen B. roentgens per hour or milli-roentgens per hour.
16. Write "s" for survey meter or "d" for dosimeter beside each statement below. ___A. measures in roentgens or milliroentgens. ___B. measures in roentgens or milliroentgens per hour.	<u>d</u> A. <u>s</u> B.
<u>DOSIMETERS</u> 17. First let's talk about the radiological instrument that measures the accumulated exposure dose to radiation -- the ______________.	dosimeter
18. Under emergency conditions, a dosimeter should be worn on the person. Since you must know the dose to which you're being exposed, when on an outside mission, you (should/should not--which?) ______________ wear a dosimeter.	should

19. Dosimeters are only a half-inch in diameter, and the CD V-742, most often used for operational purposes, is less than 4 1/2" long. These instruments have a clip on them, similar to the clip on a pen, so they can be clipped on clothing, to belts, or in pockets. When on a mission, you should (CHECK THE CORRECT ANSWER):

____A. leave the dosimeter behind to avoid contaminating it.
____B. wear the dosimeter clipped to your clothing.

B is correct.

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20. Since dosimeters are used to measure dose, their scales read in (CHECK ANY CORRECT ANSWERS):

____A. roentgens per hour.
____B. milliroentgens.
____C. roentgens.
____D. milliroentgens per hour.

B & C are correct.

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21. Readings on a dosimeter represent the radiation exposure dose of the instrument. If the monitor wears a dosimeter, we assume that his and the dosimeter's doses are (the same/different--which?)________________________.

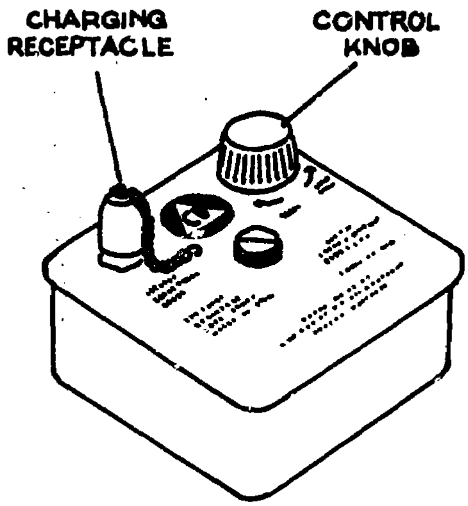
the same

22. Dosimeter readings reflect the amount of radiation to which the instrument has been exposed. If such readings are to be considered accurate representations of the monitor's dose, he must (CHECK THE CORRECT ANSWER): ___A. leave the instrument alone so the reading on the scale won't be affected. ___B. wear the dosimeter at all times when in radiation areas.	B is correct.
23. Dosimeters measure only the highly-penetrating type of nuclear radiation--____________ radiation.	gamma
24. Do dosimeters measure beta radiation? ____________.	No

CHARGING A DOSIMETER AND OBTAINING READINGS

25. A dosimeter doesn't have its own battery. Before it can be used, you must charge it. A special instrument has been developed for this purpose, and it's called--logically enough--a dosimeter____________.	charger

26. The dosimeter charger has been assigned the number CD V-750. It operates on power supplied by a single flashlight battery. On top of the charger are a charging pedestal (with cap on, here), a control knob, and one large screw, which holds the entire instrument



together. To charge a dosimeter, unscrew the cap and press the dosimeter down firmly on the charging________________.

pedestal

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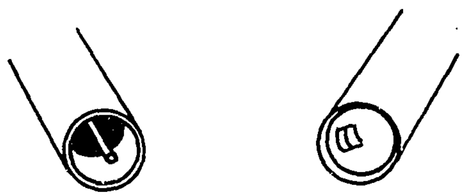
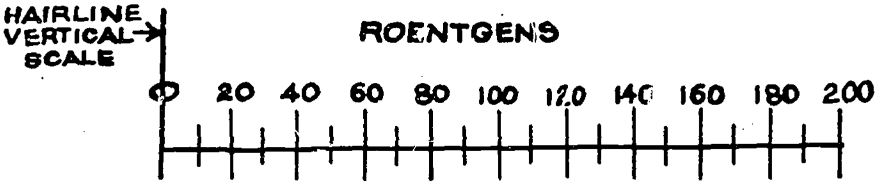
27. The charging pedestal is capped to protect the contact from damage. To use a CD V-750 for charging a dosimeter:

A. unscrew the protective cap of the ________________, then..
B. press the contact end of the dosimeter into it (firmly/gently--which?)________________.

A. charging pedestal
B. firmly

28. One end of a dosimeter has a contact for charging, and the other is a magnifying glass. By looking into the dosimeter through this glass end,  holding the instrument up to a light source, you can see the scale, magnified many times for easy reading. Since you must have a light source to shine through the dosimeter in order to read it, and since you'll have to read it while it's on the charger to set it properly, it follows that there's a ____________________ in the dosimeter charger.	light
29. When you press down gently on the charging pedestal, with the dosimeter, and look into the glass end of the instrument, the light in the charger turns on and enables you to read the ____________________ of the dosimeter.	scale

30. Here's what the scale of the operational dosimeter CD V-742



looks like. The vertical hairline mark tells you the radiation exposure______________, shown here at ____________________________.

dose, 0

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31. The objective in charging a dosimeter is to make the scale read zero. Therefore, charging a dosimeter is often referred to as _____________it.

zeroing

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32. You'll see how easy charging a dosimeter is when you work with the instruments. For now, remember:

A. Charging a dosimeter is also called_________________it.
B. Dosimeters are charged on a CD V-750__________________.
C. To charge the instrument, you press its contact end onto the charging pedestal (gently/firmly--which?)_____________________.

A. zeroing
B. charger
C. firmly

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33. To read a dosimeter, aim it at a light source and look through it. If no other light source is available, the light in the charger used primarily for adjusting the hairline scale to zero may be used to read the dosimeter, (as will be more fully explained later.) Zeroing is accomplished by turning the control knob to the left or to the right, which moves the hairline along the horizontal__________________.

scale

34. At the beginning of its use, the dosimeter should read zero. To accomplish this (CHECK THE CORRECT ANSWER): ___A. hold the dosimeter in the charger until it reads zero. ___B. while holding the dosimeter firmly in the charger, adjust the hairline to zero by turning the control knob.	B is correct.
35. Check your dosimeter after you take it off the charger. If the hairline has slipped a bit, you may have to put the instrument back on the charger and readjust the hairline. At the beginning of the period during which a reading is to be taken, the dosimeter should read__________, if possible.	zero
36. When you press the dosimeter firmly onto the charging pedestal, a __________comes on to enable you to read the scale.	light
37. You must have light coming through the instrument to read it. If no light source is available, you can use the charger for a source by pressing the dosimeter <u>gently</u> onto the charging pedestal. When charging the instrument, you must make sure contact is made by pressing__________________.	firmly

38. When using the CD V-750 for a light source, the dosimeter's charging contact point should't touch the contact on the charging pedestal. This is because the electrical charge from the charger will affect the position of the hairline, and you (CHECK THE CORRECT ANSWER): ___A. might change or lose the reading you're trying to obtain. ___B. could ruin the dosimeter.	A is correct.
39. The CD V-750 has two important uses. A. It's used to zero, or__________, dosimeters, in which case the dosimeter should be pressed __________onto the charging pedestal. B. Under poor light conditions, the charger can be used as a________ source, in which case the dosimeter should be pressed onto the charging pedestal very____________.	A. charge, firmly B. light, gently
40. When reading a dosimeter, hold the instrument about half an inch from your eye and look into it. At the beginning of a specific mission or period for which you want to know the dose, the dosimeter should read_______.	zero

41. If you've been wearing your dosimeter--and you should at all times in radiation areas--it probably won't read zero when you begin a mission or recording period. If you have time, zero it. But if you don't, you can determine the dose in a given period by (CHECK THE CORRECT ANSWER): ___A. wearing a dosimeter that reads zero, leaving your old one behind. ___B. reading the instrument at the beginning of the period, then subtracting that figure from the reading at the end of the period. ___C. adding the initial reading to the final reading for the period.	B is correct.
42. Each person must keep an accurate record of his exposure dose. Doses are usually recorded on a daily basis. If you're asked to perform a mission and record the dose you receive while on it, you may find it unhandy to go through th- extra recording of doses you'll have to perform if you zero your dosimeter. In such an instance, it may be simpler to find the (sum of/difference between--which?)_________________________readings at the beginning and end of the mission and record it.	difference between
43. When a dosimeter is charged, the hair-line is held in place at zero by electrical charges on filaments in the instrument. Under certain conditions, the charge can leak from the dosimeter, resulting in a reading higher than zero. This loss of electrical charge is called__________________leakage.	electrical

44. When the electrical charge on the filament in a dosimeter leaks off, the hairline will move up-scale. This reading is the result of electrical__________.	leakage
45. You probably won't have any trouble with the phenomenon we're discussing. We're mentioning it mainly so that you'll know that stored dosimeters can show a reading, even if they were properly zeroed before storing, due to __________.	electrical leakage

DOSIMETER CARE AND STORAGE

46. Like other radiological instruments, dosimeters are rugged enough to perform under almost any climatic conditions. They can take quite a bit of punishment. Still, to insure accurate, long-lasting life, you should handle dosimeters reasonably (roughly/carefully--which?)__________.	carefully
47. Dosimeters and other radiological instruments are (CHECK THE CORRECT ANSWER): ___A. so rugged that you can't hurt them. ___B. rugged, but can be damaged if misused.	B is correct.

48. Exercise care in regard to contamination of dosimeters and other instruments. For your own protection, you (should/ needn't bother--which?) ______________ avoid instrument contamination.	should
49. Radioactive fallout particles are dangerous, no matter where they're located, so the monitor should avoid ______________ of his instruments by fallout.	contamination
50. Contamination can occur, however. A dosimeter could be dropped in the dust, or handled with contaminated gloves. If an instrument becomes contaminated (CHECK THE CORRECT ANSWER): ___A. it should be decontaminated. ___B. it must be thrown away. ___C. you must leave it alone until radioactive decay occurs.	A is correct.
51. You can decontaminate an instrument by brushing fallout particles off it. This is possible because fallout particles are (visible/invisible--which?) ______________	visible
52. Remember in storing dosimeters that they operate on an electrical principle, so dampness can affect them. They should be stored in a location that is as __________ as possible.	dry

53. Dosimeters should be kept (charged/uncharged--which?) ________ while in storage.	charged
54. An adequate storage location has probably been provided for your radiological instruments. The location should be (damp-dry--which?) ________ and the dosimeters should be stored in a ________ condition.	dry, charged
55. Stored dosimeters should be checked periodically...the frequency is established by your State Radiological Instrument Inspection, Maintenance and Calibration Program. When checking dosimeters, read them to see that they are still charged. They're charged when the scale reads ________.	zero
56. The current operational dosimeter, the CD V-742, has a total capability of reading a 200 R dose. If a stored instrument reads 50 R or more, it should be ________.	recharged (OR) zeroed
57. A 200 R dosimeter should be recharged if you find the reading is 50 R or more when checked. In other words, stored dosimeters should be zeroed when the reading reaches (CHECK THE CORRECT ANSWER): ___A. one-third of full scale. ___B. one-fourth of full scale. ___C. one-half of full scale.	B is correct.

DOSIMETERS IN USE	
58. There are currently four dosimeters in use, three for operational purposes, and the fourth for training only. The CD V-742 is the most recent model available, and the other two operational dosimeters are the CD V-730 and the CD V-740. If you have the 730 or 740 models, you should (CHECK THE CORRECT ANSWER): ___A. use them, since they're still operational even though not as high-range as the later CD V-742. ___B. throw them away and order the CD V-742. ___C. report the situation immediately, since these instruments are obsolete.	A is correct.
59. Dosimeters CD V-730, CD V-740, and CD V-742 are all used for emergency operational purposes. They measure in units called________________.	roentgens
60. The fourth dosimeter, the CD V-138, is used for training purposes only, since it measures in units of thousandths of roentgens, or in_________ ______________________________.	milli-roentgens
61. The CD V-138's scale reads in milli-roentgens, and the maximum total dose it will measure is 200 milli-roentgens. Is this practical for operational purposes?______________	No

62. Identify the use of each instrument by writing "operational" or "training" beside each. ________ A. CD V-740. ________ B. CD V-742. ________ C. CD V-138. ________ D. CD V-730	A. operational B. operational C. training D. operational
63. We've covered most of the important points about dosimeters. Any questions you may have about them will probably be answered when you get the chance to work with the instruments. In the next part, we'll discuss survey meters, including the storage of all instruments that have batteries--and that means the dosimeter charger CD V-750 covered here. You should have no difficulty with the next part. NO RESPONSE REQUIRED	NO RESPONSE REQUIRED

PLEASE CONTINUE WITH UNIT 2 ON THE FOLLOWING PAGES.

LESSON TWO

RADEF INSTRUMENTS II

HOW TO USE INSTRUMENTS (Continued)

&

MONITOR'S RESPONSIBILITIES

LESSON TWO

RADIOLOGICAL INSTRUMENTS II

OVERVIEW

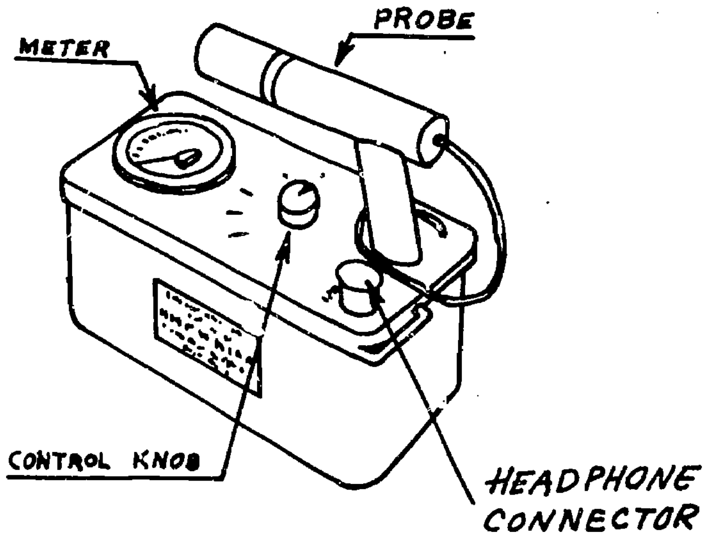
In this lesson, we'll complete our general discussion of radiological instruments. We'll cover the two most up-to-date survey meters in detail, then touch briefly or other models that are no longer being procured, but which may be encountered in the field. The monitor's responsibilities toward the instruments will be covered, as will instructions for handling instruments, protecting them from contamination and storing them. Go to frame 1 and begin.

SURVEY METERS 1. As a radiological monitor, you might find any of several different survey meters in your shelter or station. You know that if you have other than the most recent instruments available, you should (CHECK THE CORRECT ANSWER): ____A. use the instruments you have. ____B. throw away the old instruments and order new ones. ____C. report the situation to your RADEF officer.	A is correct.
2. Civil defense survey meters operate by means of a chamber of enclosed gas. When radiation passes through this gas, small electrical charges are released, causing a needle to move on a scale. The gas is enclosed in a ______________.	chamber

3. One type survey meter has a remote reading capability. A 25 foot extension cable is coiled between the read-out meter-control section, and the enclosed gas chamber or detector. In other words, with this survey meter, the reader (monitor) can be removed by distances up to 25 feet from the__________________.	chamber or detector. (EITHER ANSWER IS CORRECT)
4. Survey meters have the same power source as the dosimeter charger CD V-750. That is, survey meters are powered by (CHECK THE CORRECT ANSWER): ____A. plugging them into a 110V outlet. ____B. 220V current only. ____C. ordinary flashlight batteries. (D-cell)	C is correct.
5. Survey meters are used to measure the dose rate, so their scales read in roentgens or milliroentgens per______.	hour
6. All CD survey meters can measure gamma radiation, and some of them can even detect beta radiation. Notice we said they can (under certain conditions) even detect the presence of __________ radiation.	beta
7. Let's summarize what we've said about survey meters: A. They measure radiation by means of a small electrical current caused when radiation passes through gas in an enclosed__________________. B. They're powered by________________. C. They measure in_________________or _________________________per hour. D. All measure_________________________ radiation.	A. chamber B. batteries C. roentgens, milli-roentgens D

SURVEY METER CD V-700

8. This first survey meter is the CD V-700. As the illustration shows, there's just one control knob on the instrument. It also has a probe for monitoring close to objects; the meter; and a connector for a set of headphones. The CD V-700



measures radiation in milliroentgens per hour, and its range is from 0 to 50 milliroentgens. This tells us that (relative to an instrument that measures in roentgens) the CD V-700 is a (high/low--which?)________________range instrument. | low

9. The CD V-700 is used primarily for training purposes. There will be operational uses for it in long-range clean-up operations, when radiation has dropped to low levels. Primarily, the CD V-700 is used for________________ purposes. | training

10. As this drawing of the CD V-700 scale shows, it reads in milliroentgens per hour, and it only goes up to 0.5 mR/hr.

But earlier, we said its range is from 0 to 50 mR/hr, which would make the maximum (how many) ____________ times that shown on this scale.

100 (times)

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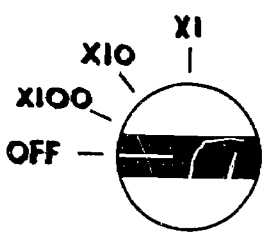
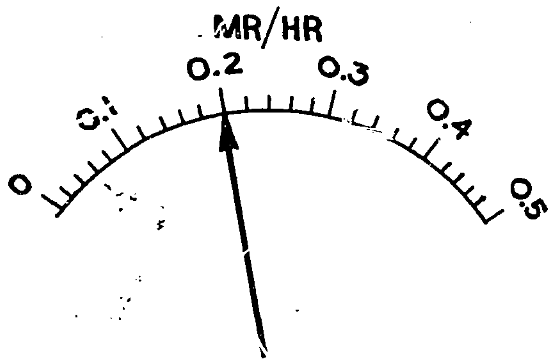
11. This top view of the control knob shows how the CD V-700 can be used for readings up to 100 times (100X) the maximum scale reading of 0.5 mR/hr. The control knob can be turned to X1 (times one): X10 (times ten), or X100 (times one hundred), giving the CD V-700 a range of from 0 mR/hr to 100 times the maximum scale reading, for a maximum reading of ____________ ____________.



50 mR/hr

12. When the control knob is set on X1, you read the dose rate directly from the meter. If the control is set on either of the other positions, you multiply the scale readings by the appropriate number.



Look at this drawing and record the dose rates when:

A. the control knob is set at X1, ____________________ mR/hr.

B. the control knob is at X10, ____________________.

C. the control is set at X100, ____________________.

A. 0.2
B. 2.0 mR/hr
C. 20 mR/hr

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13. So far, we've said this about the CD V-700:

A. It reads in ____________________.

B. The scale only goes up to ________.

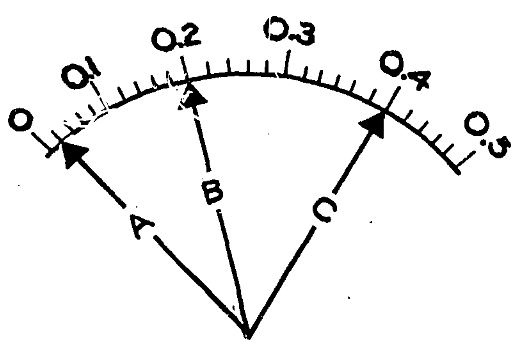
C. Readings can be obtained directly from the scale on the __________ setting; should be multiplied by 10 on the ________ setting; and by 100 on the ____________ setting.

A. milli-roentgens per hour
B. 0.5 mR/hr
C. X1; X10; X100

14. The different settings of the control knob are called "ranges." The CD V-700 has a total of three ranges: X1, ______________, and _________________.

X10, X100 (IN EITHER ORDER)

15. On the scale below, there are three different dial indications, labeled A, B, and C. Determine the dose rate turned to the range indicated.



A. Range is X10, dose rate is _____________________.

B. Range, X100; dose rate, _____________________.

C. Range, X1; dose rate, _____________________.

A. 0.8 mR/hr
B. 20 mR/hr
C. 0.4 mR/hr

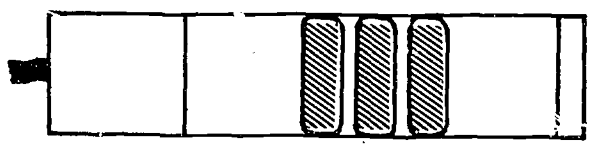
16. Even with the X100 range, the CD V-700 survey meter has a maximum reading capability of 50 mR/hr (or 0.050 R/hr) which is too low for post nuclear attack operational use. So the CD V-700 is considered as (*CHECK THE CORRECT ANSWER*):

___A. an instrument for use in training.
___B. a full-range operational instrument.

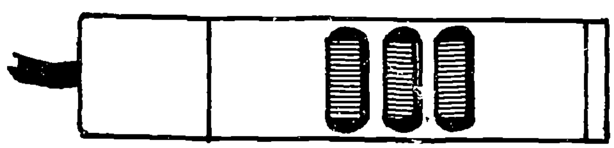
A is correct.

17. When measuring a dose rate that is to high for the X1 range, you can turn the control to the X10 range, then multiply the indicated reading by ______________________.	10
18. If the dose rate is still too high to be read on the X10 range, you can turn the control knob to the ___________range, then multiply the indicated reading by_____________. This range makes it possible to read up to ___________mR/hr, the maximum dose-rate-indicating capability of the CD V-700.	X100, 100, 50, in that order
19. The range of an instrument is from zero to its maximum dose or dose rate indicating capability. The range of the CD V-700______________.	0 to 50 mR/hr

20. The probe of the CD V-700 contains a Geiger tube encased in double metal cylinders. The tube, and the inside cylinder are rigidly attached to the base. This cylinder has an opening on one side at the sensitive area of the Geiger tube. The outside cylinder can be turned freely about the inside one. On one side of it, in a position to line up with the opening of the other cylinder, are large slotted openings.



A. Shield closed.



B. Shield open.

By turning the outside cylinder (or shield) one half turn, its slots can be lined up with the inside opening to the Geiger tube, making it possible to detect both beta and gamma radiation. Another half turn in either direction then, causes the closed side of the outside shield to cover the inside cylinder opening. With the shield in this position, the instrument measures only__________________ radiation from fallout.

gamma

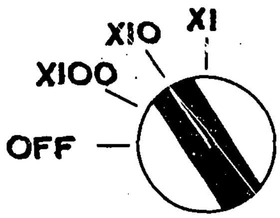
21. Even with the shield closed, some gamma radiation passes completely through the probe and is not detected; while some other gamma rays are absorbed in the probe, and therefore are detected. Most fallout beta rays cannot enter the probe when the shield is closed. Therefore, some gamma radiation is measured whether the shield is__________, or __________. Beta and gamma normally can both be detected at once only when the shield is__________________.

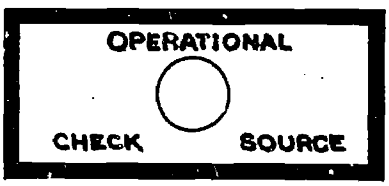
open, closed, open

22. The shield on the probe makes little or no difference in gamma measurement. With the shield open, the reading may be a little higher than a reading in the same location with the shield closed. If this is true, the difference probably (is/ is not--which?)__________ due to the presence of beta radiation.	is
23. To detect the presence of beta radiation, you must have the CD V-700 shield (open/closed--which?)__________.	open
24. Although the CD V-700 is basically a training instrument, there will be a few operational applications for it. One of these is (CHECK THE CORRECT ANSWER): ___A. for long-range decontamination actions, when radiation levels have dropped quite low. ___B. during periods of peak radiation levels.	A is correct.
25. We have said the CD V-700 is a training instrument. However, it has a very important use in training that we have not mentioned. In the practical exercise you'll take later, actual radioactive material will be utilized. The U. S. Atomic Energy Commission requires that strict personnel safety procedures be followed in the exercises. Peacetime allowable total doses are very low--in the mR levels. Therefore the__________ training survey meter, and the__________ training dosimeter are required instruments for this careful control of training exposures.	CD V-700 CD V-138

26. In addition to its primary use for monitoring in peacetime radiological training, the CD V-700 could be used for such operations as, A. (long-range/short-range--which?) ________________ decontamination operations after radiation levels have dropped quite low. B. checking people, or __________ for fallout contamination.	A. long-range B. material (OR EQUIPMENT OR EQUIVALENT)

CD V-700 OPERATIONAL CHECK

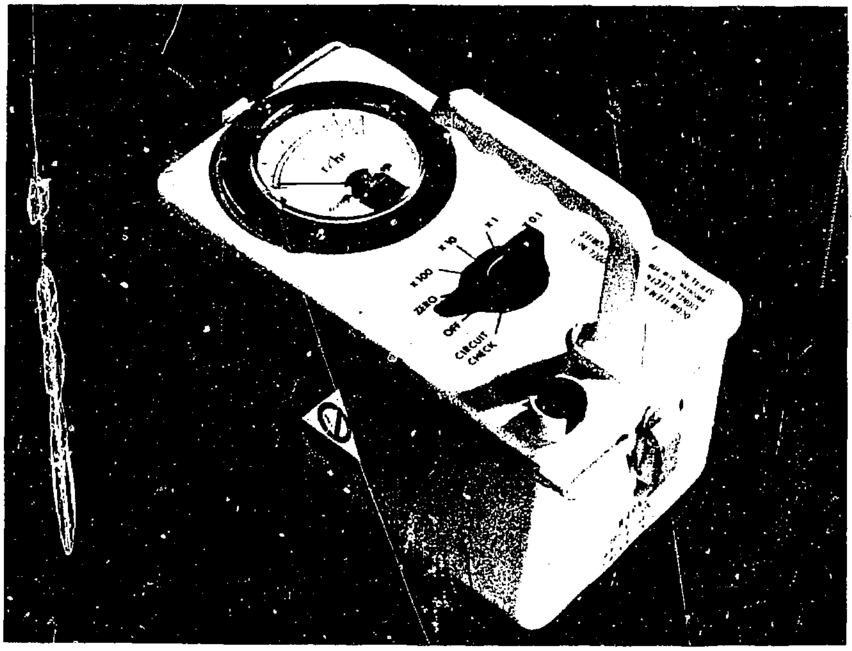
27. The first thing you must do before using a CD V-700 is to perform an operational check. First, turn the control knob to the range shown below.. the ________________________ range.  	X10
28. Allow about 30 seconds for the instrument to warm up, leaving the control knob on the ________________ range.	X10
29. The first two steps in the CD V-700 operational check are: A. Turn the selector switch (or control knob) to the ______ range. B. Allow about ____________ for warm-up.	A. X10 B. 30 seconds

30.	Next, set the probe shield so the CD V-700 will detect both beta and gamma radiation. That is, turn the probe shield to the ________ position.	open
31.	Order is important in this operational check. The points we've covered are: A. Turn the selector switch to the ________ range. B. Allow ________ for warm-up. C. Turn the probe shield to the ________ position.	A. X10 B. 30 seconds C. open
32.	The next step involves the operational check source shown here.  This source is located on the opposite side of the instrument from the side containing the Civil Defense insignia, and is used to make sure the instrument is working properly. This is a small source of ________ material.	radioactive
33.	The operational check source is a bit of radioactive material on the side of the instrument case with which you can test the CD V-700. Once the instrument has warmed up, hold the open area of the probe as close as possible to the ________.	operational check source

34. With the open probe as close as possible to the operational check source, the meter on the CD V-700 should read somewhere between 1.5 and 2.5 mR/hr, averaging around the middle of this range--______mR/hr.	2
35. To see if the CD V-700 is working properly: A. Hold the (closed/open--which?) ______________area of the probe as close as possible to the________ ________________________________. B. The meter reading may vary from ________to______ mR/hr, but should average around_____________ ____________________________.	A. open, operational check source B. 1.5, 2.5, 2 mR/hr
36. Complete these steps in the operational check for the CD V-700 survey meter. A. Turn the selector switch to the _________________range. B. Allow_________________for warm-up. C. Rotate the probe shield to the ____________________position. D. Place the open area of the probe as close as possible to the ___ ____________________________ located on the (top/side--which?) ______________of the instrument's case. E. The meter should read between ____ and _______mR/hr.	A. X10 B. 30 seconds C. open D. operational check source, side E. 1.5, 2.5

37. In an emergency, you'll perform operational checks as required by the circumstances. And in peacetime, your local CD system will have a regular timetable set up for checking instruments, such as bi-monthly or monthly. In any event, you can determine whether the CD V-700 is working properly by performing an _______________ check.	operational
38. The CD V-700 is built for rugged operation under almost any circumstances, but you should (CHECK ONLY ONE ANSWER): ____A. Handle the instrument as roughly as you wish--you can't hurt it. ____B. Keep it out of the sun, since it's easily affected by temperature. ____C. Both A and B are true. ____D. Exercise reasonable care in handling and storage.	D is correct.
SURVEY METER CD V-715 39. Survey meter CD V-700 has a very low range...0 to 50 mR/hr. By comparison, the CD V-715 has a range of 0 to 500 R/hr, instead of mR/hr. In short, the CD V-715 is a __________ range instrument.	high

40. Here's what the CD V-715 looks like.



A. An important difference between this instrument and the CD V-700 is the range of the CD V-715, which is 0 to ______ R/hr.

B. Because of its high range, the CD V-715 is considered a(n) (training/operational--which?) ______ instrument.

A. 500
B. operational

---

41. Write the number of each instrument beside its description.

______ A. Survey meter with a range of 0-50 mR/hr.
______ B. Operational dosimeter.
______ C. Survey meter with a range of 0-500 R/hr.

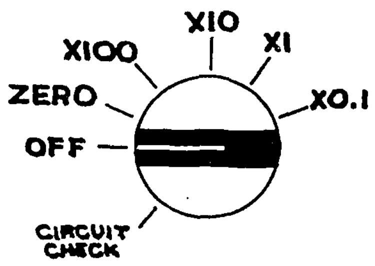
A. CD V-700
B. CD V-742 (OR 730 OR 740 OR EQUIVALENT)
C. CD V-715

---

42. What is the range of the CD V-715 ______?

0-500 R/hr

43. Here's a top view of the selector switch for the CD V-715. It's more complicated than that of the CD V-700. In addition to "off," "zero," and "circuit check" (to be explained shortly) positions, there are four ranges...X100, _____, _____, and _______.



X10, X1, X0.1 (IN ANY ORDER)

---

44. The ranges are used in the same manner as on the CD V-700. In other words:

A. on the X1 range, you multiply the reading by_________________.

B. on the X0.1, X10, and X100 ranges, you multiply the meter reading by ____, ____, and ______, respectively.

A. 1
B. .1, 10, 100

---

45. On the X1 range, you (CHECK THE CORRECT ANSWER):

____A. can just read directly from the meter.

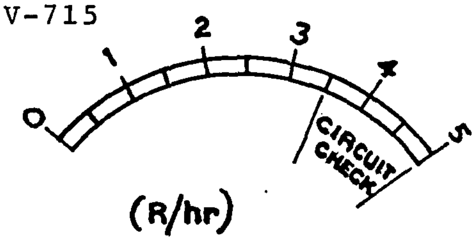
____B. must always multiply by 1.

____C. should multiply by 0.1.

A is correct.

---

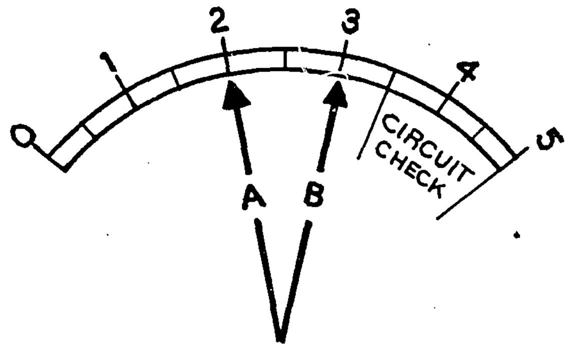
46. Here's a facsimile of the meter scale of the CD V-715



It runs from 0 to 5, and since there is a X100 range on the instrument, its range is ______to________R/hr.

0,500

47. On the CD V-715 meter shown below, two arrows have been drawn--"A" and "B"--to represent two different readings.



Bearing in mind that the CD V-715 measures the dose rate in roentgens per hour, give the dose rates if:

A. for reading A, the meter is set on the X10 range...__________.
B. for reading B, the meter is set on the X100 range...__________.
C. for reading A, the meter is set on X0.1 range...__________.
D. for reading B, the meter is set on the X1 range...__________.

A. 20 R/hr
B. 300 R/hr
C. 0.2 R/hr
D. 3 R/hr

---

48. You'll have ample opportunity to practice readings in the in-class phase of this course. Remember, the survey meter CD V-715 measures the dose__________in__________.

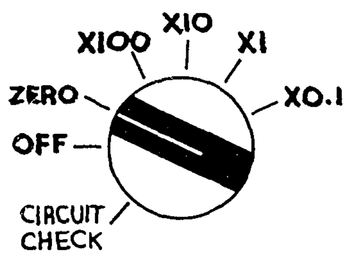
rate, roentgens per hour (R/hr)

---

49. The instrument won't be affected by radiation when the switch is on "zero." So, even in heavily contaminated areas, you can check to see that your instrument's needle hasn't moved off the zero point by turning to the __________ position.

zero

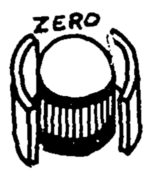
50. Even in areas of very high nuclear radiation, when the CD V-715 selector switch is turned to the position shown here, the instrument should read zero. This is because when the switch is set at the zero position, the instrument does not detect ____________ ____________.



Answer: nuclear radiation

---

51. If you test for zero and find that your instrument is reading above that mark, use the zero control knob, shown here, to adjust the needle back to ____________.



ZERO CONTROL KNOB

Answer: zero

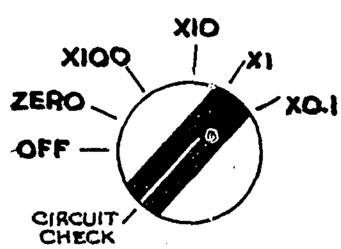
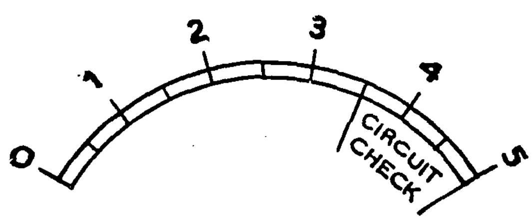
---

52. Note that the zero control knob is protected by raised shields on the case. This is to (CHECK THE CORRECT ANSWER):

___A. keep you from adjusting the needle too often.

___B. prevent accidental turning of the knob, which would result in inaccurate readings.

Answer: B is correct.

53. The final selector switch setting is the "circuit check." With the CD V-700, you were to check the instrument's operation by opening the probe shield and holding it as close as possible to the______________________, at which time the meter should have read between ______and________mR/hr.	operational check source, 1.5, 2.5
54. Checking out the CD V-715 is simplified, thanks to the circuit check feature. To make sure that the survey meter is functioning properly, just turn the selector switch to the circuit check position and look at the needle. It should point to the area of the scale that's marked "_____________check."	circuit
55. Assume that the selector switch is turned to the position shown here.  On the scale below, draw an arrow to indicate where the needle should point. 	Your arrow should point somewhere in the area marked "circuit check."

<u>CD V-715 OPERATIONAL CHECK</u> 56. You must learn the steps of the CD V-715 operational check in order, so pay close attention. The first step is to turn the selector switch to the zero position. At this position, the instrument should always read________________.	zero
57. Next, wait a minute or two for the instrument to warm up. Instruments vary as to warm-up time required, but a safe period is usually about two_____________________________.	minutes
58. The first two steps in the CD V-715 operational check are: A. Turn the selector switch to the _____________ position. B. Allow about _________________for warm-up.	A. zero B. 2 minutes
59. Next, make any necessary correction in the meter reading. To do this (CHECK THE CORRECT ANSWER): ___A. turn the zero control knob as necessary to make the meter read zero. ___B. turn the selector switch as needed.	A is correct.

60. The first three steps in the operational check of the CD V-715 are: A. Turn the selector switch to the ______________ position. B. Allow about ______________ for warm-up. C. Adjust the ______________ knob so the meter reads __________.	A. zero B. 2 minutes C. zero control, zero
61. The fourth step is to turn the selector switch to the circuit check position. When the switch is turned to this position, the needle should point to the area marked ______________ on the meter.	circuit check
62. If the needle doesn't point to the circuit check portion of the meter, you know that something's wrong--quite probably the instrument needs new batteries. At any rate, you know that: A. when the ______________ switch is turned to circuit check... B. the needle indicator should point to ______________ on the meter.	A. selector B. circuit check
63. Finally, turn the selector switch to each range--X100, X10, X1, and X0.1-check that the meter is registering zero on each range. Recheck for zero on the zero position after checking all ranges. In other words, you check for zero in the ___________ position both before and after checking all other ranges for ______________.	zero, zero

64. Complete these statements comprising the operational check for the CD V-715. A. Turn the selector switch to_______. B. Allow about______________for warm-up. C. Adjust the zero control knob so the meter reads__________________. D. Turn the selector switch to the __________________position-- the needle should point to the ______ portion of the meter. E. Finally, turn to each of the four ________________and recheck for ________________on the____________, after each range check.	A. zero B. 2 minutes C. zero D. circuit check, circuit check E. ranges, zero, zero
CD V-715 65. Here are two important operational uses for the CD V-715: (1) area or surface monitoring. (2) monitoring for public shelters or fallout monitoring stations The monitor is often required to obtain radiation levels of the area around his shelter or station, and the CD V-715 is used for this purpose. In other words, the CD V-715 is used for area monitoring, or______________ monitoring.	surface
66. The CD V-715 is also the primary instrument for monitoring in and around both types of structures in which personnel will be located after attack--both public_______________ and fallout monitoring stations.	shelters

67. Two important, operational uses of the CD V-715 are:

A. area monitoring, or ____________ monitoring.
B. monitoring for public ____________ ____________ ____________.

A. surface
B. shelters, fallout monitoring stations.

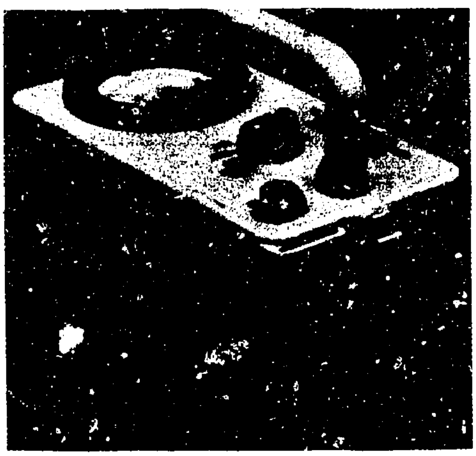
SURVEY METER CD V-717

68. Survey meter CD V-717 is a modification of the CD V-715. Its main feature is that the detector section can be placed at a distance of 25 feet from the read-out meter. That is, the CD V-717 has a 25 foot ____________ capability.

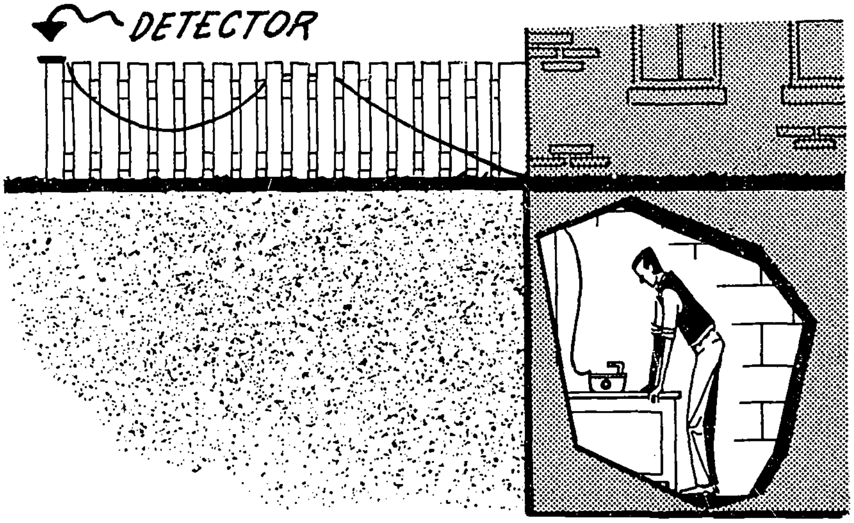
remote

69. Here's what the CD V-717 looks like. It operates on the same principle as the CD V-715 and should be handled in about the same manner. So, before using the CD V-717, you should put it through the same ____________ ____________ as you would the CD V-715.

operational check



70. This picture illustrates the main advantage of the CD V-717.



As shown, the monitor (CHECK THE CORRECT ANSWER):

___A. must go outside to take outside dose rate measurements, regardless of how dangerous it may be.

___B. simply cannot obtain outside dose rate measurements when he suspects that outside levels are too high.

___C. can use the CD V-717 to take outside dose rate readings (up to 500 R/hr) without leaving the safety of shelter.

C is correct.

---

71. The CD V-717 is basically the same as the CD V-715, except that the 717 has the advantage of a 25 foot__________ detector.

remote

---

72. Radiological instruments (should/need not--which?)__________________be protected from contamination by radioactive fallout.

should

73. The CD V-717's remote detector will normally be placed outside prior to fallout arrival. It is desirable to cover the detector section with a light bag of plastic or some other light-weight material, and a bag is provided with the instrument for this purpose. If the bag or other material is used, when the remote feature of the instrument is no longer needed, the detector section should be (CHECK THE CORRECT ANSWER): ____A. thrown away. ____B. allowed to sit until the radioactivity lessens. ____C. decontaminated by the removal of the covering bag, or other lightweight material.	C is correct.
STORING INSTRUMENTS 74. You learned that dosimeters should be stored in a charged condition in a dry location. There are some additional precautions you must take, however, when storing survey meters. These precautions are necessary because of the instruments' power source, which is the ____________________.	flashlight battery (OR) D-cell (EITHER ANSWER IS CORRECT)
75. Batteries have a tendency to leak or corrode if allowed to sit for long periods, so it's wise to (CHECK THE CORRECT ANSWER): ____A. remove batteries from instruments that are not in use. ____B. leave batteries in place at all times so the instruments will be ready for instant use.	A is correct.

76. Batteries are easy to install in an instrument. When the instrument is not in use, batteries should be ________________.	removed.
77. In the in-class portion of this course, you will learn how to install batteries in radiological instruments. You'll find that the most important thing is to match the plus and minus poles of the batteries with the same signs in the instruments. In other words, you must be careful to install batteries so that ____________ (like/unlike--which?) pole signs on the batteries match these in the instrument.	like
78. Since battery installation is simple, and because batteries can damage your instruments when stored for long periods, you should (FINISH THIS SENTENCE) ________________	remove batteries before storing instruments (OR EQUIVALENT ANSWER)
79. Stored instruments should be inspected periodically. Dosimeters should be rezeroed, and battery connections in other instruments should be inspected and cleaned as necessary. Normally, your local CD organization will have a regular schedule for you to follow in instrument ________________.	inspection

80. In regard to inspection of stored RADEF instruments (CHECK THE CORRECT ANSWER): ___A. the monitor should inspect them when he thinks of it. ___B. you should follow your local organization's SOP (standing operating procedures) for inspection.	B is correct.
81. You may sometimes carry instruments for periods of time without using them. When you do, you can avoid running the batteries down by turning the switch off all ranges. The instrument's selector switch should be turned to the ____________________ position.	off
82. When an instrument is in storage (CHECK ANY CORRECT ANSWERS): ___A. batteries should be left in so the instrument will be ready for immediate use. ___B. battery contacts should be inspected and cleaned as necessary. ___C. it should be turned on to be ready for instant use. ___D. the batteries should be removed. ___E. battery contacts should be left strictly alone so good connection will be assured.	B and D are correct.

83. You will be given time to practice with radiological instruments in the in-class (practical exercise) portion of your radiological monitoring course. You should have no trouble answering the questions on the test for this unit. If any parts give you trouble, don't hesitate to return to the program for review. NO RESPONSE REQUIRED.	NO RESPONSE REQUIRED.

PLEASE COMPLETE TEST ON NEXT PAGE

INTRODUCTION TO RADIOLOGICAL MONITORING

HOME STUDY COURSE

NOTE: DO NOT LOOK AT THE TEST BELOW UNTIL YOU HAVE COMPLETED UNIT 2.

UNIT 2 TEST

(Check the best answers)

1. New RADEF instruments:

___a. are usually refinements on previous models.

___b. operate on altogether new principles.

___c. in no way resemble previous models.

2. The instrument used to measure total exposure dose to radiation is the:

___a. survey meter.

___b. dosimeter charger.

___c. dosimeter.

3. The survey meter measures:

___a. dose rates.

___b. doses.

___c. alpha radiation.

4. Before use, a dosimeter should be charged or:

___a. plugged in for an hour.

___b. connected to a battery carried by the monitor.

___c. zeroed on a dosimeter charger CD V-750.

5. The CD V-742 dosimeter is considered:

___a. an operational instrument.

___b. a training instrument only.

___c. obsolete.

6. A charged or zeroed dosimeter can show a reading after a period of time, even without the presence of radiation due to:

___a. automatic discharge.

___b. electrical leakage.

___c. dry air in the storage location.

7. If an instrument becomes contaminated by fallout:

___a. throw it away.

___b. avoid using it until radioactive decay takes place.

___c. decontaminate it by wiping or brushing fallout particles off.

8. RADEF instruments are:

___a. very fragile, easily broken.

___b. sturdy, but should nevertheless be handled carefully.

___c. impossible to harm.

9. Once dosimeters are charged and stored:

___a. they should be checked and recharged, if necessary, periodically.

___b. they needn't be checked again.

___c. the monitor has no further responsibility toward them.

10. Dosimeters should be stored in a:

___a. damp location.

___b. dry location.

___c. location that's far away from any potential targets of nuclear attack.

11. All CD survey meters:

___a. detect alpha radiation, measure beta and gamma.

___b. measure gamma radiation.

___c. measure gamma, and detect alpha and beta.

12. The CD V-700 is a low-range instrument used mostly for:

___a. operational purposes.

___b. training purposes.

___c. unsheltered missions during peak periods of radiation.

13. When a survey meter is set on the X1 range:

___a. you must multiply the meter reading by 10.

___b. you can read directly from the meter scale.

___c. the instrument is inoperable.

14. When the shield on the CD V-700 is open, it detects:

___a. gamma only.

___b. no radiation.

___c. gamma and beta radiation.

15. Before using a survey meter, you should:

___a. recharge it.

___b. decontaminate it.

___c. run an operational check.

16. The range of the CD V-715 is:

___a. 0-50 mR/hr.

___b. 0-50 R/hr.

___c. 0-500 R/hr.

17. Whenever you turn to the zero range on a CD V-715:

____a. the instrument should read zero, regardless of radiation levels.

____b. background radiation will determine what the instrument will read.

____c. the instrument will read 100 R/hr.

18. The advantage of a CD V-717 survey meter is that it has:

____a. a meter that glows in the dark.

____b. fewer ranges to worry about.

____c. a remote detecting capability.

19. When survey meters are stored for long periods:

____a. they needn't be checked out.

____b. batteries should be removed to protect contact points.

____c. batteries should be left in so the instruments are ready for immediate use.

20. Instruments should be inspected:

____a. only when you think it's necessary.

____b. when you're told to do so by the Office of Civil Defense.

____c. according to the schedule established by your community CD organization.

WHEN YOU HAVE FINISHED THIS TEST, CHECK YOUR ANSWERS USING THE ANSWER KEY ON PAGE xxx IN THE BACK OF THIS BOOK.

UNIT 3

PROTECTIVE MEASURES AND DECONTAMINATION PROCEDURES

DOSE AND DOSE RATE CALCULATIONS

LESSON ONE

PROTECTIVE MEASURES AND

DECONTAMINATION PROCEDURES

OVERVIEW

&

FRAMES

FOLLOW

LESSON ONE: PROTECTIVE MEASURES

AND DECONTAMINATION PROCEDURES

OVERVIEW

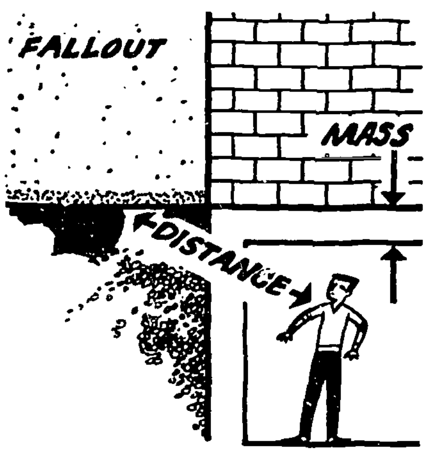
In this lesson, you'll learn what you can do to protect yourself, other people, and your equipment from fallout radiation. We're not going to tell you how to build a fallout shelter; public fallout shelters are already available, and Civil Defense publications are available to guide you if you intend to build your own shelter. Rather, we'll be giving you some rules to follow to keep radiation exposure from fallout to a minimum, while inside the shelter or monitoring station and on missions outside of shelter.

We'll also discuss the relative insignificance of the contamination of clothes, equipment, food and water. The best way for an individual to avoid fallout contamination is to get to shelter before fallout arrives and remain there until competent authority determines emergence from shelter can begin. Go to frame 1 and let's get started.

INTRODUCTION

1. There are two important factors in protection against radioactive fallout. Both factors are provided by an adequate shelter. As the drawing shows, these two factors are ______________ and ______________________.

distance, mass, (IN EITHER ORDER)

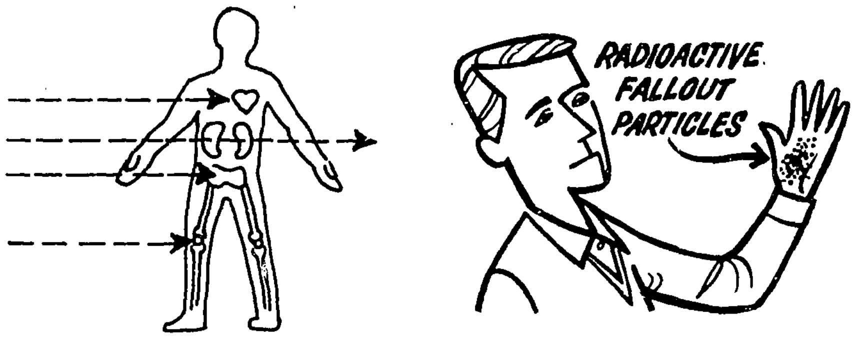


2. Mass provides shielding, and even a few feet of space between you and fallout can be important. Both mass (shielding) and distance are provided with an adequate ________________.	shelter
3. In terms of protection against radioactive fallout: A. The two most important factors are ______________ and ______________. B. How are these best obtained? ______________.	A. distance, mass (OR) shielding B. adequate shelter

WHEN FALLOUT ARRIVES

4. It can't be accurately predicted where fallout will be deposited, or when it might arrive at a particular location. High altitude winds of the day, the size and type of burst--these and many other factors determine when radioactive particles could begin falling in a particular area. You should receive official warning of the expected time of fallout arrival. However, if you haven't: when gritty dust and dirt can be seen to be increasing on surfaces around you, you should assume fallout has arrived. The greatest potential hazard will then be from exposure to the gamma radiation from radioactive ______________.	fallout

5. Two familiar hazards of radioactive fallout are pictured here.



A. RADIATION ABSORBED IN VITAL INTERNAL ORGANS FROM GAMMA EMITTING FALLOUT PARTICLES.

B. POSSIBLE BURNS OF THE SKIN BY BETA EMITTING FALLOUT PARTICLES.

Since "hazard" in Civil Defense terms means a <u>definite threat to survival</u>, the "hazard" of greatest concern from fallout is that of serious damage to vital internal organs from absorbed ____________ ________________; while contamination of the skin by________________emitting fallout particles, although it may produce burns, is not a threat to survival.

gamma radiation, beta

---

6. It's true that breathing fallout particles into the lungs, ingesting fallout particles in food and water, and contamination by fallout particles of a person's clothing are threats to health. But the greatest threat from fallout is from large amounts of (alpha/beta/gamma) _________ radiation that might be absorbed by the body.

gamma

7. With an effective warning system you should have enough time to get to the shelter or fallout monitoring station before fallout arrives. But if you suspect that fallout is present before you get to your assigned shelter or station, you should hurry to the shelter just as fast as you can. As you go, remember that fallout consists of particles of earth, weapons residue and other materials returning to the earth's surface after having been drawn up in an ascending nuclear cloud, and if it's a survival hazard, it will be (CHECK THE CORRECT ANSWER): ____A. visible ____B. invisible.	A is correct.
8. Never panic, but don't waste time, either. When you suspect that fallout has arrived before you reach the shelter, cover as much of your body as you can to keep fallout particles from depositing on your skin. Based on this idea, if you aren't wearing a hat (CHECK THE CORRECT ANSWER): ____A. don't try to get to your assigned shelter or monitoring station, but take the first cover available. ____B. don't worry about it, since neither beta nor gamma radiation can get to your skin through your hair. ____C. cover your head with a newspaper or some other material to keep fallout from depositing on your head.	C is correct.

9. To help keep fallout away from your body, you should adjust your clothing to cover as much skin as possible. In addition, if you're not wearing a hat, you can do as this fellow is doing--use a newspaper or other material to cover your__________. 	head
10. If fallout particles in large numbers are allowed to remain in contact with the skin for several hours they can cause beta burns. If you are unable to reach your shelter or monitoring station before the arrival of fallout, you should (CHECK ONLY ONE ANSWER): ___A. adjust clothes to cover as much skin as possible. ___B. cover your head with newspaper or some similar material if you aren't wearing a hat. ___C. Both A and B are correct. ___D. Neither A nor B is correct.	C is correct.
11. Harmful fallout particles are usually visible. When you see them on your clothing, you can brush them off. (But don't overly delay entry into shelter for this purpose.) It would be best to use a small brush, such as a whiskbroom, if one is available, since it (is/is not-which?) ________ a good idea to transport fallout particles into the shelter.	is not

12. When you arrive at the shelter or station, avoid carrying in any fallout particles that may be on you. Do what this man is doing--____________ 	Brush fallout particles from your clothing (OR EQUIVALENT ANSWER)
13. Fallout contamination on a surface does not contaminate that surface itself. If fallout lands on a window ledge, for example, the particles (CHECK THE CORRECT ANSWER): ___A. permanently contaminate the ledge. ___B. are radioactive, but the ledge is not. ___C. are no longer dangerous.	B is correct.
14. If radioactive fallout particles or nuclear radiation passes through the air, the air itself (does/does not--which?) ____________ become radioactive.	does not

15. Under ordinary circumstances, you can't breathe in enough fallout particles to worry about. However, if it is very dusty, you can hold a folded handkerchief over your nose and breathe through it. Ordinarily, though, you (can/cannot--which?)__________________ breathe enough particles into your lungs to cause you significant harm.	cannot
16. Let's summarize this section on what you can do if you suspect fallout is present before you reach your assigned shelter or monitoring station. Does it help to cover your head in such a situation?____________________.	yes
17. When you suspect fallout is present before you reach shelter, you should (CHECK ANY CORRECT ANSWERS): ___A. hurry to the shelter as fast as possible. ___B. avoid the shelter altogether to prevent contaminating it. ___C. adjust clothing to cover as much skin as possible. ___D. unzip your jacket to facilitate movement. ___E. brush your clothes to remove fallout particles. ___F. pick up anything you see that might be of use to you in the shelter.	A, C, & E are correct.

ARRIVAL AT THE SHELTER OR STATION

18. As previously mentioned, when you reach the shelter, you should avoid carrying fallout particles in with you. Therefore, you should (FINISH THIS SENTENCE)______________________ ______________________ ______________________.	brush your clothes to remove fall-out particles (OR EQUIVALENT ANSWER)
19. If fallout arrives before you reach shelter, your shoes may have picked up some fallout. You should (CHECK THE CORRECT ANSWER): ___A. stomp and shake your shoes to remove as much fallout as possible. ___B. walk right in, since you probably won't be carrying enough fallout to harm anyone.	A is correct.
20. The primary objective of our entire RADEF system is summed up in the word "survival." If it is necessary to take shelter, the dose rate outside will be of far greater significance than any fallout material a person could carry into the shelter on his body. Therefore, (CHECK THE CORRECT ANSWER): ___A. he should remain outside until he's absolutely decontaminated. ___B. do not delay entry of people coming to the shelter, even though they may be contaminated.	B is correct.

21. When a person arrives at the shelter or station and fallout is present he should (CHECK THE CORRECT ANSWER): ___A. brush or shake off any visible fallout particles and get into the protected area. ___B. remain outside the shelter to prevent spreading contamination. ___C. be permanently isolated in a special area of the shelter.	A is correct.
22. When it's especially dusty, or when mud has become caked on clothing, shaking or brushing may not remove all fallout from outer clothing. Outer clothing can be removed and placed in an isolated part of the shelter or station. These clothes can later be washed or disposed of, or the natural decay of radioactivity will make them usable at some later time. If contaminated clothing is kept in the shelter, or fallout station, it should be stored (as close to/as far from--which?)____________________personnel as possible.	as far from
23. Studies have shown that most fallout particles are removed if clothes are washed in a washing machine. The machine doesn't retain much fallout material, either. So, if fallout particles can't be satisfactorily removed from clothing by the normal methods of brushing and shaking, the clothes (CHECK ANY CORRECT ANSWERS): ___A. must be destroyed. ___B. can be stored in an isolated part of the shelter or station. ___C. will stay radioactive forever. ___D. cannot be washed. ___E. can be washed, if such facilities are available.	B and E are correct.

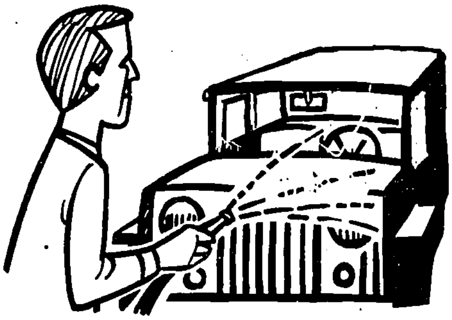
24. As you know, if fallout particles remain on the skin for several hours, they can cause (CHECK ONLY ONE ANSWER): ___A. Beta radiation burns. ___B. Alpha ray penetration of the body which injures body tissues. ___C. Both A and B are correct. ___D. Neither A nor B is correct.	A is correct.
THE SHELTER DURING FALLOUT 25. Because the wind could blow fallout particles into the shelter, and because these particles emit highly-penetrating gamma rays, any vents or openings in the shelter that don't have to be open should be kept __________________ during shelter occupancy.	closed
26. Ventilation passages must be kept open all or most of the time. These are considered vital to the survival of the shelter's or station's occupants. However, windows and doors are actually non-vital--that is, they can be closed for long periods without seriously affecting the occupants' survival. Such non-vital vents should be (CHECK THE CORRECT ANSWER): ___A. kept open so the occupants can see what's going on outside. ___B. closed as much as possible during the presence of fallout.	B is correct.

27. As soon as radiation levels become measurable within the shelter--you'll learn how to determine this later--you should monitor all areas of the shelter with a radiological instrument (again, more on this later) to see which area provides the best protection. As many personnel as is feasible should be put into the (best/least--which?) ____________ protected part of the shelter or station.	best
28. Because of wind and rain, fallout material (particles) which have deposited on the outside surfaces of the ground and the roof of the shelter will shift with time, thus possibly causing areas within the shelter of lower radiation levels to shift also. To make certain that shelterees are in the best-protected area, you should check levels in the entire shelter or station (only once/ periodically--which?) ____________ ____________.	periodically
29. A check for the safest area should be made as soon as the radiation level in the shelter becomes high enough to read on a survey meter. In other words, a check should be made as soon as the radiation level becomes ____________ ____________.	measurable.
30. Once radiation becomes measurable in the shelter, the monitor should (CHECK ONLY ONE ANSWER): ___A. Make plans to move to a better shelter. ___B. Determine the safest area in the shelter to hold shelterees' (and his own) exposure to a minimum. ___C. Both A and B are correct. ___D. Neither A nor B is correct.	B is correct,

PROTECTION OUTSIDE THE SHELTER

31. If it's necessary to perform urgent missions outside of shelter, every possible measure should be taken to protect your body from radioactive fallout particles. The first step is adequate clothing to cover as much of the body as possible. Clothing will (CHECK THE CORRECT ANSWER): ___A. keep fallout particles from the skin, thus reducing danger of beta burns. ___B. protect from all types of radiation. ___C. protect the body from gamma, but not from beta, radiation particles.	A is correct.
32. While on urgent missions outside of shelter, perform only those tasks that cannot be postponed. Wear outer clothing that can be removed upon your return to shelter, because ___A. otherwise you will not be allowed to re-enter the shelter. ___B. In this way you can avoid transporting excessive amounts of fallout material (contamination) into your shelter.	B is correct.
33. You cannot completely avoid contamination while out of shelter. Therefore, after removal of the outer clothing, you should (FINISH THIS SENTENCE)____________	Stomp your feet, brush any areas of your body that were not covered, and visually inspect yourself and others who may have been with you for fallout particles, and remove as many as is practicable (OR EQUIVALENT ANSWER)

VEHICLES	
34. If available, vehicles can be used on your outside missions. If possible, vehicles that were intended for use on postattack missions should have been protected from fallout in advance by placing them in garages or under plastic or fabric covers. Such pre-planning would have protected the vehicles from (CHECK ONLY ONE ANSWER): ___A. Gamma radiation. ___B. Contamination by radioactive fallout particles. ___C. Both A and B are correct. ___D. Neither A nor B is correct.	B is correct.
35. A closed vehicle can provide protection against contamination by fallout particles, but very little against highly-penetrating____________.	gamma rays
36. If you drive a vehicle around in fallout contaminated areas with the vents open and the windows rolled down, the interior may become contaminated with fallout____________.	particles
37. The same principle is true of the area in which a vehicle is stored. Garages and warehouses can protect vehicles from contamination by fallout particles, provided the building's doors and windows are kept____________.	closed

38. Normally you won't have to do what this man is doing. If you drive a vehicle on missions, most loose fallout particles on the exterior will be dislodged by the vehicle vibration and will be blown off. Therefore, you probably (will/won't--which?)____________ have to wash it. 	won't
FOOD AND WATER 39. Food and water contamination is not a big problem. Normal water supplies are probably all right to use, and any food or water stored in any shelter that keeps fallout away should be used. You (should/should not--which?)____________ expect stored food or water to be significantly contaminated.	should not
40. Shelterees will need food and water to maintain their strength--perhaps repair injuries. Do not keep anyone from eating and drinking food and water on the basis that it may be __________ __________________________.	contaminated

41. If you receive warning in advance that an attack is imminent or that fallout is likely, cover any open sources of water, such as open wells and cisterns. This will prevent that water supply from being contaminated by___________.	fallout
42. Food and water have been stored in many public fallout shelters and monitoring stations. It (is/is not--which?) _____________likely that these supplies have been contaminated by fallout.	is not
43. Take every precaution to keep food and water supplies from becoming contaminated by fallout particles. Keep water and food covered or in closed containers. But if water or food should become contaminated don't throw it away. It is better to eat and drink food and water that are contaminated, than none at all. Contaminated food and water probably (can/cannot--which?) __________be used.	can
44. If your only food and water sources are contaminated, you have no alternative. You (must/cannot--which?) ___________ use it.	must
45. If it is known that a portion of your food and water supplies only is contaminated, use your_______________ _______________supplies first.	uncontaminated

46.	Any food that is brought in from the outside should be carefully inspected, and, if the dose rate in the shelter is low enough, the food should be monitored. If contamination can be detected, or is visible, all containers should be wiped, fruits and vegetables should be washed if possible, and peeled or pared where applicable. Any food placed in a public fallout shelter or a radiological monitoring station prior to the arrival of fallout must be assumed to be (FINISH THIS SENTENCE) ______________________ ______________________	free of radioactive contamination (OR EQUIVALENT ANSWER)
47.	The procedures we've just discussed are for use only in case your food or water supply becomes contaminated with radioactive fallout particles (material). Preattack planning, which includes the stocking of public fallout shelters with food and water; and which makes provision for such stocking of fallout monitoring stations, will very significantly help to assure that your food and water won't be __________ ____________________.	contaminated
48.	You should now have a general understanding of protective measures you can and should take, both in and outside the shelter, or monitoring station during radioactive fallout conditions.	NO RESPONSE REQUIRED

PLEASE CONTINUE WITH UNIT 3 ON THE FOLLOWING PAGES.

LESSON TWO

DOSE AND DOSE RATE

CALCULATIONS

LESSON TWO: DOSE AND DOSE RATE CALCULATIONS

OVERVIEW

As long as normal communications can be maintained with the area emergency operating center (EOC), calculations of projected dose rates for given times in the future will be made by the EOC. When fallout deposition has ceased, EOC personnel can use information provided by monitors to determine approximately what the unsheltered dose rate will be at a given time in the future. But if communications are disrupted, the monitor must be able to calculate projected dose rates and doses, plus entry times and stay times for emergency missions. And those are the subjects of this lesson--computation of projected future dose rates based on information known at the moment; doses; and entry and stay time calculations.

RADIOACTIVE DECAY

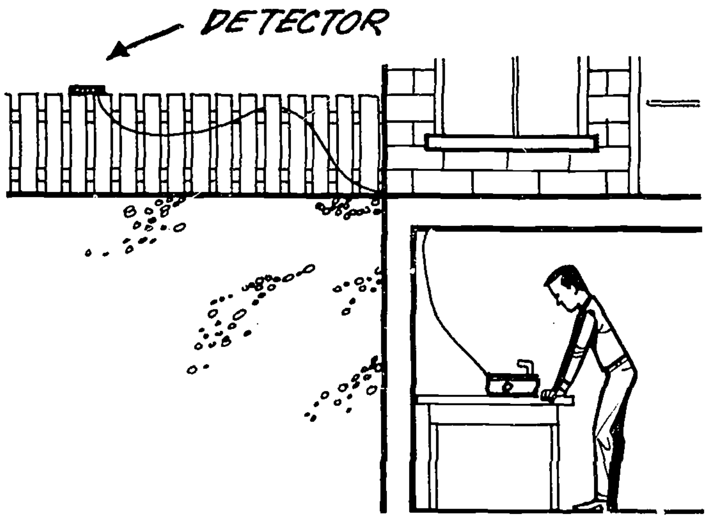
1. At some point after a nuclear attack, shelter and fallout monitoring station personnel must begin performing outside monitoring to support emergency activities. Outside operations can't begin until the dose rate is (CHECK THE CORRECT ANSWER):

   ____A. back to normal--as low as it was prior to attack.

   ____B. low enough that limited outside emergency activities can be performed without extreme danger.

B is correct.

2. The outside dose rate is easy to determine when you have a CD V-717



remote reading survey meter. Why?

____

____

____

____

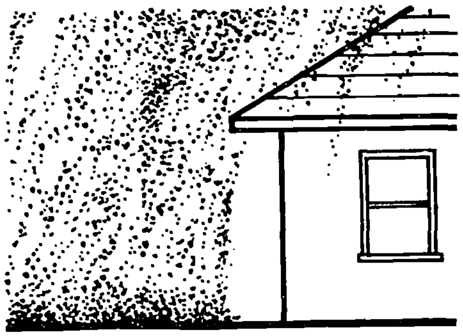
____

The CD V-717's detector can be positioned at distances up to 25 feet from the control and meter section. It can therefore be left outside where it can measure the unsheltered dose rate, which can be read by the monitor inside his shelter. (OR EQUIVALENT ANSWER)

3. Later, you'll learn to determine the approximate unsheltered dose rate based on a comparison between the in-shelter and unsheltered dose rates. But for now we'll discuss the calculation of future dose rate projections, since when a dose rate is known, the dose rate for a given time in the future can be estimated.

NO RESPONSE NECESSARY

4. As radioactive fallout particles fall to earth, they accumulate on the ground, roofs



HEAVY FALLOUT ACCUMULATION

of buildings, bushes, ledges, and other surfaces that are exposed to the air. These particles emit gamma radiation, and as they accumulate, the unsheltered dose rate usually (increases/decreases--which?) ______________ | increases

5. Due to radioactive fallout accumulation, the unsheltered dose rate usually increases. (CHECK THE CORRECT ANSWER):

____A. forever.
____B. until all or most of the particles have fallen.
____C. for exactly three days, regardless of the yield of the weapon.

B is correct.

6. The unsheltered dose rate usually reaches its highest level after all or most of the radioactive fallout has been deposited. An interesting and very important phenomenon called "radioactive decay" (which begins at the moment of the weapon detonation) and continues to occur, even though the dose rate may be increasing from a heavy accumulation of radioactive fallout material (particles). As radioactive decay takes place (CHECK ONLY ONE ANSWER): ___A. The radioactivity of fallout material decreases with time. ___B. Unsheltered dose rates decrease as the radioactivity of the fallout material decreases. ___C. Both A and B are true. ___D. Neither A nor B is true.	C is correct.
7. In regard to the unsheltered dose rate after a nuclear attack: A. Fallout material becomes less radioactive with time through the process of ________________. B. This results in a gradual decrease in the unsheltered ______________.	A. radioactive decay B. dose rate

8. Because of radioactive decay, the unsheltered dose rate doesn't stay the same for long. A. The unsheltered dose rate gradually (increases/decreases--which?) ______________.	A. decreases
B. To estimate when limited outside missions can be performed, the (present/future--which?) __________ dose rates must be projected.	B. future
9. If communications are kept open between the monitor and the EOC, the monitor (CHECK THE CORRECT ANSWER): ___A. will be able to obtain projected future dose rates from the EOC. ___B. still has to figure the future unsheltered dose rate for himself. ___C. needn't worry about unsheltered dose rates, since they aren't important anyway.	A is correct

DOSE RATE NOMOGRAMS

10. To simplify calculating rough estimates or projections of future unsheltered dose rates, a special chart has been developed. This chart, called a Dose Rate Nomogram, is reproduced and discussed in detail in the optional Additional Information Appendix. When you're interested in more detailed information about this subject, study the material on it in the Appendix. You won't be tested on this information, however, since it is optional. NO WRITTEN RESPONSE REQUIRED.	NO WRITTEN RESPONSE REQUIRED

THE 7:10 RULE OF THUMB

11. Another method of predicting future dose rates is the "7:10 Rule of Thumb." Like any other rule of thumb, the answers you'll obtain using it are (CHECK THE CORRECT ANSWER): ___A. extremely accurate. ___B. just approximations.	B is correct.
12. The 7:10 Rule of Thumb says this: For every 7-fold increase in time after detonation, there is a 10-fold decrease in the dose rate. Thus, if you know the dose rate at any given time after burst, then 7 times that time-after-burst (CHECK THE CORRECT ANSWER): ___A. The known dose rate will have decreased to 10% of its former intensity. ___B. The known dose rate will have decreased to 90% of its former intensity. ___C. The known dose rate will have decreased by 90%.	A and C are correct.

13. Suppose the dose rate at H + 1 is 1000 R/hr. You can apply the 7:10 rule like this: Multiply the time by 7, which gives you H + 7. At that future time, the dose rate will be about 10% of the H + 1 dose rate. So the dose rate at H + 7 will be about ______________.	100 R/hr
14. This rule can be extended as far as you wish. However, the further into the future estimates are made, the less reliable they become. Apply it to your new time and dose rate to determine what the dose rate will be even longer after the burst. In other words: A. Multiply your new time, H + 7, by 7, which gives you H + ____. B. Next, determine the H + 49 dose rate by figuring 10% of the H + 7 dose rate, which was ____________________. C. So, the approximate H + 49 dose rate will be________________.	A. 49 B. 100 R/hr C. 10 R/hr
15. There's nothing to prevent you from carrying the rule as far into the future as you wish except, as we stated before, it becomes less and less reliable as it is extended in time. The next step in another extension would be to: A. Multiply your last time, H + 49, by __________, which gives you H +________________. B. Determine____________% of the last dose rate (H + 49 dose rate), which gives you a dose rate at H + 343 of _______________.	A. 7, 343 B. 10%, 1 R/hr

16. The dose rate at H + 10 is 500 R/hr. Apply the 7:10 Rule of Thumb to preduct future dose rates. A. First, multiply the time by 7, which gives you_________. B. Then find 10% of the H + 10 dose rate, which gives you_________. C. You now know that the approximate dose rate at __________will be _____.	A. H + 70 B. 50 R/hr C. H + 70, 50 R/hr
17. Now, apply the 7:10 Rule of Thumb to the answer of part "C" of the above question to estimate the <u>next</u> possible future dose rate. A. You'll be determining the dose rate for H + __________________. B. Thus, the approximate dose rate for H +____________________ will be 10% of the H + 70 dose rate, or ______________.	A. 490 B. 490, 5 R/hr
18. Let's work one more problem together before you do one on your own. The dose rate at H + 5 is 200 R/hr. A. What will it be at H + 35?______ B. Taking the problem one step further, the dose rate will be 2 R/hr at __________________.	A. 20 R/hr B. H + 245
19. Your turn. If the dose rate at H + 2 is 650 R/hr, work out the first three <u>future</u> dose rates based on the 7:10 Rule of Thumb. A. At _____, dose rate will be _____. B. At _____, dose rate will be _____. C. At _____, dose rate will be _____.	A. H + 14, 65 R/hr B. H + 98 6.5 R/hr C. H + 686, .65 R/hr

20. To estimate approximate future dose rates, you can use the 7:10 Rule of Thumb. This rule states that for every ______________-fold increase in time after burst, there will be a ____________________ decrease in dose rates.	7, 10-fold
21. The dose rate at H + 4 is 900 R/hr. Use the 7:10 Rule of Thumb to determine: A. Approximate dose rate at H + 28: ____________________. B. At what time after burst will the dose rate be about .9 R/hr? ____________________.	A. 90 R/hr B. H + 1372 hrs
22. As far as the 7:10 Rule of Thumb is concerned (CHECK ANY CORRECT ANSWERS): ____A. it's 100% accurate. ____B. you'll only rely on it in emergency situations such as when communications are interrupted. ____C. it helps you estimate approximate future dose rates. ____D. it's been adopted as SOP.	B and C are correct

23. In terms of accuracy and reliability, nothing can replace a direct instrument reading. But under certain circumstances, you may need to apply the general rules you've learned in this portion of this program. If you wish, you can study the information on Dose Rate Nomograms, which, as mentioned, appears in the Additional Information Appendix to this book. And an occasional practice session with the 7:10 Rule of Thumb will help you keep it fresh in your mind should you ever need to use it. With this rule, you have some basic knowledge which--some day--may help you survive. We hope you never have to use it! Now, just why are the survey meters we've discussed so reliable? How do they actually work to tell you the radiation level? Let's discuss this interesting subject next. NO RESPONSE REQUIRED.	NO RESPONSE REQUIRED

IONIZATION

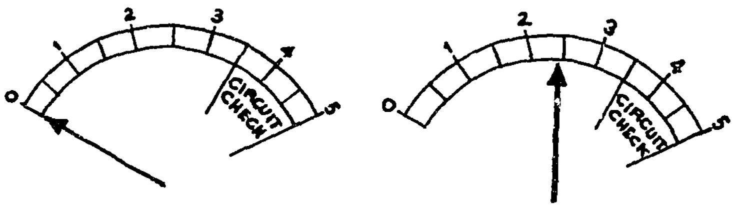
24. Shortly after the discovery of radioactivity, it was learned that exposure to radiation causes gases to ionize. Simply put, the atoms of gases change their electrical charge when exposed to radiation. As you might imagine, the greater the amount of radioactivity the gas is exposed to, the (greater/smaller--which?)________________the change in electrical charge.	greater

25. This ionization phenomenon was used quite early--by Madame Curie, in fact--for comparing the radio-activities of different materials. For example, if the electrical charge of a gas was changed X-amount by the radioactivity from Substance A, and was changed by 2X by the radioactivity from Substance B, it would indicate that (CHECK THE CORRECT ANSWER): ___A. Substance A was more radio-active than Substance B. ___B. Substance B was more radio-active than Substance A. ___C. There was little difference in the radioactivity of the two substances.	B is correct.
26. The change in electrical charge caused by exposure to radiation has been most useful in developing instruments that measure radioactivity. Remember, this change in the charge of an atom is called_______________, and it occurs in (solids/liquids/gases)________________________.	ionization, gases
27. To use this phenomenon in measuring the amount of radioactivity present in an area, an instrument must have some means of detecting and displaying the change in___________of a gas.	electrical charge

28. The survey meters we discussed earlier are ionization instruments. They are capable of detecting the charge in trapped gas and displaying this change by means of electrical meters--the dials you read when using the instruments. There's nothing special about the gas used in the instruments. Almost any gas would work, so we use the one that's most available--_______________.	air
29. Let's look at an operational survey meter, the CD V-715, to see how one type of ionization instrument works. This instrument has a metal cylindrical-shaped gas chamber. You learned earlier that: A. alpha and beta particles of radiation (will/won't)________ penetrate metal, so... B. the CD V-715, with its metal _______________chamber, measures _______________radiation.	A. won't B. gas, gamma

30. Within the gas chamber of the CD V-715 survey meter, there's a disc called a <u>collector</u>. There's a potential electrical charge difference of about 125 volts between the collector and the chamber itself. Now, when radioactivity passes through the gas in the chamber, the atoms of the gas become ionized--their_____________changes.	electrical charge
31. The ions created when radioactivity passes through the gas in the metal gas chamber (or ionization chamber) are positively charged. They then go to the disc in the chamber--they're drawn to it by electromagnetic attraction. The disc, as mentioned, is called the _______________and since the positively-charged ions go to it, we know that the disc is (positively/negatively--which?)____________________-charged.	collector, negatively
32. So the ions, or electrically charged particles, are drawn to the collector, a disc of (the same/a different) __________________electrical charge.	a different

33. The number of ions created is directly proportionate to the amount of radioactivity passing through the gas in the chamber. The electrons from these ions, once collected on the disc, creates an electrical charge.



NO CURRENT CURRENT

This current then passes into the measuring circuit of the instrument, where it's amplified and operates an electric meter. In other words, the electrons from the collected ions result in a current which, when amplified, causes what's pictured above to happen--the instrument's ____________________ shows a reading.

meter

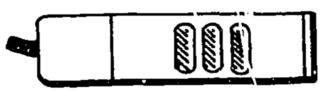
34. The radioactivity passing through the gas in the chamber, then causes ionization of the gas atoms. This results in an imbalance of electrons in these atoms, which gives them an electrical charge.

A. The charge of the ions is the opposite of the ________________, which is a disc in the chamber.
B. Therefore, the ions (avoid/are collected on/move around) ____________________the disc.
C. The electrons from these ions create an________________charge which, when amplified, operates an electric___________--the part of the instrument you read.

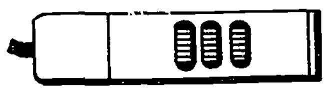
A. collector
B. are collected on
C. electrical, meter

35.	The current we're talking about in this type of instrument is quite low, of course. Therefore, before it can cause the needle on the meter to move, it must be (reduced/amplified) ________________________.	amplified
36.	In a few minutes, we'll discuss the properties of the three different types of radioactive particles--alpha, beta, and gamma. But you already know enough to answer this question: Since we're talking in this instance about ionization of gas within a metal chamber, which type of radioactivity will such an instrument measure?________Why?__________.	gamma--the other two won't penetrate the metal of the chamber
37.	Remember the CD V-700? As you'll recall, this instrument measures very small amounts of radioactivity, so it's considered an (operational/training)_____ _________instrument only, for all practical purposes.	training

38. This instrument operates on the ionization principle, like the CD V-715 and other operational instruments. But it measures beta radiation, as well as gamma, as you'll probably remember. How? Well, the shield on the probe of the CD V-700 can be turned, as we discussed.



SHIELD CLOSED



SHIELD OPEN

With the shield closed, the probe is a metal ionization chamber, so it'll only measure____________radiation.

gamma

39. Now, beta radiation will penetrate glass. When the shield on the probe of a CD V-700 is open, there's a glass chamber inside the metal one. So when this glass is exposed--the shield is open--the instrument (CHECK THE CORRECT ANSWER): ____A. measures only the gamma radiation anyway. ____B. measures beta only. ____C. measures both the gamma and beta radiation passing through the chamber. ____D. measures neither type of radiation, since the instrument won't work without its protective shield.	C is correct.
40. With the shield open, the CD V-700 measures both the gamma and beta radiation passing through the enclosed gas. To determine the amount of beta, of course, you'd have to take both readings--open and closed shield--and find the difference. The point is, due to the glass chamber that can be exposed, an instrument such as the CD V-700 can measure both ______________ and ___________________ radiation.	beta, gamma
41. These instruments operate on the same principle as the others we've discussed--those with metal chambers only. That is, the radioactivity passes through the gas in the chamber (whether the shield is open or closed is not important to this point) and causes ______________ of the atoms of the __________________________.	ionization, gas

42. This type of meter operates at a higher voltage than the others, and this means that there's a greater difference in charge between the collector and the ionized particles. It follows, then, that the ions move to the collector at a much (faster/slower) ______________ rate than in the other type of instrument.	faster
43. Due to this greater acceleration of ions, the instruments with a glass-and-metal ionization chamber will measure much smaller amounts of radioactivity...the instruments are more sensitive. That's why they're capable of detecting ______________ radiation, as well as gamma.	beta
44. The greatly accelerated ions in instruments like the CD V-700 (these are Geiger-Mueller counters, for your information) collide with other gas atoms on their way to the collector, ionizing them as well. And all of this activity creates an electrical current. The electrical current thus created is what causes the meter to show a reading. And since the built-in acceleration effect created in these ionization chambers causes so much electrical activity, the current thus created (must/should/need not) __________________ be amplified before it can cause a reading on the electrical ______________ of the instrument.	need not, meter

45. Both types of instruments we've discussed--those with all-metal gas chambers, and those with metal and glass chambers--operate on the same principle. Radioactivity passes through the gas in the chamber and ionizes the gas, thus creating electrical current that is capable of moving the needle of a meter. But with the all-metal chamber, the current created is not as great as that which results in the other instruments. Therefore: A. In an instrument like the CD V-715, the current must be ____________ before it can move the needle of the meter. B. In an instrument like the CD V-700, the current is greater so it (FINISH THIS SENTENCE) ______________________________.	A. amplified B. need not be amplified (OR SIMILAR ANSWER)
46. So the fact that radioactivity causes ionization of the atoms of gas in a chamber is especially important to us in detecting and measuring radiation levels. This phenomenon is the principle upon which some of our most useful instruments--especially ____________ meters--are constructed.	survey

47. A whole program--and more--could be written on this subject of ionization, and how it applies to the instruments we use in measuring radioactivity. But we've gone far enough for our purposes here. Remember, the survey meters you'll work with are electrical instruments, and the electrical energy that causes a reading on the meter of such an instrument is created by (CHECK THE CORRECT ANSWER): ____A. 110V current from any wall outlet. ____B. batteries. ____C. ionization of the atoms of gas in a chamber.	C is correct.
PROPERTIES OF RADIOACTIVE PARTICLES 48. Directly related to the ionization of gases caused by radioactivity are the properties of the types of radioactive particles. There are three types of these particles, as we've discussed: ____________, ____________, and __________.	alpha, beta, gamma
49. Alpha particles are rapidly-moving particles of positive charge. They're actually nuclei of helium atoms--but we don't expect you to remember that. As we've already discussed, alpha particles (will/will not) ________________penetrate metal or glass, so it (can/cannot)_____________be measured with the survey meters we've been discussing.	will not, cannot

50. Alpha particles are fast moving, as mentioned...they're shot out at speeds of about 10,000 miles per second. You'll learn soon that this is actually slow, compared to beta and gamma particles, even though it sounds incredibly fast at this time. But alpha particles lose speed quickly, because they run into atoms in their path. So, in spite of their initial speed, they travel only an inch or two! This is one of the reasons we said earlier that we (are/aren't)_______________especially concerned about alpha radiation.	aren't
51. For injury to result from alpha radiation, you'd almost have to swallow (inhale, ingest) alpha particles. This is because they travel (CHECK THE CORRECT ANSWER): ___A. too fast to cause damage. ___B. only very short distances. ___C. quite far.	B is correct.
52. Alpha particles cannot penetrate the chamber wall of a survey meter--it can't reach the gas trapped in the chamber. Therefore, for all practical purposes, alpha radiation (can/cannot) ____________be measured on our instruments.	cannot

53. Beta particles move much faster than alpha--at speeds of about 184,000 miles per second. But, as we discussed earlier (CHECK THE CORRECT ANSWER): ____A. beta penetrates neither metal nor glass, so it can't be measured. ____B. beta penetrates metal, but not glass. ____C. beta penetrates glass, but not metal, so it is detected only by our Geiger-Mueller counters.	C is correct.
54. Beta particles can penetrate thin sheets of metal, and pass through glass fairly easily. They may even penetrate as far as half a centimeter into lead. The important aspect here is that these radiations will pass through glass, so they can be detected using the CD V-700, as long as the shield on the instrument's probe is (open/closed)________________.	open
55. Finally, gamma radiation consists of rays similar to X-rays. It's a form of electromagnetic radiation of very high frequency. A. Gamma rays (will/will not) ____________ penetrate metal, including several centimeters of that very dense metal, ____________. B. For this reason, gamma rays can be detected and ultimately measured through the ____________ of the atoms of gas, even if it's in a metal chamber.	A. will, lead B. ionization

56. Gamma rays travel at the speed of light, so they're much faster than both alpha and beta radiation particles. They can cause chemical and biological alterations in living cells and tissues, so they're especially dangerous. Still, it's this ability to penetrate that also makes gamma rays (easier/more difficult)_______________to detect and measure.	easier
57. Alpha and beta radiation are actually particles which shoot out at tremendous speeds. But gamma radiation is more like X-rays. In this regard, then, gamma radiation is (CHECK THE CORRECT ANSWER): ___A. also composed of visible particles. ___B. made up of rays of electro-magnetic radiation of very high frequency. ___C. low-frequency rays of electro-magnetic radiation.	B is correct.
58. As we discussed in a previous section, beta radiation can penetrate only a slight distance into the skin. It can produce an effect similar to a burn on the skin's surface. But gamma rays are capable of penetrating (CHECK THE CORRECT ANSWER): ___A. a little bit farther into the body. ___B. no farther than beta radiation. ___C. completely through a person's body.	C is correct.

59. But this same penetrating capability of gamma radiation is the same thing that makes it possible for us to detect and measure gamma radiation. If it couldn't penetrate the metal ionization chambers of instruments such as the CD V-715, we (could/could not)_________ use such instruments to detect and measure______________radiation.	could not, gamma
60. Concerning the properties of the three types of radiation: A. Alpha particles travel (very short/long)____________distance through the air. B. We do not use an instrument that measures or even detects the presence of_____________radiation. C. Beta particles travel (longer/shorter/about the same)_________ distances, compared to alpha radiation. D. Gamma radiation is__________ radiation similar to__________. E. Gamma rays (can/cannot)__________ penetrate seemingly solid materials.	A. very short B. alpha C. longer D. electro-magnetic X-rays E. can

61. So the penetrating capabilities of gamma and beta radiation make it possible to detect and measure them (directly in the case of gamma; indirectly for beta) using the ionization of gases phenomenon we've discussed. As you can imagine, the properties of each of these types of radiation are the subjects of many complete books, so we could continue indefinitely with this subject. But you now know enough to understand how and why we can detect and measure beta and gamma radiation--and why we can't measure alpha radiation with most of our instruments. So let's end this unit at this point; when you're ready, take the quiz, which follows. NO RESPONSE REQUIRED.	NO RESPONSE REQUIRED

PLEASE COMPLETE THE TEST ON THE FOLLOWING PAGES.

You have now completed 3 of the 4 units of this course. Regardless of how much time it has taken, you may feel it necessary either to take a long break, if you have not already taken one, or to push right on to finish the course.

Either way the distance left to go in the course is relatively short. You are within sight of your course certificate, the acquisition of which will be rewarding enough to encourage you to continue, not to mention the personal satisfaction of accomplishment you will experience.

We would recommend, however, that if you haven't yet taken a restful break, that you do so now so that you can return and complete the last unit refreshed.

INTRODUCTION TO RADIOLOGICAL MONITORING

HOME STUDY COURSE

NOTE: DO NOT LOOK AT THE TEST BELOW UNTIL YOU HAVE COMPLETED UNIT 3.

UNIT 3 TEST

(Check the best answers)

1. The two factors in protection against radiation which are provided by a good shelter are:

   ___a. time, space.

   ___b. distance, mass.

   ___c. beta, gamma.

2. After the initial surge of radiation at the time of the burst (which will always be accompanied by the release of tremendous levels of blast and thermal energies) the greatest radiation hazard from a nuclear burst is:

   ___a. polluted water.

   ___b. biological changes in the environment.

   ___c. radioactive fallout.

3. Two hazards from radioactive fallout are:

   ___a. gamma burns, alpha ingestion.

   ___b. beta burns, alpha ray penetration.

   ___c. exposure to gamma-emitting particles, beta skin burns.

4. If fallout arrives before you reach shelter:

   ___a. cover your head and adjust your clothing to cover as much skin as possible as you hurry to shelter.

   ___b. walk slowly to avoid stirring up dust and dirt.

   ___c. stay outside shelter to avoid carrying fallout particles in.

5. In general, radioactive fallout particles from a burst that are deposited in specific areas in great enough concentrations that their associated radiation levels cause a threat to survival, are of densities and physical sizes that are:

___a. too small to see.

___b. visible to the naked eye.

___c. so small and light in weight that they remain suspended in the air.

6. If fallout particles land on you:

___a. brush them off.

___b. you're doomed.

___c. they can't hurt you, so ignore them.

7. When radioactive fallout particles land on a surface or pass through the air:

___a. the material they pass through or land on becomes permanently radioactive.

___b. the surface, or the air, is radioactive for only a short period of time.

___c. the air or the surface isn't radioactive, but the particles are.

8. Monitors in a monitoring station, and shelterees in shelter should, if possible, remain in:

___a. areas with the highest dose rates.

___b. the best-shielded areas.

___c. areas that are most comfortable.

9. Dose rate levels in various areas in a shelter:

___a. may change and should be checked periodically.

___b. never change and needn't be checked once determined.

___c. can't be determined with present equipment.

10. A car or other closed vehicle can provide:

____a. good protection against all types of nuclear radiation.

____b. little or no protection against any type of nuclear radiation.

____c. very little protection from gamma rays, but some protection against beta radiation.

11. Once all or most of the radioactive fallout particles have been deposited, radiation levels begin decreasing due to:

____a. better shielding from the accumulated particles.

____b. radioactive decay.

____c. the effects of direct sunlight.

12. It's possible to determine approximately when outside activities can be resumed by estimating:

____a. present dose rates.

____b. current doses.

____c. future dose rates.

13. The monitor:

____a. will always have to determine future dose rates for himself.

____b. can usually get estimated future dose rates from EOC.

____c. isn't concerned with unsheltered dose rates.

14. According to the Rule of Thumb, if the dose rate at H + 1 was 500 R/hr, the dose rate at H + 14 days will be:

____a. 50 R/hr.

____b. .5 R/hr.

____c. 5 R/hr.

15. Radioactivity which causes a change in the electrical charge of the atoms of gases, is a phenomenon called:

___a. nuclear fission.

___b. ionization.

___c. radioactive decay.

16. In the OCD survey meter that has an all-metal ionization chamber, there's a disc called a collector on which:

___a. dust and other impurities are collected.

___b. positive electrical charges are repelled.

___c. positively-charged ions are collected.

17. In instruments that have all-metal chambers:

___a. the electrical current generated by the ions is small and must be amplified before it can operate the meter.

___b. no electrical current is allowed to reach the meter portion of the instrument.

___c. it's not necessary to amplify the current created by the electrons.

18. In a Geiger-Mueller counter, which has a tube inside the metal probe:

___a. only alpha radiation can be measured.

___b. only gamma radiation can be detected.

___c. beta radiation, as well as gamma can be detected.

19. A Geiger-Mueller type survey meter is:

___a. much less sensitive than the instruments with all-metal ionization chambers.

___b. more sensitive than the other type of meter.

___c. about the same, in terms of sensitivity, as the other type of survey meter.

20. The highly-penetrating nature of gamma rays:

___a. makes them relatively easy to detect with survey meters.

___b. makes them almost impossible to detect and measure.

___c. has no bearing on the ability to detect and measure with survey meters.

WHEN YOU HAVE FINISHED THIS TEST, CHECK YOUR ANSWERS USING THE ANSWER KEY ON PAGE xxx IN THE BACK OF THIS BOOK.

UNIT 4

RADIOLOGICAL MONITOR TASKS AND PROCEDURES

RADIOLOGICAL MONITOR RESPONSIBILITIES AND REPORTING

LESSON ONE

RADIOLOGICAL MONITOR

TASKS & PROCEDURES

OVERVIEW

&

FRAMES

FOLLOW

LESSON ONE: RADIOLOGICAL MONITOR TASKS AND PROCEDURES

OVERVIEW

In the event of nuclear attack, your job will be to collect and report radiological data for your locality. This information will be used in making decisions that will result in the saving of lives. It must be as accurate and reliable as possible. While you're reporting only a small portion of the total information needed, every part of it is important. Many people's lives are dependent upon how well you perform your tasks.

You may be assigned to a large public fallout shelter, or to a remote fallout monitoring station. In either event, you must be able to perform the same tasks... especially since a shelter may also be a monitoring station, if its location makes this desirable. So, in this lesson, we'll be teaching you what your duties are and how to perform them. We won't distinguish between the duties you'd have if assigned to one place or another, unless the location has some bearing on the specific task.

WHY RADIOLOGICAL MONITORING?

1. Radiological monitoring is performed to obtain nuclear radiation hazard information for the area of concern. This information is used by the governmental organization to which the monitor reports, to:

   A. Determine the severity of, and the location of the fallout; and,
   B. Help decide on courses of action which will minimize the radiation hazard for the greatest number of people.

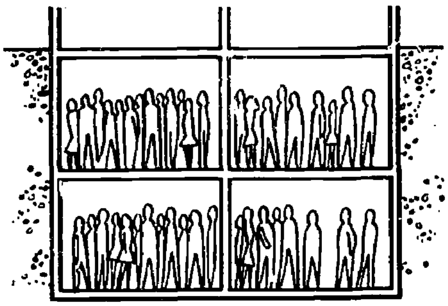
   The information you gather will help delineate the location of the fallout, indicate and record the variations in radiation levels from it, and be useful to higher authorities in their determination of what can be done to minimize its effects on ______________ and their resources.

   people

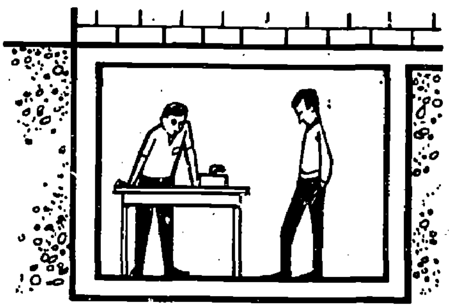
2. Based on information reported by monitors all over the affected area, decisions must be made as to how to insure the greatest safety for the most people. This information helps our leaders decide on a course of _____________.	action

3. Whether you're assigned..

HERE...



OR HERE...



You will be (CHECK THE CORRECT ANSWER):

____A. trained to perform the same basic tasks.

____B. trained according to your location.

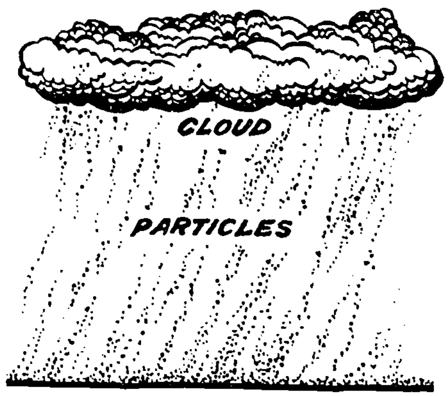
____C. taught to function only in one place or the other.

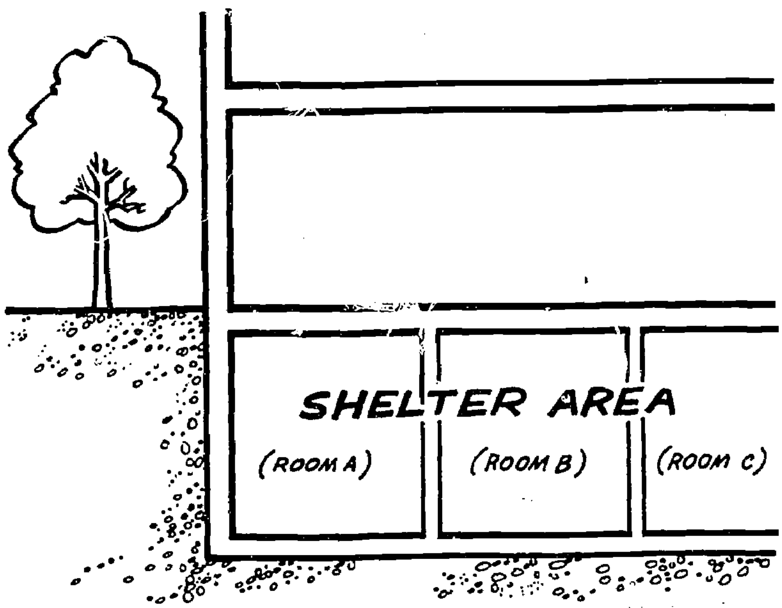
A is correct.

4. So whether you're assigned to a shelter or a fallout monitoring station, you'll be developing the capability to gather and report radiological information that will enable those to whom you report it, to: A. know the levels of radiation, and the location of the ________; and, B. to decide on a course of________ that will be of benefit to the most ____________________.	A. fallout B. action, people

TAKING FIRST MEASUREMENTS

5. Each shelter or monitoring station will have been provided with radiological instruments: the public fallout shelter with the CD V-777-1 "Shelter Radiation Kit;" the monitoring station with the CD V-777 "Operational Monitoring Set," and in some specially qualified stations, the CD V-777A "Monitoring Support Set." These contain the instruments in the numbers you'll need to perform your particular monitoring function: A. CD V-742's, which are______. B. CD V-750's, which are______. C. CD V-700's, which are low range ____________________. D. CD V-715's, which are high range ____________________.	A. dosimeters B. dosimeter chargers C. survey meters D. survey meters
6. In the event of nuclear attack (CHECK THE CORRECT ANSWER): ___A. you should have already assured yourself that your instruments were in your shelter, or in your monitoring station. ___B. you'll have to wait for instruments to arrive from the EOC. ___C. you must stop by your RADEF officer's home and pick up your instruments.	A is correct.

7. The initial radiation, blast, and heat of a nuclear burst are an extreme threat to the survival of anyone within a few miles of it at its time of detonation. However, those survivors will still be faced with another far more persistent and widespread threat to their continuing survival from that burst, by that which is illustrated here--radioactive________. 	fallout
8. When enough fallout particles arrive to cause an instrument reading, you must begin recording radiological data. One of the earliest measurements you should take is the dose rate in various locations within the shelter or station. This tells you which locations are best shielded from radiation. You're measuring the sheltered dose rate, so you should use (CHECK THE CORRECT ANSWER): ___A. a dosimeter. ___B. the CD V-750. ___C. an operational survey meter, such as the CD V-715.	C is correct.
9. Not every area in even the best of shelters provides the same amount of protection from radiation. Shortly after fallout arrival, you should determine which areas are best ____________________.	shielded (OR) protected

10. Fallout may not arrive at the shelter or monitoring station until after you do. You should begin to check for radiation as soon as you have your instruments operable after your arrival. Information obtained will be of value when (CHECK THE CORRECT ANSWER): ___A. you arrive before the fallout does. ___B. enough radiation is present to register a reading on your instruments. ___C. no reading is obtained: since this will indicate to you that significant amounts of fallout have not yet arrived.	C is correct.
11. Here's a drawing of a shelter in the basement of a large building. It's divided into three rooms.  A. Is the protection from gamma rays the same in Room A as it is in B or C?____________ B. As soon as you can obtain a reading on your survey meter, you should monitor each part of the shelter to see which provides ________________.	A. no B. best protection (OR) shielding

12. To be certain when fallout arrives, you must make sure your instrument is functioning properly. To do this, perform an operational check on your instrument: A. Turn the selector switch to ________. B. Allow about ________ for warm-up. C. Adjust the zero control knob so the meter reads ________. D. Next, turn the selector switch to the ________ position, in which the indicator needle should point to the ________ portion of the meter. E. Then turn to each of the four ________ and check the ________ setting after each range check.	A. zero B. 2 minutes C. zero D. circuit check, circuit check E. ranges, zero
13. When taking your readings in the shelter, use the CD V-715 (or other operational survey meter), carrying it at about 3 feet above the floor. This means you should hold the instrument about (CHECK THE CORRECT ANSWER): ___A. at belt level. ___B. even with your head. ___C. even with your shoulders.	A is correct.

14. 

In checking radiation levels, the survey meter should be held at about the height shown here--about ________ level.

belt

---

15. When taking inside measurements, you are determining the dose rate to which people will be and are being exposed. Since lives are at stake, you (should/should not --which?) ______________ record the measurements on a sketch of the shelter area.

should

---

16. When taking in-shelter or in-station readings, it's best to (CHECK THE CORRECT ANSWER):

____A. commit the dose rates to memory.
____B. write the dose rates on a blank piece of paper.
____C. write the dose rates for various areas on a sketch of the shelter or station.

C is correct.

UNSHELTERED DOSE RATES

17. When assigned to a monitoring station, or when asked to do so in a shelter, you must determine the outside dose rate in relation to the sheltered dose rate. To hold your own exposure to a minimum, take an initial unsheltered dose rate reading (CHECK THE CORRECT ANSWER):

    ___A. as soon as the dose rate in the shelter or station reaches or exceeds 0.05 R/hr.
    ___B. within a few minutes of burst, in every case.
    ___C. ten minutes after burst.

    A is correct.

---

18. If you know that your inside dose rate at a given time is "X" R/hr and your unsheltered dose rate at that same time is so-many-times as <u>great</u>, you won't have to go outside during peak radiation periods to estimate fairly accurately what the outside dose rate is. To get this correlation between sheltered and unsheltered dose rates, you must use the instrument that measures dose rate, your CD V-715 or CD V-717 operational ______________________.

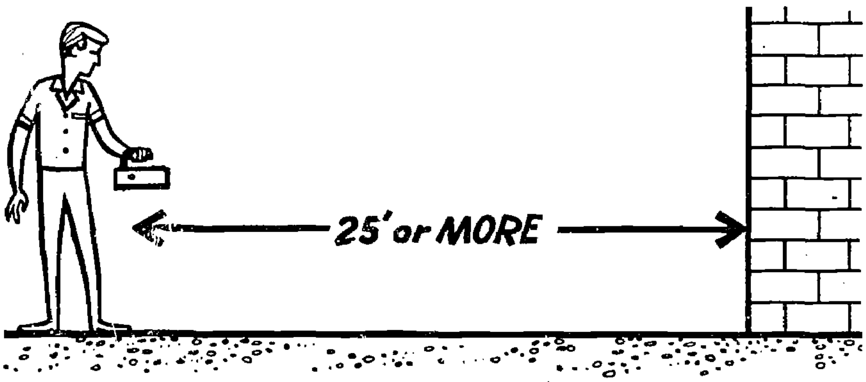
    survey meter

---

19. You may be able to take unsheltered dose rate readings from inside shelter, if you have a CD V-717 remote detector survey meter. This instrument's ______________ can be positioned outside, by the use of a 25 foot extension cable, while the meter face and controls remain inside with you.

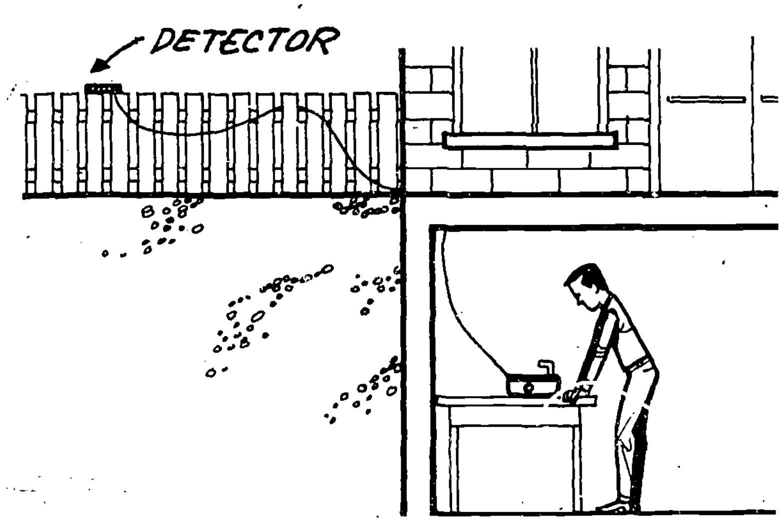
    detector

20. If you don't have a CD V-717. the first step is to pick a spot inside the shelter or station and take a reading. This is the (sheltered/unsheltered--which?)__________ dose rate at that moment.	sheltered
21. Next, as quickly as possible, go outside to a preselected location and take a dose rate reading. This gives you an unsheltered dose rate that (CHECK THE CORRECT ANSWER): ____A. means nothing for the future. ____B. correlates to your sheltered dose rate.	B is correct.
22. If the correlation between inside and outside dose rates is to be accurate, you must get outside and take the unsheltered reading (CHECK THE CORRECT ANSWER): ____A. when you get around to it. ____B. within a few days of the sheltered reading. ____C. as quickly as possible after taking the sheltered reading.	C is correct.

23. The spot you select for the unsheltered dose rate reading should be 25 feet (preferably more) from surrounding buildings, if possible. It should be  representative of the area around the shelter or station. In a city location, you may not be able to get 25 feet from buildings, and since you want to hold your exposure to a minimum, you should (CHECK THE CORRECT ANSWER): ___A. take a reading quickly and get back to shelter, even if you take it fairly close to a building. ___B. go as far as necessary to get away from buildings.	A is correct.
24. The ideal spot for taking an outside dose rate reading is one that's at least ____________________ feet from buildings and is representative of the area around the _______________.	25, shelter (OR) station

25. Try to take the two readings within a very short time, preferably 3 minutes. While you're outside, the radiation level is probably building up rapidly, so you should (CHECK THE CORRECT ANSWER): ____A. get back into the shelter without delay. ____B. hunt for the ideal location for the outside reading. ____C. take your time.	A is correct.
26. If at all possible, take the initial sheltered and unsheltered dose rate readings within (how many?)______ minutes of each other.	3

27.



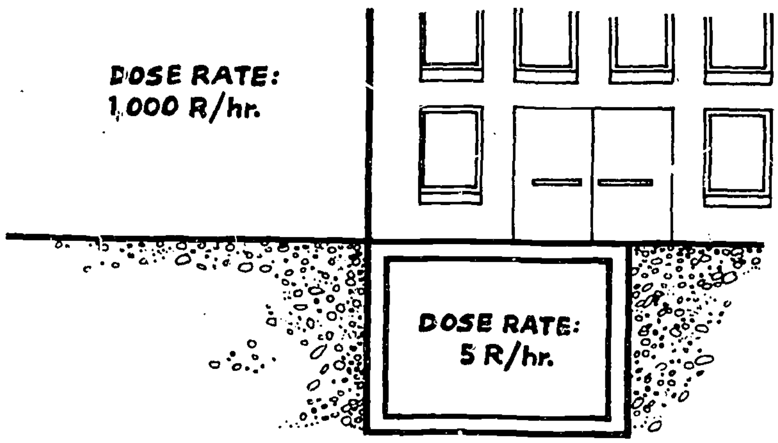
If you have the instrument shown above, you won't have to estimate the unsheltered dose rate. You can read it directly. This man is using a_________________________survey meter.	CD V-717 remote detector

28. Notice in the preceding drawing that the detector has been placed on a fence post several feet from the nearest building. That's because the ideal situation should apply when using a CD V-717: A. The detector should be (close to/ away from--which?)______________________ buildings. B. The spot should be____________________________ of the surrounding area.	A. away from B. representative

SHELTER PROTECTION FACTOR

29. You've now picked a specific spot or area in the shelter and taken a sheltered reading. Then, within three minutes, you've taken an unsheltered dose rate reading. As with all readings in and around the shelter area, don't trust your memory--write the readings on your ______________________ of the area.	sketch
30. Now, if the outside dose rate is divided by the sheltered dose rate you took at the particular area inside, the result will be a number which is called the Protection Factor, (PF) for that area. These measurements of the actual dose rates will confirm or correct the PF which was mathematically calculated for this shelter during pre-attack planning. The PF tells you how much protection your shelter is against the outside unsheltered radiation levels. If the unsheltered dose rate is 500 R/hr and the dose rate you measure inside is 2 R/hr, you have a protection factor of________at that location.	250
31. By dividing the unsheltered dose rate by the sheltered dose rate, you can determine the__________factor at the area in which the inside dose rate measurement was taken.	protection

32. Look at this drawing.	



What is the protection factor of this shelter?________________.	200
33. A shelter's or station's protection factor can be determined by (CHECK THE CORRECT ANSWER):	
____A. subtracting the inside dose rate from the unsheltered dose rate.	
____B. dividing the sheltered dose rate by the unsheltered dose rate.	
____C. dividing the unsheltered dose rate by the sheltered dose rate.	C is correct.

34. This protection factor may not remain the same over very long periods of time. You will learn why, and what to do about it later. The reason you should read the outside dose rate as soon as possible after fallout arrival is (CHECK THE CORRECT ANSWER): ___A. for the protection of your instruments. ___B. to minimize your own exposure.	B is correct.
35. At a later time, when you may want to estimate the outside dose rate, take an inside reading in the same area used to calculate the PF, and multiply it by the protection factor. The answer will be an approximation of the unsheltered dose rate at that time. Be certain to take the sheltered dose rate reading at (the same/a different--which?)___________location in the shelter.	the same
36. When you multiply a sheltered dose rate reading by the protection factor: A. you're using the protection factor to determine the______________ dose rate. B. you should take the sheltered reading in the same_________as the one you used in calculating the shelter's____________________________________.	A. unsheltered B. location, protection factor

37. The initial unsheltered dose rate was 300 R/hr, and the corresponding sheltered dose rate is 3 R/hr. A. What is the protection factor? ____________________. B. If the sheltered dose rate an hour later was 4 R/hr, what would the estimated unsheltered dose rate be?________________	A. 100 B. 400 R/hr
38. At later times, when the outside dose rate has gotten high, unsheltered dose rates can be approximately determined without leaving the shelter or monitoring station by (CHECK THE CORRECT ANSWER): ___A. multiplying the inside dose rate at the same location by the original outside dose rate. ___B. multiplying the sheltered dose rate readings taken then and in the same spot by the protection factor. ___C. dividing future sheltered readings by the protection factor.	B is correct.
39. You should be sure to remember that a shelter's PF will change with time, for these two reasons: one, because the energy level (or penetrating capability) of _______________radiation changes with time; and two, because rain, wind and weather will cause the radioactive fallout material to physically shift on the roof and ground, possibly causing areas that have been the best _________also to shift within the shelter.	gamma, protected

40. For these reasons you should recalculate the shelter's _________ factor at least once every 24 hours during the first few days postattack, unless the unsheltered dose rate is estimated to be above 100 R/hr. When the outside dose rate has decreased to 25 R/hr, you (cannot/should--which?) ________________ go outside to check it.

protection, should

---

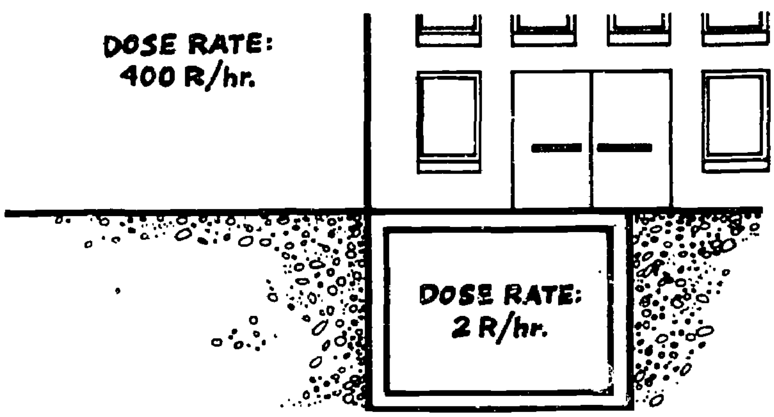
41. The protection factor (CHECK ONLY ONE ANSWER):

___A. will probably change with time.
___B. should be recalculated at least every 2 or 3 hours.
___C. Both A and B are true.
___D. Neither A nor B is true.

A is correct.

---

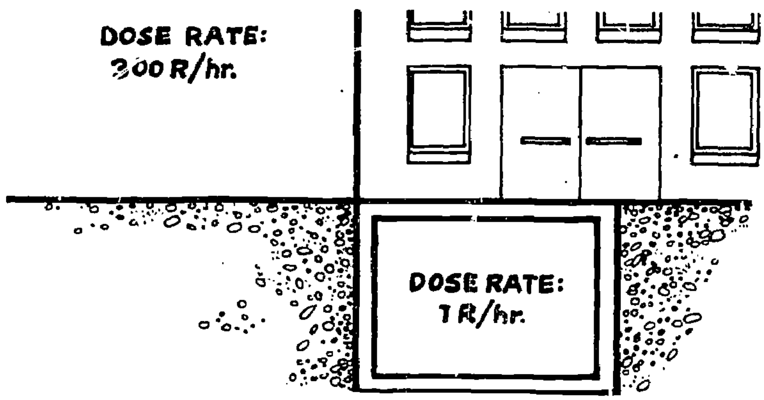
42. Look at this drawing.



A. What is the shelter's protection factor? ________________
B. If the sheltered dose rate later becomes 5 R/hr, what will the unsheltered dose rate be _________.

A. 200
B. 1,000 R/hr

43. If the figures on this drawing are initial unsheltered and sheltered dose rates answer the questions below.



A. What will the sheltered dose rate be if the unsheltered dose rate reaches 900 R/hr?________

B. What is the unsheltered dose rate if the sheltered dose rate reaches 5 R/hr?________________

C. What's the protection factor for this shelter?________________

A. 3 R/hr
B. 1,500 R/hr
C. 300

---

44. Two possible ways you can determine the outside dose rate are:

A. Use the CD V-717 remote__________ survey meter.

B. Multiply the existing sheltered dose rate by the current__________ ______________________.

A. detector
B. protection factor

45. A third method of determining the unsheltered dose rate is to quickly step outside with a CD V-715 and measure it. But you should not use this method regularly until the unsheltered dose rate has decreased to 25 ______.	R/hr
46. Keeping personnel radiation doses to a minimum is important, but it's even more essential for people who will be involved in emergency outside operations and early clean-up. Unless unavoidable, don't measure outside dose rates directly when radiation levels are above ______.	25 R/hr
47. It is possible to take or calculate unsheltered measurements by any of these methods: A. reading a CD V-______ directly at any time. B. multiplying the protection factor by the existing ______ dose rate. C. reading directly with a CD V-715, when unsheltered dose rates have decreased to ______.	A. 717 B. sheltered C. 25 R/hr
48. The local dose and dose rate information you obtain may be important in the overall picture. If you are in a monitoring reporting station, the information you gather (should be/needn't be--which?) ______ reported.	should be

49. By knowing the unsheltered dose rates in most areas affected by fallout, personnel in the EOC can determine the best actions to take to save the greatest number of lives. So if you are in a radiological monitoring reporting station, the radiological information you have gathered, (FINISH THIS SENTENCE)____________________ ____________________.	should be reported (OR EQUIVALENT ANSWER)

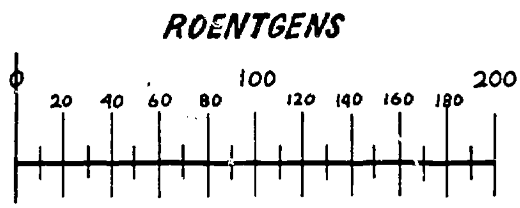
DOSIMETERS FOR MEASURING DOSE RATES

50. There is a way to use the dosimeter to measure the dose rate. Suppose you must determine the unsheltered dose rate, but all of your survey meters are inoperable or the dose rate is above the capability of your instrument. You can simply place a dosimeter outside, let it remain there for a timed fraction of an hour, then read the dose it has received in that time. This tells you the (CHECK THE CORRECT ANSWER): ___A. dose rate in the area. ___B. dose the dosimeter measured in that fraction of an hour. ___C. dose rate the dosimeter received.	B is correct.
51. By setting the dosimeter outside, you have learned the dose it measured in the time it was unsheltered. The dose is measured in__________, and you want to know the dose rate, which is measured in__________ __________.	roentgens, roentgens per hour

52. Suppose you left your dosimeter outside for 15 minutes. During that time, it received a dose of 50 R. To find out what the dose rate per hour is, simply multiply the dose the dosimeter received by 4, since there are 4 periods of 15 minutes in an hour. This tells you that the unshelterd dose rate is__________ R/hr.

200

53. Here's the scale of the operational dosimeter CD V-742.



The range is 0 to 200 R only. Therefore, if you suspect the dose rate is above 1000 R/hr. outside, you should be certain the hairline is on____________ ____________before putting the dosimeter outside.

zero

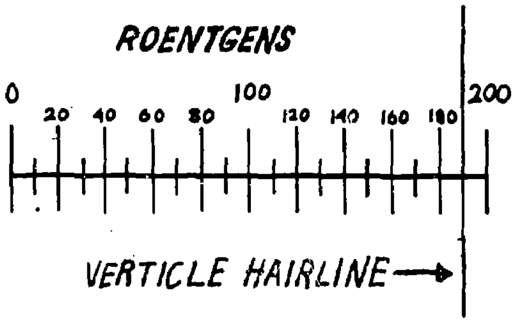
54. If the dosimeter shows a very low reading, you can probably just record it before putting the instrument outside, then find the difference when you bring the instrument in. But if the hairline is near or above half scale, you should be certain to______________________the dosimeter before putting it outside.

zero (OR) recharge

55. Leave the dosimeter outside for a fraction of an hour; determine the dose it has received in that time; then calculate how many roentgens it would have received in one hour. This gives you a useable estimate of the unsheltered dose rate in ________ per ________.	roentgens (per) hour
56. Assume no operational survey meter is available, so you must use a dosimeter to determine the unsheltered dose rate. You expose the dosimeter for 20 minutes, and it receives a dose of 40 R. What is the unsheltered dose rate? ________	120 R/hr (since 20 minutes is 1/3 of an hour, and the dose in that time was 40 R, the dose rate is 40 x 3, or 120 R/hr)

UNSHELTERED DOSE ACCUMULATION MEASUREMENTS

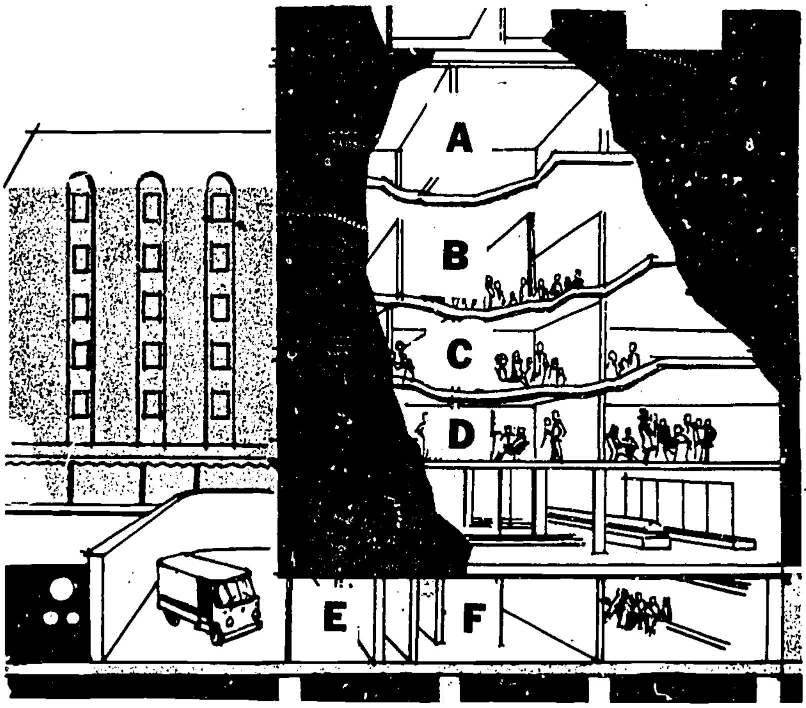
57. Fallout monitoring stations measure, record and report unsheltered total dose accumulations for their locations, to the EOC. If a public fallout shelter is also a radiological ________ and reporting station it will also ________, ________ and report its accumulated unsheltered radiation ________ to the ________.	monitoring, measure, record, dose, EOC
58. First zero a ________ dosimeter. Then using a ________ survey meter measure the unsheltered dose rate. Still using the survey meter, position the dosimeter inside where the dose rate is 1/10 to 1/20 the unsheltered dose rate. Determine the protection ________ for the dosimeter position.	CD V-742 CD V-715 factor

59. Multiply daily ________ dosimeter readings by the PF obtained for that location. In the next lesson you'll learn that the result will be unsheltered accumulated ________ for your station, and when you'll have to __________ it to the ________________________.	CD V-742, dose, report, EOC
60. Since the location of this dosimeter will probably be in a part of the shelter or station which is less protected than others, the dose could approach full scale, or __________ on the CD V-742 as shown here, before the time when you would require another unsheltered dose reading. If this occurs, record the reading, which is ________, note the time it took to reach this dose, recharge, or _______ the dosimeter and put it back in its position. Do not stay with this dosimeter, but check it often to be sure it does not go past the 200 R mark. 	200 R, 190 R, zero
61. If this dosimeter approaches full scale so rapidly that it cannot be watched carefully, find a new ________ for it that is better protected, then ________ the procedure shown in Frames 58 through 60. NOTE: the next section concerns IN-SHELTER personnel DOSE measurements. <u>This</u> section shows you how to _________ and _______ the total _________________ accumulated daily _______ from arrival of fallout to date. The next lesson will tell you when and how to _______ it to the ________________.	position, repeat, measure, record, unsheltered, dose, report, EOC

MEASURING DAILY IN-SHELTER DOSES

62. An accurate record must be kept of the total doses accumulated by shelterees and fallout monitoring station personnel. If enough dosimeters are available, each person can wear his own at all times. However, in a large shelter with many occupants, there probably won't be enough to go around. In this situation, place the available dosimeters at various locations in the shelter or station. The dosimeters should be charged, that is, set on_______________.	zero
63. Before doing anything else, make sure that all of the dosimeters are charged. This means that the hairline on the scale should cross_______________.	zero

64. You should then position the dosimeters in locations that are most often occupied by shelterees, or fallout monitoring station personnel. These locations should be (CHECK THE BEST ANSWER): ___A. the areas no one is occupying. ___B. least shielded areas. ___C. changed if the distribution of the people in the shelter changes.	C is correct.
65. Your objective is to determine the daily accumulated dose of shelterees or monitoring station personnel, so you must pick the locations that are most frequently occupied by your people. Look at this picture of a large public shelter. Then write the letters of the areas in which you'd put dosimeters under the circumstances shown._______________ ____.	B, C, and D are locations in which dosimeters should be placed.



66. People will move around in a shelter. And, unless such high radiation exists in one area that they shouldn't move around, it's better psychologically if they do. If you note population shifts within the shelter, you should (CHECK THE CORRECT ANSWER): ___A. reposition the dosimeters to match the shifts of the people. ___B. quit monitoring, since your readings won't be accurate. ___C. leave dosimeters in their original positions.	A is correct.
67. Here are three important points about determining shelterees" daily doses. A. First, you should ____________ all available dosimeters. B. Then position them in (the most exposed/representative--which?) ____________ locations where people are located. C. If the population shifts, you should (FINISH THIS SENTENCE) ____________________ ____________________ ____________________	A. zero (OR) charge B. representative C. change instrument location to adjust to population changes (OR EQUIVALENT ANSWER)

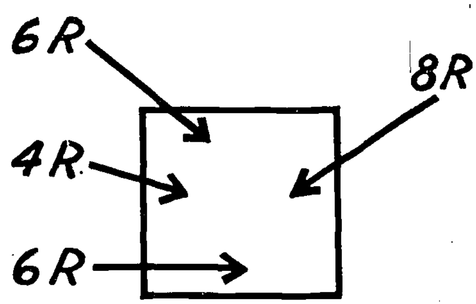
68. In a room of a shelter, you may find that your dosimeters don't all read the same after equal exposure time. Take the average of the readings and record that as the dose. These differences exist largely because (CHECK THE CORRECT ANSWER):

___A. the various dosimeters don't operate on the same principle.
___B. your instruments are probably inaccurate.
___C. the shelter doesn't have the same protection factor throughout.

C is correct.

---

69. Suppose you obtain the readings shown on four dosimeters in this given room.



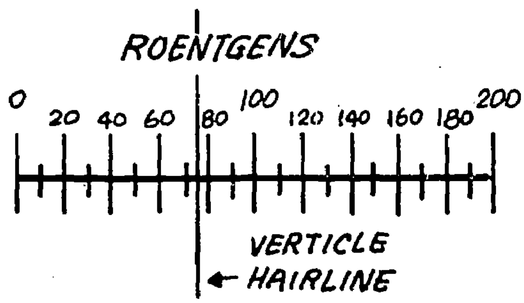
What dose will you record for the people in this room?______________

6 R (the average of 4, 6, 6, and 8 roentgens)

---

70. If several dosimeters positioned in a room give you different readings, you should add the readings together and record their______________________as the dose.

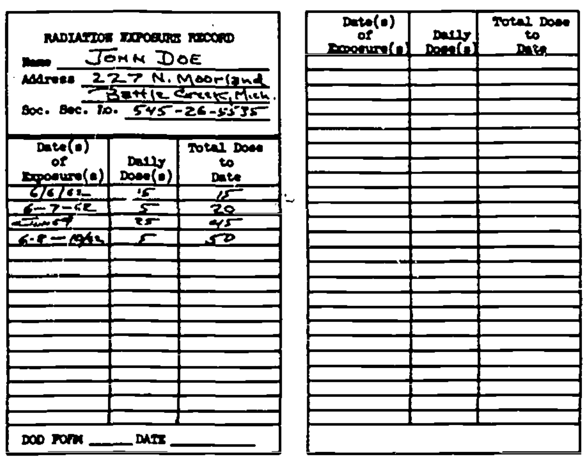
average

71. In a later lesson you will learn that if the total dose to shelterees (or monitoring station personnel) reaches the amount indicated here, (which is______) in any two-day period, you should tell the Shelter Manager to notify the EOC and request assistance or guidance. Monitoring Station personnel should also notify the EOC under such circumstances. 	75 R
72. All personnel are to record their doses daily. You must examine these records daily. If any record indicates the dose may have been received at a RATE of 10 R/hr, you should first check the dosimeter of the person who recorded it. This dosimeter could be reading unduly high from____________leakage. If it is a valid reading, question the wearer as to where he spent most of the past day. He may have lingered too long in a less protected area. If more than one record indicates as much as this one, have the Shelter Manager contact the ____________for guidance.	electrical, EOC
73. If you have dosimeters in representative areas, (due to a lack of enough for each shelteree to have his own), and their dose measurements differ by as much as ____________R, you (should/should not--which?)__________________add these together and average them.	10, should not

74. You must record the daily__________of dosimeters you have positioned for area ____________dose measurements, and rezero them before you____________ them. You should identify these doses with the shelterees who were in that representative area.	readings, representative, reposition

RADIATION EXPOSURE RECORDS

75. Here's a picture of the radiation exposure record each individual must maintain.



FRONT SIDE BACK SIDE

If there are not enough dosimeters to go around, each person should be instructed to record his dose every day. In this situation (CHECK THE CORRECT ANSWER):

____A. you'll have to tell everyone what his dose is.
____B. they should just forget about their exposure records.
____C. the records are worthless.

A is correct.

76. As you can see in this closer look at the top of the form, it calls for only basic information about an individual--his ________________, ________________ and ________________ ________________.

RADIATION EXPOSURE RECORD

Name ________________________

Address ________________________

____

____

Soc. Sec. No. ________________________

name, address, social security number (IN ANY ORDER)

---

77. Even the columns for recording are simple:

Date(s) of Exposure(s)	Daily Dose(s)	Total Dose to Date

The form provides for the recording of:

A. the date or dates of ____________.
B. daily exposure ________; and,
C. total dose to ______________.

A. exposures
B. doses
C. date

78. Each individual must keep a running total of his dose. The amount of each daily dose must be (added to/ subtracted from--which?)________ ______________the accumulated dose at each recording.	added to
79. Reporting procedures are covered in greater detail in the next lesson. For now, we'll simply point out that (CHECK THE CORRECT ANSWER): ___A. once daily doses and accumulated doses have been recorded on radiation exposure records, you can forget about them. ___B. doses must be reported as directed in your local organizational SOP.	B is correct.
80. Remember, people may not be able to read their dosimeters, or there may not be enough instruments to go around. In these situations, it will be your responsibility to (CHECK ONLY ONE ANSWER): ___A. inform people what their doses are and help them record them, if necessary. ___B. help people read their dosimeters and complete their radiation exposure records. ___C. Both A and B are correct. ___D. Neither A nor B is correct.	C is correct.

THIS CONCLUDES THIS LESSON. PLEASE GO TO THE NEXT LESSON.

LESSON TWO

RADIOLOGICAL MONITOR

RESPONSIBILITIES & REPORTING

LESSON TWO - RESPONSIBILITIES AND REPORTING

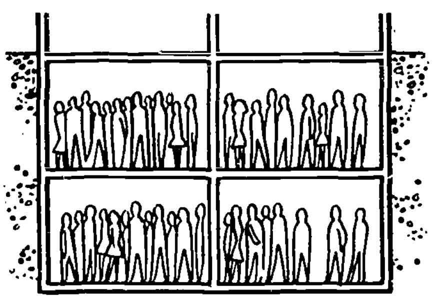
OVERVIEW

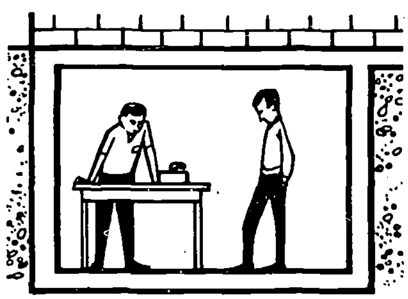
In this lesson, we'll take a further look at the monitor's responsibilities, both in peacetime and in times of emergency. First we'll discuss duties that pertain to all monitors; then we'll cover some duties applicable only when you're assigned to a fallout monitoring station. We'll discuss reporting procedures, why they're important, and how and to whom you should make reports.

You know that there are two possible locations for monitors--public shelters and fallout monitoring stations. And some shelters will also be assigned monitoring station responsibilities. The duties are basically the same in both locations, with a few exceptions. These instances will be covered in this lesson.

MONITOR'S LOCATION

1. In an earlier lesson, you learned that a monitor can be located in either of the two locations shown below. Label them.





A.______________ B.______________

A. shelter
B. fallout monitoring station

2. Regardless of your location, your main objective is the same--(CHECK THE CORRECT ANSWER):

___A. to organize recovery parties and conduct outside missions.
___B. to obtain and report essential radiological data about the local situation.
___C. take over leadership of all persons in the area.

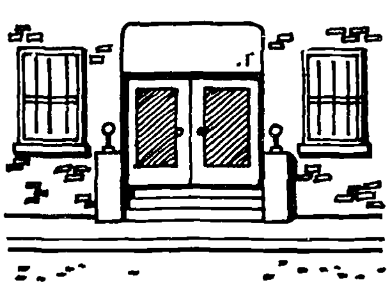
B is correct.

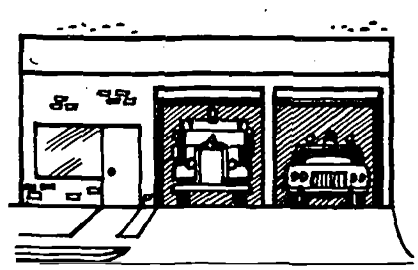
3. If you are assigned to a large public shelter, you'll have to make sure that everyone records his daily exposure dose. In this respect, your duties may be more complicated at a (CHECK THE CORRECT ANSWER):

___A. fallout monitoring station.
___B. large public shelter.

B is correct.

4. A fallout monitoring station can be set up in almost any location that has proper communication facilities and provides adequate shelter--usually a minimum protection factor of 100. For practical purposes, most fallout monitoring stations are established in places such as these. Label them.

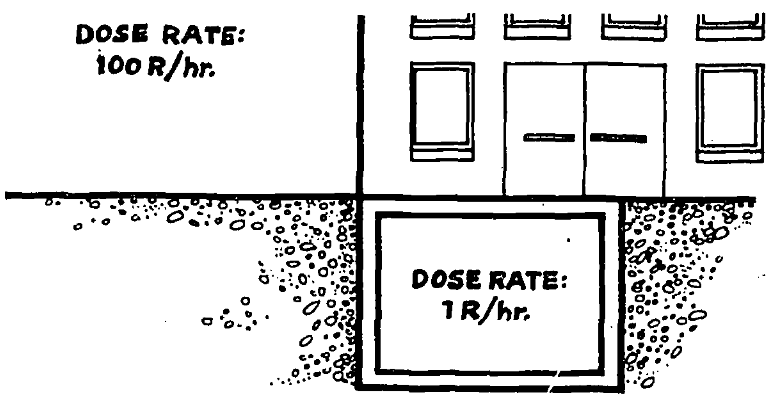




A.________________ B.________________

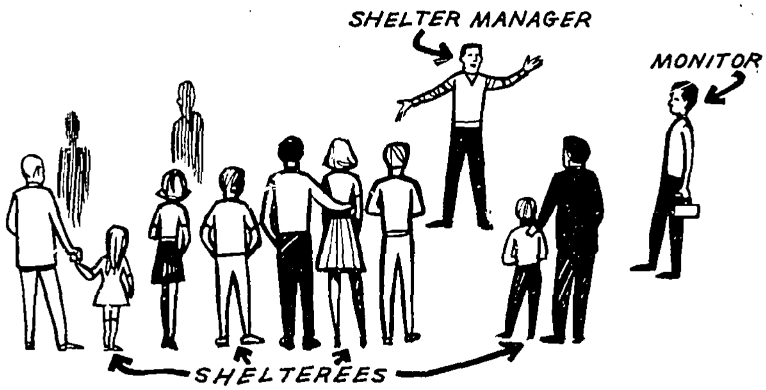
A. police stations
B. fire stations

5. Police and fire stations are just examples of places where fallout monitoring stations can be located. In addition to proper location, a fallout monitoring station (CHECK THE CORRECT ANSWER): ____A. must provide adequate protection and communications. ____B. must be established in such locations as county and state buildings. ____C. must be located in downtown areas only.	A is correct.
6. Communications should be able to function under fallout conditions so the most important factor is the protection provided by the location. The minimum protection factor should be_________.	100
7. Look closely at this drawing of a typical location.	



A. This location provides a protection factor of______________. B. On this basis, can it provide sufficient protection as a fallout monitoring station______________?	A. 100 B. yes

8. You should report as directed by your local SOP. As this drawing shows, one man is usually established as the head of a public shelter.



In a large shelter, there could be many more shelterees and a few more monitors. But they all look for leadership to the man who is designated ______________ ____________________.

shelter manager

---

9. The monitor is to report certain vital information to the EOC. In addition, if assigned to a shelter, he will have to provide radiological data that will help the shelter manager (CHECK THE BEST ANSWER):

___A. rule the shelter with an iron hand.

___B. make decisions that could save the maximum number of lives.

B is correct.

---

10. Monitors assigned to both shelters and fallout monitoring stations will report a certain amount of information to their ____________________.

Emergency Operations Center (or EOC)

11. The monitor assigned to a shelter must provide information about the immediate radiological conditions to the ________________.	shelter manager
12. So the basic duties of monitors assigned to both shelters and fallout monitoring stations are the same, with the shelter monitor having an additional relationship with the shelter manager. The keynote in this relationship is cooperation designed to (CHECK THE CORRECT ANSWER): ___A. save as many lives as possible. ___B. rebuild our cities. ___C. push the monitor and shelter manager into positions of power.	A is correct.
PEACETIME DUTIES 13. Monitors have some peacetime duties, most of which involve preparedness. For one thing, you'll have to make sure your instruments are ready for immediate use. You should: A. perform periodic operational checks on the instruments used to determine dose rates--the__________. B. recharge, or zero, instruments used to measure accumulated dose, the ________________.	A. survey meters B. dosimeters
14. A regular inspection schedule will be established for performing operational checks on survey meters. When performing these checks, you should also recharge, or________, all of your ______________.	zero dosimeters

15. When you perform operational checks and zero dosimeters, you should record it on this type of form.

INSPECTION, MAINTENANCE AND CALIBRATION LOG FOR RADIOLOGICAL INSTRUMENTS

DATE	ACTION	REMARKS	SIGNATURE
8/1/70	INSPECTION	O.K	John Doe
10/3/70	INSPECTION	O.K. ECEPT CD V-715	John Doe
	OUT FOR REPAIR	CD V-715, #86376	John Doe
10/15/70	RETURNED	CD V-715, #86376	John Doe
12/2/70	INSPECTION	O.K	John Doe
1/6/71	BATTERIES REPLACED		John Doe
1/15/71	CALIBRATION	O.K.	John Doe

This form is called the ____________
____
____
____

Your organizational SOP will show that the State Inspection, Maintenance and Calibration Shop will include your shelter or station in its inspection, maintenance & calibration schedule. It is this group's responsibility at least once every two years to check the operational capability of your station or shelter, including: its status as to assigned monitors; their latest refresher training; their possession of an up-to-date SOP, etc. Your ion chamber instruments (CD V-715's and CD V-717's) will be recalibrated, inoperable or obsolete instruments will be repaired or replaced, and fresh batteries will be issued. Shop personnel are OCD trained RADEF Officers, who will be able to advise and assist in your endeavors toward preattack preparedness.

Inspection, Maintenance and Calibration Log for Radiological Instruments

16. A closer look at the columns of the inspection, maintenance and calibration log shows that you'll have no trouble completing this form.

DATE	ACTION	REMARKS	SIGNATURE
10/5/70	INSPECTION	O.K	John Doe
12/2/70	INSPECTION	O.K. EXCEPT CD V-715	John Doe
	OUT FOR REPAIR	CD V-715 #86714	John Doe
12/20/70	RETURNED	CD V-715 #86714	John Doe
[illegible]	[illegible]	O.K.	John Doe

In the first column, enter the date on which you perform your inspection. Under "action," write what you did--inspected the instruments, sent one out for repair, etc. Under "remarks," enter such things as the condition of the instruments--if good, just write "O.K." Sign the form, since there may be several monitors alternating on inspections.

Suppose you inspect the instruments on November 3, 1972. All are functioning properly, except for one dosimeter, serial number 0016725. Enter the inspection report information on this blank form.

DATE	ACTION	REMARKS	SIGNATURE

DATE: 11/3/72
ACTION: inspection
REMARKS: O.K., except for CD V-742 #0016725
SIGNATURE: (your name)

17. Assume that you send the inoperable dosimeter out for repair on the inspection date. Dosimeters aren't repaired, however; replacements are sent. The new one, serial number 0024318, arrives ten days after your inspection. Record this additional information--both sending the instrument out, and its return-on the Log.

DATE	ACTION	REMARKS	SIGNATURE

(FIRST LINE)
DATE: 11/3/72
(operational, since date is same as inspection line)
ACTION: out for repair
REMARKS: CD V-742, #0016725
SIGNATURE: (name)

(NEXT LINE)
DATE: 11/13/72
ACTION: new dosimeter received (OR EQUIVALENT ANSWER)
REMARKS: CD V-742, #0024318
SIGNATURE: (name)

18. There's nothing complicated about the Inspection, Maintenance and Calibration Log for Radiological Instruments. The important thing is to (CHECK THE CORRECT ANSWER):

____A. fill it out whenever you get around to it.
____B. record any actions you take regarding the instruments.
____C. complete it annually, regardless of the number of inspections during the year.

B is correct.

19. On the schedule established by your local organization, you should: A. perform an operational check on all__________. B. recharge, or zero, all______ __________. C. record your inspection results on the______________________ ______________________ ______________________ ______________________.	A. survey meters B. dosimeters C. Inspection, Maintenance and Calibration Log for Radiological Instruments.
20. In our examples, the monitor didn't repair an inoperable instrument. He simply initiated action to get the instrument repaired according to SOP. Under most circumstances, the monitor (is/is not--which?)____________ responsible for repairing inoperable instruments.	is not
21. If repair of an instrument is necessary, the monitor should (CHECK THE CORRECT ANSWER): ___A. initiate action for repair or replacement with the State Inspection, Maintenance & Calibration Shop, through his own civil defense organization. ___B. repair the instrument himself. ___C. do nothing, unless nuclear attack seems inevitable.	A is correct.
22. The monitor isn't responsible for instrument calibration. However, he (is/is not--which?)__________expected to cooperate with the State Inspection, Maintenance & Calibration Shop in scheduling its calibration of his instruments.	is

23. Does the monitor perform annual calibration of instruments?________ The State Inspection, Maintenance, & _________Shop calibrates instruments on a scheduled basis.	no Calibration
24. No matter how well you think you understand a job, occasional reinforcement of your knowledge is necessary. Therefore, you (should take/should not bother with--which?) ______________refresher training periodically; and participate in exercises that are scheduled.	should take
25. When refresher training exercises and tests are scheduled (CHECK THE CORRECT ANSWER): ___A. the well-trained monitor can skip them. ___B. the monitor should participate in them if at all possible.	B is correct.
26. You know that dose rates in and around the shelter must be recorded. The best approach is to (CHECK THE CORRECT ANSWER): ___A. commit these dose rate measurements to memory. ___B. write them on a piece of scrap paper. ___C. write them on a sketch of the shelter and surrounding area.	C is correct.

27. If an attack should occur, the first thing you'd need is your instruments. Keep your sketches of the shelter and surrounding area (CHECK THE CORRECT ANSWER): ____A. with you at all times, so you'll have them if an attack should occur. ____B. in the same place you keep your instruments, since you'll head there first. ____C. away from the shelter or station.	B is correct.
28. If assigned to a shelter, set up an area to be the center of monitoring operations. In a fallout monitoring station, this is no problem, because (CHECK THE CORRECT ANSWER): ____A. the entire station is designed as a monitoring center. ____B. only one small part of it will be used. ____C. there's no room for a fallout monitoring function.	A is correct.
29. The monitor assigned to a shelter should work out the location of the monitoring center with the man in charge of the shelter--the ________ ________________.	shelter manager
30. Decisions such as the location of the monitoring center within a shelter (CHECK THE CORRECT ANSWER): ____A. should be predetermined in consultation with the shelter manager. ____B. can't be determined until after attack. ____C. needn't be discussed with anyone.	A is correct.

UPON ATTACK OR WARNING	
31. When attack, or warning of an impending attack, occurs, the first step you should take is to (CHECK THE CORRECT ANSWER): ___A. hurry to the emergency operations center (EOC). ___B. move slowly to your shelter or fallout monitoring station. ___C. move to your assigned shelter or station as quickly as possible.	C is correct.
32. If you're assigned to a fallout monitoring station, there should be at least two of you there--and preferably four. As soon as possible after you reach the station, contact the emergency operations center and inform your__________officer you are at your station.	RADEF
33. When you reach your assigned fallout monitoring station, you should: A. Let your community__________ officer know you're there. B. He'll be located in the________ __________________.	A. RADEF B. Emergency Operations Center (OR EOC)
34. If you're assigned to a community shelter, go there immediately and report to the man in charge--the ____________________.	shelter manager

35. Shelter managers will be aware of the importance of radiological monitoring, and they must know that this capability is provided. Therefore, as soon as you arrive at the shelter (CHECK THE CORRECT ANSWER):

___A. report to the shelter manager.
___B. check to see that your friends have made it to the shelter.

A is correct.

---

36. Next, regardless of your location--shelter or fallout monitoring station--make sure that your instruments are functioning properly. First, run operational checks on all ____________ ____________.

survey meters

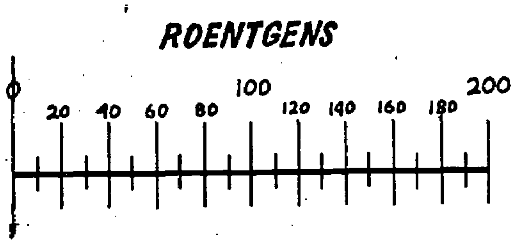
---

37. Then get out the instruments used to measure dose--the ____________.

dosimeters

---

38. A dosimeter is charged and ready for use when the scale looks like this.



To obtain this reading, you must ____________, or ____________.

charge, zero (IN EITHER ORDER)

39. Position the charged dosimeters around the shelter or station. These locations should be (CHECK THE CORRECT ANSWER): ___A. next to any door or other opening. ___B. away from the shelter wall. ___C. representative of the locations occupied by people.	C is correct.
40. Original positions for dosimeters can be predetermined with the shelter manager by estimating where people are likely to gather. As people change location, the dosimeters' positions (should/should not--which?)________ ________________ be changed.	should
41. Dosimeter positioning is important in any location, because you need to know which locations are best (FINISH THIS SENTENCE)____________________________ ____________________________________ ____________________________________.	shielded (protected) from radiation (OR EQUIVALENT ANSWER)
42. The monitor assigned to a fallout station is now ready for action. In the shelter, there may be other immediate tasks to perform. So, as soon as operational checks are completed and dosimeters are positioned, report to the____________________________.	shelter manager

43. The shelter manager will have special assignments for the monitor, once the instruments are checked. There's plenty to do before fallout arrives. For example, entrances to the shelter or station must be (opened/closed--which?)_______________before fallout arrives.	closed
44. Any vents that don't have to remain open, such as air vents, should be closed before_____________________ arrives.	fallout
45. If you're assigned to a shelter, once you've checked out survey meters and positioned charged dosimeters, you should (CHECK THE CORRECT ANSWER): ___A. sit back and relax--you're ready. ___B. report to the shelter manager and follow his instructions. ___C. rest to conserve your strength.	B is correct.
FALLOUT ARRIVAL 46. We've assumed that there will be some time before radioactive fallout arrives, which isn't necessarily the case. It's the monitor's duty to determine when fallout arrives. To do this, you must begin (sheltered/unsheltered--which?) _______________________dose rate measurements to detect fallout.	unsheltered

47. With good shelter, fallout could arrive and build a high unsheltered dose rate before inside measurements would show a reading. Therefore, you must (CHECK THE CORRECT ANSWER): ___A. begin unsheltered dose and dose rate measurement before a sheltered dose rate is ever recorded. ___B. wait until inside dose rate reaches a predetermined level. ___C. take unsheltered dose rates only after all fallout has landed.	A is correct.
48. When assigned to a fallout monitoring station, you should send a FLASH REPORT to the EOC when the outside dose rate reaches 0.5 (CHECK THE CORRECT ANSWER): ___A. roentgens. ___B. roentgens per hour.	B is correct.
49. So, in addition to shelter monitoring functions, the monitor assigned to a fallout station should make a FLASH REPORT: ___A. to the ________________.. ___B. when the outside dose rate reaches or exceeds__________.	A. EOC B. 0.5 R/hr
50. The report lets the EOC know when fallout reaches your area. This report must reach the EOC quickly, so you should (CHECK THE LOGICAL ANSWER): ___A. prepare a written report and send it in. ___B. run to the EOC with the message. ___C. use radio, telephone, or other immediate communications arranged for your station.	C is correct.

51. The local EOC is part of the network of centers involved in tracking fall-out, and the faster your EOC knows about fallout arrival in your area, the better this job is performed. Immediately inform your EOC of fallout arrival by sending a FLASH ________.	REPORT
52. Since several stations will probably be making FLASH REPORTS at about the same time, it's important to avoid tying up communications. For this reason you'll be provided with a short format for your FLASH REPORT--a format that includes only such essentials as the time, an identifying code for your station, and the word "Fallout." Your EOC will know that the fallout level has reached the level at which you're to send your FLASH REPORT, and that level is ________.	0.5 R/hr
53. Each monitoring station is assigned an identifying code--this may be a number of a letter designation. Use the code your EOC assigns to you, and follow the prescribed format for your district. Suppose the format was this: tttt eee Fallout. If fallout arrived at 10:30 A.M., and identifying code assigned to your station was ABC, you'd make a FLASH REPORT in this manner: ________ And if your station first measured 0.5 R/hr radiation at 10:00 P.M., your FLASH REPORT should read ________.	1030 ABC Fallout 2200 ABC Fallout (Since 24-hour-clock time continues through 12:00 Noon in this way: 1200, 1400, 1700 2200, etc., to 2400 = midnight, and 1 minute past midnight is 0001.)
54. Your identifying code is 350. Write the FLASH REPORT (assuming you use the tttt ### Fallout format) if your unsheltered dose rate is 2 R/hr: A. at 1:00 A.M.: ________ B. at 1:00 P.M.: ________	A. 0100 350 Fallout B. 1300 350 Fallout

55. Fallout arrives at 11:15 A.M. The initial unsheltered dose rate is 1 R/hr, and your station is XYZ. Write the report you'd use to inform the EOC of the situation.__________________	1115 XYZ Fallout

LATER DOSE AND DOSE RATE REPORTS

56. The world is divided into 24 alphabetically designated time zones, separated by 15° meridians. By international agreement, the 0° meridian runs through Greenwich, (pronounced Grĕn'ich) England, which is located in time zone "Z." For national civil defense emergency operations, all times across the nation are adjusted to the 0° meridian or the Greenwich Meridian. This name has been shortened to the first letters of this term, or GMT by some people. Civil defense has shortened it further by using its alphabetical designation: "Z." The phonetic word for Z is ______________, which is why GMT is often referred to as "__________ time."	ZULU ZULU (time)
57. Since the time zones are 15° apart, and an examination of a U. S. map would show us that our Eastern Time zone is at the 75° meridian, we could tell by dividing 15 into 75 = 5, that our EST is 5 meridians or 5 time zones or 5__________to the West of the 0° Greenwich Meridian. You will see this on the Time Conversion Chart which is on the back of the Radiological Reporting Log. (See Frame 59.) Remember that ZULU time, as well as all other times in radiological reporting, are written in__________ ______________time.	hours, 24-hour-clock

58. As you have learned, when reporting and recording monitored data, we use the 24-hour clock system. You can practice with it by comparing the two columns below.

Regular Time	24-Hour Time
1:00 AM	0100 Hours
2:00 AM	0200 "
11:00 AM	1100 "
12:00 Noon	1200 "
1:00 PM	1300 "
2:00 PM	1400 "
6:00 PM	1800 "
11:00 PM	2300 "
12:00 Midnight	2400 "

Greenwich Meridian (or Mean) Time is also expressed in the 24-hour system. Let's try expressing Greenwich Meridian Time (Z Time) a couple of times, as well as using the Time Conversion Chart to convert local time to Greenwich Mean Time. (Refer to Frame 59.)

Suppose the Greenwich Meridian Time is 1:00. This would normally be written as a 4-digit number, thus: 0100. At this same time, what would the time be in Z time?____________________ 0100Z

59. This Time Conversion Chart helps you determine the local time that corresponds to each Z time on reporting forms. Just convert the Z times on the forms to local times using this chart, which appears on the back of the Radiological Reporting Log (the main reporting form).

TIME CONVERSION CHART

Greenwich Mean Time	Eastern Daylight	Eastern Standard or Central Daylight	Central Standard or Mountain Daylight	Mountain Standard or Pacific Daylight	Pacific Standard
0100	2100*	2000*	1900*	1800*	1700*
0200	2200*	2100*	2000*	1900*	1800*
0300	2300*	2200*	2100*	2000*	1900*
0400	2400*	2300*	2200*	2100*	2000*
0500	0100	2400*	2300*	2200*	2100*
0600	0200	0100	2400*	2300*	2200*
0700	0300	0200	0100	2400*	2300*
0800	0400	0300	0200	0100	2400*
0900	0500	0400	0300	0200	0100
1000	0600	0500	0400	0300	0200
1100	0700	0600	0500	0400	0300
1200	0800	0700	0600	0500	0400
1300	0900	0800	0700	0600	0500
1400	1000	0900	0800	0700	0600
1500	1100	1000	0900	0800	0700
1600	1200	1100	1000	0900	0800
1700	1300	1200	1100	1000	0900
1800	1400	1300	1200	1100	1000
1900	1500	1400	1300	1200	1100
2000	1600	1500	1400	1300	1200
2100	1700	1600	1500	1400	1300
2200	1800	1700	1600	1500	1400
2300	1900	1800	1700	1600	1500
2400	2000	1900	1800	1700	1600

*Add 1 day to the local Calendar date for equivalent date in GMT. Example: Observed Central Standard Time is 10:00 PM (2200 CST) on the 14th day of the month (142200 CST). Expressed as GMT, that time would be 0400Z on the 15th day of the month (150400Z).

A. If the time is 0700 ZULU in the Pacific Standard zone, it's ______ ______.

B. If it's 2000 Z time in the Central Standard time zone, local time is ______.

A. 2300 of the day before
B. 1400

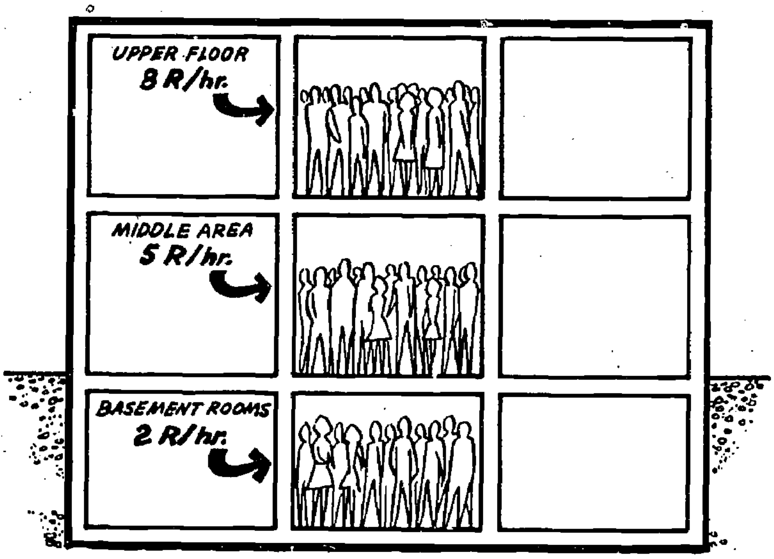
60. To convert Z time to local time, you (CHECK THE CORRECT ANSWER): ___A. must calculate Z time by adding a specified number of hours to local time. ___B. can use the Time Conversion Chart on the back of the Radiological Reporting Log. ___C. should leave conversion to the RADEF officer in charge at EOC.	B is correct.
61. On radiological reporting forms, you're told to record and report data at specified Z times each day. The forms provide space beside these Z times for you to write corresponding local times. This simplifies the task of determining when to obtain and report __________ data.	radiological
62. The main reporting form is the Radiological Reporting Log. This form is reproduced at the back of this book. Go there now, remove that page from the book, and return to the program at the next frame. NO WRITTEN RESPONSE REQUIRED.	NO RESPONSE EXCEPT TO OBTAIN THE RADIOLOGICAL REPORTING LOG.
63. Several frames of this discussion are keyed to your copy of the Log form. The first column deals with the FLASH REPORT. There are instructions on the Log as to how this should be recorded--including the fact that you must make the FLASH REPORT to your EOC as soon as the unsheltered dose rate reaches or exceeds __________.	0.5 R/hr

64. The second column is used during a certain period of time after fallout arrives. The reports in this column are to be made hourly during the 1st to the 12th hours after (CHECK ONLY ONE ANSWER): ___A. your FLASH REPORT. ___B. burst of the nuclear weapon (s). ___C. Both A and B are correct. ___D. Neither A nor B is correct.	A is correct.
65. After your FLASH REPORT, the outside unsheltered dose rate should be measured hourly for the 1st 12 hours, and at least every 3 hours for the next 12 hours. These measurements and the others shown on the Log must be taken at the times shown to be available if needed, however, the actual frequencies of reporting will be set by the EOC to meet its specific needs for the information. All measurements indicated on the Log must be made. The schedule for reporting each of them to the EOC will call for a report to be made (CHECK THE CORRECT ANSWER): ___A. immediately after each measurement is made. ___B. only after the Log is completely filled out. ___C. only as directed by the EOC for that station.	C is correct.
66. Dose rate reports will generally be by voice. To make them as brief as possible this abbreviated format will be used: tttt eee rrr Where the tttt is the local time of measurement, eee is the identifying code, and rrr is the dose rate in R/hr reported to the nearest whole R/hr: 1.4 R/hr would be 001, while 11.6 R/hr would be 012. Dose rates that have decayed to less than 1 R/hr will be reported in tenths, hundredths, and thousandths of R/hr. Show how the following dose rates would be reported: A. 125.4 R/hr:__________. B. 1/10 R/hr:__________. C. 50 mR/hr:__________.	A. 125 B. .100 C. .050

67. A dosimeter reading of the accumulated unsheltered DOSE as of 0300Z shall be combined with the 0300Z dose rate report by adding the word "dose" and 4 or 5 numbers as required for the total________.	DOSE
68. Fill in the blanks following this combined dose rate--dose report: 2200 XYZ 030 DOSE 1500, is an 03000Z report for the ________time zone. XYZ is the________________. The dose rate of___________is followed by the accumulated outside DOSE of__________.	Eastern, Identifying Code, 30 R/hr, 1500 R
69. Accumulated unsheltered DOSES shall be reported daily for the first 6 days after attack unless the EOC____________officer asks for it for a longer time.	RADEF
70. You should now be able to handle the Log without difficulty. The thing to remember is (CHECK THE CORRECT ANSWER): ___A. maintaining the Log is required only to keep you busy. ___B. the Log isn't especially important, since communications will be maintained for verbal reports. ___C. the Log is essential to an accurate, permanent record of radiological hazards in your area. ___D. no written record is necessary.	C is correct.

SHELTERED DOSE RATES 71. Let's review taking sheltered dose rates, since they mean more to you with the knowledge you've gained. You must keep track of sheltered dose rates to provide the greatest protection to the most people. The dose rates you read should be written on_________________ of the shelter.	sketches
72. Taking sheltered dose rates helps you determine shelter areas that provide the best protection. Such dose rates must be taken at least daily. And if the unsheltered dose rate is rising rapidly during fallout, you should (CHECK THE CORRECT ANSWER): ___A. take readings less frequently. ___B. measure sheltered dose rates much more frequently, as often as once an hour. ___C. forget about taking dose rate measurements altogether.	B is correct.
73. At locations representative of where people are: A. measure the___________rates; B. record them on your_________of the shelter and surrounding area; C. record the time of each reading to get an indication of how fast ________________are changing.	A. dose B. sketches C. dose rates

74. On your sketches, indicate both the measured dose rate and the_______ of the measurement.	time
75. Dose rates should be read (CHECK ANY CORRECT ANSWERS): ___A. at least once daily. ___B. at least once weekly. ___C. if there's a rapid dose rate change, at least every hour. ___D. only upon orders of the shelter manager.	A and C are correct.
76. Based on dose rates, you may make recommendations to the man in charge of the shelter. For example, if sheltered dose rates climb, you should recommend that shelterees occupy those areas in which the dose rates are below 2 R/hr. Make this recommendation to the_______________________.	shelter manager
77. You should recommend that shelterees use areas where the radiation exposure is the lowest. Some areas provide better protection than others. Shelterees should occupy the areas that have the (highest/lowest--which?) _______________dose rates.	lowest

78. The shelter manager is in charge. But if the shelter provides better protection in one place than in another, you should recommend to him that shelterees occupy those areas with: A. dose rates below_____________; or, B. those areas with the___________ dose rates.	A. 2 R/hr B. lowest
79. When dose rates in parts of a large shelter are high, crowded conditions may make it impossible to get everyone into the best-shielded areas. One possible way to save more lives is to  spread the accumulated dose out among all shelterees by rotating the people so that each one's time in the least-protected areas is limited. Do not rotate personnel unless there is a difference of 10 R between the doses of the best and the least protected shelterees. The decision to rotate may require the shelter manager to obtain advice from the ____________.	EOC

80.	Under all conditions, you should attempt to provide the best available protection from radiation exposure to pregnant women, children under 18 years of age, and personnel assigned to early ____________ operations.	emergency
81.	Based on dose rate readings in the shelter, you might recommend one of the following to the shelter manager: A. that shelterees occupy only areas with dose rates up to ________; or, B. if dose rates aren't uniform, that shelterees occupy areas with the (lowest/highest--which?)________ dose rates; or, C. that if the inside dose rate reaches or exceeds 10 R/hr at any time during the shelter period, the shelter manager should check with the EOC to see if personnel should be__________.	A. 2 R/hr B. lowest C. rotated
82.	If the in-shelter dose rate should reach or exceed 10 R/hr, inform the shelter manager that he should notify his EOC and request guidance. The same is true if the total dose in any two-day period reaches 75 R. The shelter manager can get advice from the __________.	EOC
83.	The dose rate may be high enough that a two-day dose exceeds 75 R, or the dose rate may reach or exceed 10 R/hr. If this occurs some of the shelterees may begin showing signs of __________ sickness, within a day or two.	
84.	Two danger areas--points at which you should advise the shelter manager to contact the EOC and ask for help are: A. when the in-shelter dose rate reaches or exceeds________; and B. when the total dose reaches________ in a ________-day period.	A. 10 R/hr B. 75 R, two

85. Perhaps nothing can be done. However, the EOC may know of a better shelter within a few minutes of the present shelter. Or EOC personnel may have suggestions on how to improve your present shelter. Who should ask the EOC for help?____________________	the shelter manager

OUTSIDE MISSIONS

86. Emergency outside missions may be required while radiation levels are still high. When you're directed to perform a mission, the EOC will provide you with such information as: A. the time you can leave the station or______________________________; B. when you can go into an area--the mission's____________time; C. the allowable exposure on this mission, or the_______________ you can receive; and, D. the anticipated___________rate for the area of the mission.	A. shelter B. entry C. dose D. dose (rate)
87. You'll know the dose rate in your immediate area. But you may be asked to perform a mission some distance away. Based on radiation levels in the mission area, your area, and points between, the EOC (will/will not--which?)______________tell you when to leave on the mission.	will

88. The EOC will also tell you when to go into the mission area-the____________.	entry time
89. You know how to use an entry time nomogram. But when you're asked to perform a mission in a radiation area, you'll usually be told the entry time by the______________.	EOC
90. The EOC will also tell you the maximum radiation exposure dose you can receive on a given mission. That is, the EOC will inform you as to both the allowable _____________and dose__________________ for the mission.	dose, rate
91. While the EOC will tell you the estimated dose rate in the mission area, their information may not be completely accurate. Your job on a mission is to monitor radiation levels continuously, advise the mission director on necessary radiological protective measures, and assure return to shelter without exceeding the planned mission dose. Therefore, (CHECK THE CORRECT ANSWER): ____A. you'll have to advise the crew continuously throughout the mission based on actual radiation levels encountered. ____B. you can assume that the EOC is right in estimated radiation levels.	A is correct.

92. The EOC can't tell you exactly when to leave the mission area either. If actual dose rates are much higher than those estimated by the EOC, you will be responsible for determining when to leave, based on the (CHECK THE CORRECT ANSWER): ____A. judgement of the crew leader. ____B. amount of devastation in the area. ____C. actual dose rate and allowable mission dose.	C is correct.
93. If a mission allows a total dose of 10 R and the dose rate in the mission area is 100 R/hr, you'll only be able to stay in the area about________minutes.	six
94. If possible, complete the mission. But remember, your main concern is to prevent the operational crew from exceeding mission radiation_______dose.	exposure
95. You must advise the crew of any precautions they must take to protect themselves. For instance, if one spot in the mission area is especially "hot" (CHECK THE CORRECT ANSWER): ____A. alert the crew to this fact. ____B. ignore the warnings of your instruments. ____C. stay away from that area yourself, but don't bother to caution crew members.	A is correct.

96. When you are monitoring in support of emergency operations, you have many responsibilities; but the three most important are: (a) continuous monitoring of the ____________ levels through, and in areas where emergency mission workers are moving and working; (b) the constant provision of advice to the mission director on the required radiological personnel ____________ measures his crew should be taking; and, (c) the full time surveillance of each of the crew's accumulated radiation ____________ for that particular mission, to assure that the allowable total mission dose is not exceeded.	dose rate, protective, doses
97. When one or more emergency workers return to shelter from a mission into a highly contaminated fallout area, as much care as is practicable under the circumstances should be taken to prevent contamination of the shelter or station by radioactive fallout material. If fallout material is visible on the workers (CHECK THE CORRECT ANSWER): ___A. they cannot re-enter the shelter or monitoring station. ___B. they may re-enter, but must be isolated from all others. ___C. they should brush each other and shake the material from their clothing, and re-enter the shelter or station as quickly as possible.	C is correct.
98. If instruments become contaminated (CHECK THE CORRECT ANSWER): ___A. they should be thrown away. ___B. if practicable, they should be brushed, wiped or shaken clean. ___C. they should be placed in an out-of-the-way area of the shelter or station to await radioactive decay of the contaminant.	B is correct.

MONITORING DURING EARLY TRANSATTACK RECOVERY OPERATIONS

99. As outside radiation levels decrease due to radioactive decay, the demand for in-shelter monitoring decreases. Shelter and station monitors will become more involved in monitoring in support of operational recovery missions. However, until the end of the shelter period, each shelter should retain a ________ capability.	monitoring
100. Most large shelters require four or more monitors. During the latter part of the shelter period, some of these shelter monitors will be required to provide monitoring support for other Civil Defense operations, such as decontamination of, and recovery of vital facilities like public water works, power plants, etc. Still, a monitoring capability (should be/doesn't need to be--which?) ________ retained at shelters until the conclusion of the shelter period.	should be
101. At the conclusion of the shelter period all shelter monitors except those having primary mission assignments in regular governmental services, such as police, firemen, public works personnel, etc., and most operational monitoring station monitors (can/should not--which?) ________ expect reassignment to monitoring in support of other Civil Defense ________ operations.	can, recovery

102. You have now completed the home study portion of the INTRODUCTION TO RADIOLOGICAL MONITORING course, but you are still not a fully qualified radiological monitor. You've had a good introduction to the subject; now you must complete the practical exercise, and the required in-class sessions. The only time the monitor would perform his functions would be under the most difficult conditions imaginable by man--nuclear attack conditions! Therefore, even more than this good introduction is necessary for anyone to become qualified enough to be able to perform the extremely difficult and important functions of the Civil Defense radiological monitor! However, you do have a fine start! Good luck on the test for this Unit, and on the final exam for the course. Do continue on and become a fully qualified radiological monitor! NO RESPONSE REQUIRED	NO RESPONSE REQUIRED.

PLEASE COMPLETE THE TEST ON THE FOLLOWING PAGES.

INTRODUCTION TO RADIOLOGICAL MONITORING

HOME STUDY COURSE

NOTE: DO NOT LOOK AT THE TEST BELOW UNTIL YOU HAVE COMPLETED UNIT 4.

UNIT 4 TEST

(Check the best answers)

1. The location to which the monitor is assigned:

____a. has little bearing on the training he receives and the basic tasks he must perform.

____b. greatly affects the training he receives.

____c. makes a great deal of difference in the tasks he must perform.

2. Shortly after fallout arrival, the monitor should determine which areas of the shelter or station are:

____a. least protected from radiation so he can assign people to those areas who are especially strong.

____b. the best-shielded from radiation.

____c. the best for storing food and water.

3. In checking radiation levels, the survey meter should be held at about:

____a. head level.

____b. six inches from the ground or floor.

____c. belt level.

4. Unsheltered dose rates should be taken in an area that is:

____a. as close to the building as possible.

____b. representative of the area, preferably at least 25 feet from buildings.

____c. as far away from the shelter as possible.

5. If the unsheltered dose rate is 500 R/hr and the sheltered dose rate is 10 R/hr, the protection factor is:

____a. 5,000.

____b. 5.

____c. 50.

6. A shelter's protection factor:

____a. will change as the energies of gamma radiation change with time.

____b. will always remain exactly the same.

____c. usually varies greatly from minute to minute.

7. The important thing to remember about taking unsheltered dose rate readings is:

____a. don't drop your instruments and break them.

____b. avoid exposure.

____c. take your time and get very accurate readings.

8. When making a timed exposure of a dosimeter:

____a. stay with it to protect your instrument.

____b. leave the dosimeter outside forever--it's contaminated and can't be used.

____c. don't stay with the dosimeter, but wait inside for the duration of the timed exposure.

9. Doses should be determined daily by placing dosimeters:

____a. at the entrances of the shelter or station.

____b. in areas where people aren't likely to knock them over.

____c. in areas that are representative of where people are located.

10. If people move around in the shelter, you should:

____a. leave your dosimeters in their original positions.

____b. make the people go back where they were.

____c. reposition the dosimeters so they're in areas representative of where people are located.

11. If different readings are obtained from dosimeters placed around a room, you should:

____a. disregard the readings.

____b. determine an average of the readings.

____c. throw out your dosimeters and get new ones.

12. The Radiation Exposure Record is used to record:

____a. monthly exposure doses.

____b. daily exposure doses.

____c. daily dose rates.

13. Reports about radiation are made to:

____a. the local EOC.

____b. the Pentagon.

____c. the State Capital.

14. In peacetime, the monitor:

____a. has nothing to do.

____b. should inspect instruments every day.

____c. should inspect instruments per the inspection schedule established by his local organization.

15. Whenever the monitor inspects instruments, he should:

____a. just do it, telling no one.

____b. report his actions to his RADEF Officer.

____c. record his actions on the Log.

16. If warning or attack should come, the monitor should:

____a. report to his assigned location as quickly as possible.

____b. go home for his equipment.

____c. go straight to the EOC.

17. The monitor should send a FLASH REPORT to the EOC when the unsheltered dose rate reaches or exceeds:

___a. 5 R/hr.

___b. 0.5 R/hr.

___c. 500 R/hr.

18. If the time of fallout arrival is 1:00, the dose rate is 3 R/hr, and the station's identification code is QXY, the FLASH REPORT to EOC should read:

___a. 003 1:00 Fallout.

___b. 1:00 003 QXY.

___c. 0100 QXY Fallout.

19. If the in-shelter dose rate reaches or exceeds 10 R/hr, or if the total dose is 75 R in two days, the monitor should:

___a. quit taking readings.

___b. advise the shelter manager to request guidance from his EOC.

___c. move out of the shelter.

20. A monitoring capability should be retained in a shelter until:

___a. the conclusion of the shelter period.

___b. all monitors are needed for outside missions.

___c. the shelter manager decides it's no longer needed.

WHEN YOU HAVE FINISHED THIS TEST, CHECK YOUR ANSWERS USING THE ANSWER KEY ON PAGE xxx IN THE BACK OF THIS BOOK.

NOTICE TO THE STUDENT

CONGRATULATIONS!!!

AT THIS POINT YOU HAVE COMPLETED THE FOUR REQUIRED UNITS OF THE INTRODUCTION TO RADIOLOGICAL MONITORING HOME STUDY COURSE.

YOU ARE NOW ELIGIBLE TO TAKE THE FINAL EXAMINATION. TO DO SO YOU MUST COMPLETE ALL OF THE CARD ON THE LAST PAGE OF THIS TEXT. UPON RECEIPT OF THE CARD THE EXAMINATION WILL BE SENT TO YOU. YOU WILL BE AWARDED A CERTIFICATE UPON SUCCESSFUL COMPLETION OF THE EXAMINATION.

YOU MAY WISH TO STUDY OR READ THE ADDITIONAL INFORMATION APPENDIX THAT FOLLOWS. YOU WILL FIND IT USEFUL AND CHALLENGING.

A LIST OF ABBREVIATIONS

CD	Civil Defense
EOC	Emergency Operations Center
kilo	thousand
mega	million
mR	milliroentgen
mR/hr	milliroentgen per hour
NUDET	Nuclear detonation
RADEF	Radiological Defense
RDO	RADEF Officer
R	Roentgen ('rent - gan)
R/hr	Roentgen per hour
SOP	Standing Operating Procedures
TNT	Trinitrotoluene (a high explosive)

ADDITIONAL INFORMATION APPENDIX

The information included in the next several pages is important to you only if you're serious about becoming a Radiological Monitor, or if you're especially interested in the subject for some reason. In this Appendix, we're going to discuss such subjects as the use of Dose Rate Nomograms to determine such things as an estimated unsheltered dose rate, projected dose rates, when it's safe to enter an area, and how long it's possible to stay there without running the risk of injury. This portion of the Appendix will be programmed, like the portions of the program you've just completed.

Still other parts of this Appendix aren't programmed, but are presented in straight narrative form. Subjects to be covered in this manner include emergency operations should nuclear accidents occur with radioactive materials being used for peaceful purposes, as well as situations involving nuclear weapons.

Remember, this portion of the text is strictly optional--you don't have to study it. You won't be tested on it, so if you decide to read it, you don't have to worry about memorizing the information covered.

All right...when you're ready, begin with the programmed material on Dose Rate Nomograms, which follows.

DOSE RATE NOMOGRAMS

As mentioned in an earlier portion of the programmed text, Dose Rate Nomograms--charts correlated to help you estimate future dose rates based on the present unsheltered dose rate--have been developed. These nomograms are printed on the two pages immediately following this short programmed sequence.

Turn to those pages now and remove the nomograms from your book. The pages are perforated to make for easy removal. You should keep the forms in front of you--you'll have to use them as you work your way through the next several pages of the book.

All set? Then begin with frame 1, which follows.

USING NOMOGRAMS	
1. At this point, you should have the two charts--the Dose Rate Nomogram, and the Entry Time-Stay Time-Total Dose Nomogram--in front of you. You'll need them as we work through the next several frames in this section. First let's discuss the Dose Rate Nomogram. As its name states, you can use this table to estimate future ______ based on certain known factors, such as the time after burst and the dose rate at a certain time after the ______.	dose rates, burst
2. To use the dose rate nomogram to project how much future dose rates will have decreased due to radioactive decay, you need to know what the dose rate is at the time you make your computations, and how long it's been since the nuclear burst. As you can see in the "time after burst" column, the time is shown in both ______ and ______.	hours, days (IN EITHER ORDER)

3. The "dose rate at H + t" is the unsheltered dose rate that would exist at a given time ("t") after the burst, if all the radioactive fallout material produced by the burst were deposited at that time and location. "H" stands for the hour of the burst, and "t" stands for the amount of time that has elapsed since the____________________.	burst
4. You need a straightedge, such as a ruler, to use the dose rate nomogram. The first step is to lay the straightedge on the nomogram so that it passes through your two known factors--the present dose rate, and the amount of time that's passed since the (CHECK THE CORRECT ANSWER): ___A. last time you computed the future dose rate. ___B. time of the burst.	B is correct.
5. Next, with the straightedge passing through the present dose rate in "dose rate at H + t" column and the appropriate figure in the "time after burst" column, read the figure on the straightedge in the "dose rate at H + 1" column. So if the unsheltered dose rate at the time you make your calculation is 200 R/hr and 3 hours have elapsed since the burst, the dose rate at H + 1 was about____________________.	750 R/hr

6. In estimating future dose rates it is necessary to go back to the dose rate as near to the time of the burst as possible. For convenience in this type calculation, it has been agreed that one hour past burst time (H + 1) is near enough. It is impossible to ever actually have a real dose rate at a specific location at one hour past burst time. Since the radioactive material produced by the burst could never all be deposited within one hour after burst, a theoretical beginning point for calculating the amount of radioactive decay is used. If all the radioactive material produced by a nuclear burst were considered to have been deposited at a specific location, by one hour after burst, the dose rate at that place and time would be what is known as the "dose rate at ________________."

H + 1

7. To calculate what the dose rate was at H + 1 with a dose rate nomogram, lay the straightedge across the nomogram so that it passes through (CHECK THE CORRECT ANSWER):

____A. the known dose rate and the figure representing the time that has elapsed since the burst.
____B. the current dose rate and the time of day of the burst.
____C. the current dose rate and the amount of time that will have elapsed by the time you want to estimate the dose rate.

A is correct.

8. Once you've determined the value of the H + 1 dose rate, this point in the "Dose Rate at H + 1" column becomes a pivot point for your straightedge. Simply keep the straightedge in line with the dose rate at H + 1 and move the edge in such a way that it passes through the figure in "time after burst" that represents the amount of time that will have elapsed between the rate you're estimating. Thus, if the dose rate at H + 1 is 750 R/hr, and you're estimating the approximate dose rate at H + 20 hours, you position your straightedge and read the figure in the "dose rate at H + t" column______________________.	20 R/hr
9. We're determining a rough estimate of future dose rates, and slight differences in our figures are to be expected. Generally, plus or minus 10% is acceptable. The dose rate is presently 600 R/hr, and it's now 2 hours after burst. We're trying to calculate the dose rate at 30 hours after burst. A. Laying the straightedge across the nomogram so that it is on 600 in the "dose rate at H + t" column and 2 hours in the "time after burst" column, we find that the dose rate at H + 1 was________________. B. Then, turning the straightedge so it passes through 1,300 in the "dose rate at H + 1" column, and 30 hours in the "time after burst" column, we find that the dose rate at H + 30 hours is______________________.	A. 1,300 R/hr B. 23 R/hr (Remember, your answer may be up to 10% off and still be reasonably accurate.)

10. This time, we won't help you quite as much. It's now 4 hours after burst, and the unsheltered dose rate is 100 R/hr. Calculate the unsheltered dose rate for 10 hours after the burst. A. Dose rate at H + 1 was________. B. Dose rate at H + 10 will be________.	A. 525 R/hr B. 34 R/hr
11. Calculate the future dose rate at H + 40 hours if the dose rate at 3 hours after burst is 400 R/hr. ________	17 R/hr
12. Any time you already know the dose rate at H + 1, you can save a step in determining a future dose rate. Just position the straightedge so it passes through the known H + 1 dose rate in the "dose rate at H + 1" column and the appropriate time in the "time after burst" column. Then take your future dose rate reading from the "________ ________" column.	Dose Rate at H + t
13. When you have to use the dose rate nomogram, you usually won't know the dose rate at H + 1. Therefore, you'll have to perform all of the steps we've discussed. Solve these dose rate nomogram problems. A. Calculate the dose rate at 30 hours after burst (H + 30) if the dose rate at H + 3 is 200 R/hr. ________ B. Dose rate at H + 4 hours is 80 R/hr, so the dose rate at H + 20 will be________. C. If the dose rate at 2 hours after burst is 300 R/hr, the dose rate at H + 10 will be approximately ________.	A. 13 R/hr B. 12 R/hr C. 44 R/hr

14. You should now be able to use the dose rate nomogram to calculate future dose rates fairly accurately. You may never have to use this knowledge, because (CHECK THE CORRECT ANSWER): ___A. Nomograms simply aren't accurate enough to use. ___B. as long as communications are open between you and EOC, you should obtain future dose rate projections from the EOC.	B is correct.

ENTRY TIME-STAY TIME-TOTAL DOSE NOMOGRAM

15. Another tool you can use in the event of nuclear attack is the entry time-stay time-total dose nomogram. With this nomogram, you can calculate such important data as:

(1) When you can safely enter an area.
(2) How long you can stay.
(3) Total dose received in a given period of time in an area.

This nomogram ties directly into the <u>dose rate</u> nomogram; you will often be using the two of them in conjunction. For example, you might use the dose rate nomogram to determine the dose rate at H + 1, then use that figure with other known data on the entry time-stay time-total dose nomogram to determine one or more of the above factors.

The entry time-stay time-total dose nomogram will be used under the same conditions as the <u>dose rate</u> nomogram.. you'll use these ools (CHECK THE CORRECT ANSWER):

____A. any time you must have information these forms can provide.
____B. only when communications with the EOC have been disrupted and decisions must be made concerning such factors as whether, when, and how long it's safe to enter and stay in an area.
____C. only when directed to do so by your RADEF officer.

B is correct.

16. The entry time-stay time-total dose nomogram is reproduced on the last page of this unit. Go to that page, remove the nomogram from the book, and return to this page to frame 17. NO WRITTEN RESPONSE REQUIRED.	NO WRITTEN RESPONSE REQUIRED

17. This nomogram is somewhat more complicated than the dose rate nomogram. It has five columns, and here's what each means:

A. Total Dose--the exposure dose received in a given set of circumstances.
B. Dose Rate (1 hour) (R1)--dose rate at H + L.
C. D/R1--dose divided by dose rate at H + 1.
D. Stay Time (hours)--the amount of time, in hours, that you stay in a radiation area.
E. Entry Time--the time after burst at which entry into a radiation area is made.

Don't be confused by the D/R1 column. It's simply a common focal point that applies to the sets of columns on either side of it. It functions as a "bridge" between the columns surrounding it. The figures are determined by dividing the dose by the dose rate at H + 1; but for purposes of using the nomogram, this fact (is/is not--which?) ______________ important to you.

Answer: is not

18. When using the entry time-stay time-total dose nomogram, you always use the center column, in combination with either the two columns to its left, or the two to its right. Check any correct combination or column headings in this list. ____A. Total Dose, D/R1, Entry Time. ____B. D/R1, Stay Time, Entry Time. ____C. Total Dose, Dose Rate, Stay Time. ____D. Total Dose, Dose Rate, Entry Time. ____E. Total Dose, Dose Rate, D/R1.	B and E are correct.
19. This nomogram is about as accurate as the <u>dose rate</u> nomogram already studied. This is (CHECK THE CORRECT ANSWER): ____A. the entry time-stay time-total dose nomogram will help you calculate adequate estimates of these factors. ____B. you can expect calculations made with this nomogram to be 100% accurate.	A is correct.
20. You use the entry time-stay time-total dose nomogram in basically the same manner as the dose rate nomogram. In other words, you connect known quantities on the nomogram using a ____________________.	straightedge

21. To use the dose rate nomogram, you had to know two quantities. With the entry time-stay time-total dose nomogram, you need three known quantities, and you apply them in two steps. (1) Connect two known quantities and locate the point at which the straightedge crosses the D/R1 column...then, (2) Connect this point on the D/R1 column with the third known quantity. When you've accomplished step (2) the point at which the straightedge crosses the third column gives you the unknown you're seeking in each case. Regardless of which they are, you must know (how many?)__________ of the factors involved.	3
22. The dose rate in an area at H + 5 is 20 R/hr. A man must enter this area at H + 10, and his mission will take 2 hours to complete. What total dose will he receive? Let's find out. We'll need both nomograms. A. First, use the <u>dose rate</u> nomogram to find the dose rate at H + 1, which is__________________. B. Next, go to the entry time (etc.) nomogram and connect the stay time (2 hours) in the "stay time" column with the entry time figure (10) and read the figure on the D/R1 column, _________________. C. Then connect this point with the dose rate at H + 1, which you found was_______________. D. Read the "total dose" column at the point the straightedge crosses it--_________________.	A. 140 R/hr B. .115 (just under the .120 mark) C. 140 R/hr D. 16 R

23. If you had already known the dose rate at H + 1, you could have gone directly to the entry time-stay time-total dose nomogram. Most of the time, however, you will probably have to use (both/only one--which?)______________nomogram(s) in solving problems.	both
24. Assume that the dose rate at H + 1 in a given area was 250 R/hr. You must enter that area at H + 10 and remain for 3 hours. To calculate your total dose: A. Lay your straightedge across the entry time-stay time-total dose nomogram so that the entry time (10) and stay time (3) are connected. The straightedge crosses the D/R1 column just above the .160 mark. B. Next, connect the .160 mark with the dose rate at H + 1 (250 R) in the Dose Rate column, and you'll see that your total dose on this mission will be about ____________________.	41 R
25. While you'll usually use both nomograms, it all depends upon what factors you already know. In the above problem, for example, you were given enough information that you only needed one nomogram, the__________________________.	entry time-stay time-total dose nomogram

26. If the dose rate in a given area is 50 R/hr at H + 6, what dose will you receive if you must enter the area at H + 15 and stay for 2 hours? ____________________ (HINT: First find the dose rate at H + 1, using the dose rate nomogram. Then move to the entry time-stay time-total dose nomogram and apply the data.)	31 R
27. You can also use your nomograms to determine entry time for a given mission when you want to hold the mission dose to a given total. For instance, you want to keep your dose below 20 R for a stay time of 2 hours in a given area. Compute the earliest possible entry time if the H + 1 dose rate was 120 R/hr. A. First, on the entry time (etc.) nomogram, connect your maximum total dose (20 R with the dose rate at H + 1 (120 R/hr.). B. Connect the point crossed in the D/R1 column by the above arrangement with the appropriate number in the "stay time" column, ______ hours. C. Read the "entry time" column at the point where the straightedge crosses it, and you find the earliest possible entry time, H + ________________.	B. 2 C. 7 (hours)
28. If you want to keep your dose below 10 R and the dose rate in the area at H + 20 is 5 R/hr, what's the earliest time you can enter the area and stay 3 hours?______________.	H + 27

29. We could go on indefinitely with problems such as these. You should now have a good idea of how flexible and useful these nomograms can be in an emergency situation. Remember, you will only have to resort to the use of nomograms when contact between you and the EOC has been ________________________.	interrupted (OR) disrupted (OR EQUIVALENT ANSWER)

FACTS ABOUT NOMOGRAMS

30. As we've discussed, it may become necessary for you to rely on computations made with nomograms in deciding if an outside mission can be safely performed. But keep in mind that (CHECK THE CORRECT ANSWER): ___A. nomograms are not 100% accurate. ___B. you can always consider your nomogram computations 100% accurate.	A is correct.
31. To make accurate calculations with a nomogram, you must know with fair accuracy the time of the burst. For computations to be made within 12 hours after the burst, you must know the time of burst within one hour, either way. For later forecasts, you must know the time of the burst within 2 to 3 hours, either way, from the actual time. So, in order to make good predictions with nomograms, you must know the time of detonation (CHECK THE CORRECT ANSWER): ___A. within a few days ___B. with reasonable accuracy ___C. for reporting purposes only	B is correct.

32. If you don't know when the burst occurred, and no one can tell you with reasonable accuracy, you (cannot/must--which?)_______________ use nomograms.	cannot
33. If several nuclear detonations occur over a period of 24 hours or more, each of them will contribute to the fallout accumulation. So, if you're using your nomograms based on the fallout of the first burst, the results of your computations will be (CHECK THE CORRECT ANSWER): ___A. especially accurate. ___B. slightly inaccurate. ___C. grossly inaccurate.	C is correct.
34. If fallout at one particular location is due to more than one weapon, the bursts of which were 24 hours or more apart, the resultant radioactive fallout decay <u>rate</u> will be different than the decay rate of the fallout of one burst only. The design of the nomograms we've been using is based on the characteristic decay <u>rate</u> of one burst only. Therefore, nomograms (could/could not--which?)_______________ be used for projecting future dose rates in this situation.	could not

35. This concludes the programmed portion of this Additional Information Appendix. You'll probably need a lot of practice to master the nomograms as well as you'd like, so don't hesitate to make up practice problems of your own. Use the nomograms as directed, and you'll find they're fairly reliable in helping you determine projections of future dose rates under a number of circumstances.

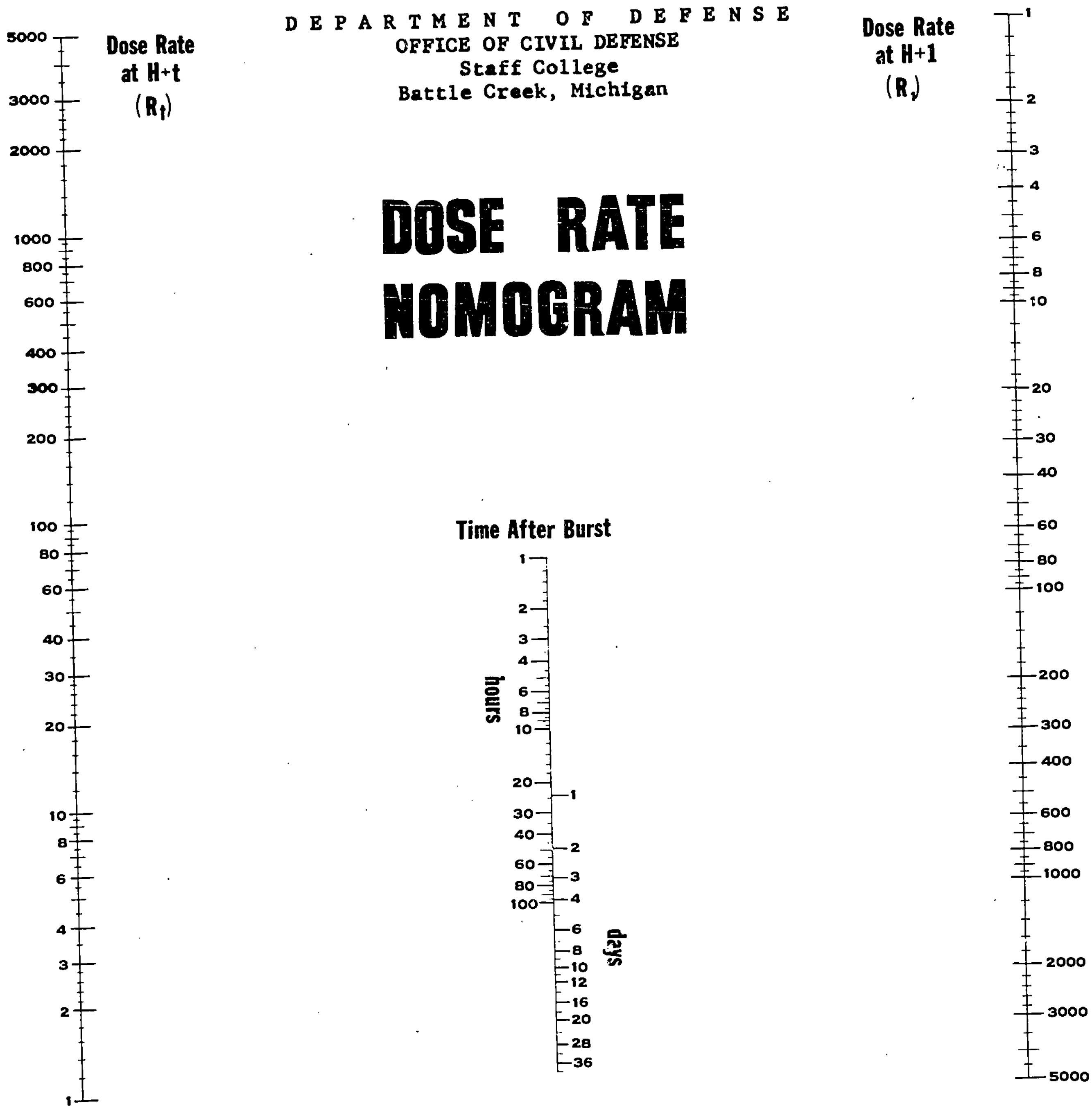
Now, when you're ready, go on to the next subject, which isn't in programmed form.

NO RESPONSE REQUIRED

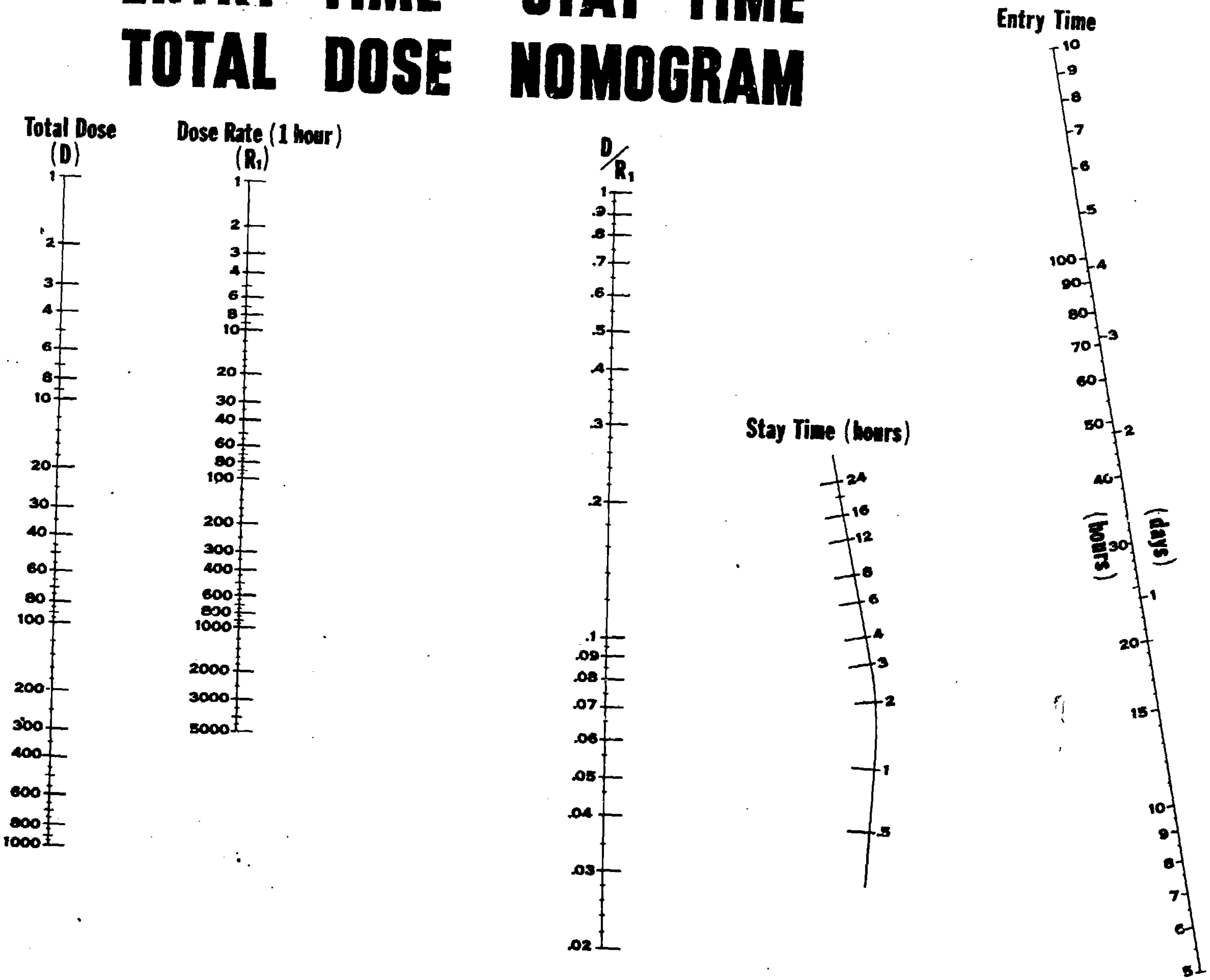
NO RESPONSE REQUIRED

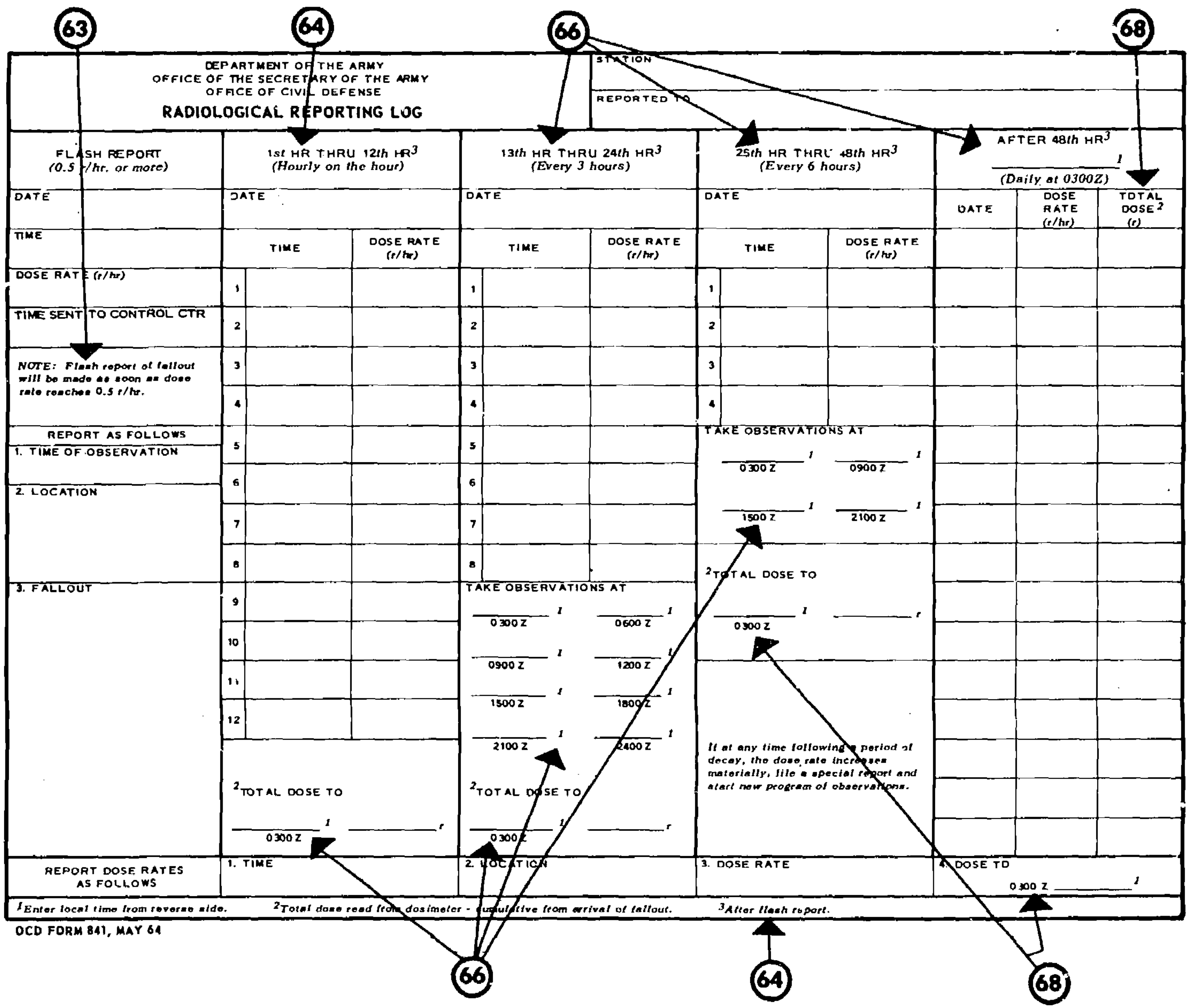
DEPARTMENT OF DEFENSE
OFFICE OF CIVIL DEFENSE
Staff College
Battle Creek, Michigan

DOSE RATE NOMOGRAM



ENTRY TIME - STAY TIME TOTAL DOSE NOMOGRAM





DEPARTMENT OF THE ARMY
OFFICE OF THE SECRETARY OF THE ARMY
OFFICE OF CIVIL DEFENSE

RADIOLOGICAL REPORTING LOG

STATION

REPORTED TO

FLASH REPORT (0.5 r/hr. or more)	1st HR THRU 12th HR[3] (Hourly on the hour)			13th HR THRU 24th HR[3] (Every 3 hours)			25th HR THRU 48th HR[3] (Every 6 hours)			AFTER 48th HR[3] ______[1] (Daily at 0300Z)		
DATE	DATE			DATE			DATE			DATE	DOSE RATE (r/hr)	TOTAL DOSE[2] (r)
TIME		TIME	DOSE RATE (r/hr)		TIME	DOSE RATE (r/hr)		TIME	DOSE RATE (r/hr)			
DOSE RATE (r/hr)	1			1			1					
TIME SENT TO CONTROL CTR	2			2			2					
NOTE: Flash report of fallout will be made as soon as dose rate reaches 0.5 r/hr.	3			3			3					
	4			4			4					
REPORT AS FOLLOWS 1. TIME OF OBSERVATION	5			5			TAKE OBSERVATIONS AT ______[1] 0300 Z ______[1] 0900 Z					
	6			6								
2. LOCATION	7			7			______[1] 1500 Z ______[1] 2100 Z					
	8			8								
3. FALLOUT	9			TAKE OBSERVATIONS AT ______[1] 0300 Z ______[1] 0600 Z			[2]TOTAL DOSE TO ______[1] 0300 Z ______ r					
	10			______[1] 0900 Z ______[1] 1200 Z								
	11			______[1] 1500 Z ______[1] 1800 Z								
	12			______[1] 2100 Z ______[1] 2400 Z			If at any time following a period of decay, the dose rate increases materially, file a special report and start new program of observations.					
	[2]TOTAL DOSE TO ______[1] 0300 Z ______ r			[2]TOTAL DOSE TO ______[1] 0300 Z ______ r								
REPORT DOSE RATES AS FOLLOWS	1. TIME			2. LOCATION			3. DOSE RATE			4. DOSE TO 0300 Z ______[1]		

[1]Enter local time from reverse side. [2]Total dose read from dosimeter - cumulative from arrival of fallout. [3]After flash report.

OCD FORM 841, MAY 64

PEACETIME USES OF NUCLEAR ENERGY

Since the spectacular flight of the Enola Gay brought an abrupt end to World War II, most Americans--indeed, most of the earth's inhabitants--have been acutely aware of the spectre of the mushroom cloud. It's true, of course, that nuclear energy forms the basis of the most devastating weaponry known to man. But it's equally true that we have already discovered hundreds of so-called "peaceful" uses of nuclear energy, and the possibilities are limited only by our imaginations and devotion to the discovery of additional applications of this tremendous force.

As then-President Dwight D. Eisenhower stated in a message to the Atomic Exposition in Rome in 1954: "We have only recently passed the midpoint of the 20th Century, yet, I am convinced that one day history will record as the most far-reaching physical accomplishment of all the century, or even twenty centuries, the discoveries which in recent years unlocked for the use of mankind the boundless energy of the atom. From among the numberless generations which have peopled this planet, destiny has now called upon those living to reach decisions on the use of nuclear energy that will govern a major measure of the future of mankind."

Let's take a closer look, now, at how nuclear energy is created and controlled for peacetime purposes. Then we'll discuss some of the uses to which this energy has been put.

TYPES OF NUCLEAR REACTIONS

The nucleus of the atom isn't a simple structure. Instead, it's a complex, dynamic system that can be modified to form other structures--an almost infinite number of them, in fact.

The atomic nucleus tries to maintain stability, much like water seeks to remain level. If the nucleus of the atom becomes unstable for some reason, it will emit one or more particles until it regains stability. These emissions are often made with much greater energy than the force that caused the atom to become unstable to begin with, and this can cause the "chain reaction" of energy we've heard so much about.

A stable atomic nucleus can be made unstable by bombardment with fast-moving projectiles, such as protons, deutrons, alpha particles, electrons and X-rays. These projectiles that nucleus unstable--until it releases sufficient energy to stabilize itself once more.

Sometimes, instead of coalescing with the bombarded nucleus, the projectiles actually cause instability by knocking out one or more nuclear particles. In either event, energy is released by the bombardment of a stable nucleus with one of the high-speed projectiles mentioned above.

NUCLEAR FISSION

The atoms of certain materials, when bombarded with energy projectiles such as the protons, alpha particles, electrons, X-rays, etc., mentioned above, actually split into two new atoms. This process is called fission, and the new elements thus formed are known as fission products. Nuclear fission--the production of fission products--is accompanied by the release of tremendous amounts of energy, which we have learned to harness and put to work.

By placing such fissionable materials as uranium-235, plutonium-239, or thorium-233 in a chamber known as a nuclear reactor, we can bombard the nuclei of their atoms with projectiles--"bullets" of energy, like protons or neutrons--in a controlled manner. This causes the fissionable atoms to split, releasing energy as described, which we can then direct to our own uses. The fission products are highly radioactive and have varying half-lives (they retain radioactivity for varying periods of time), and we've been able to use them in medicine, agriculture, and industry, as well as in weaponry. In addition, the release of energy in a nuclear reactor results in the production of a great deal of heat, which we've also learned to channel for our own uses.

ISOTOPE USES

Radioactive elements which characteristically emit radiation are called isotopes. We've learned to use these isotopes in several ways, one of which is as tracers of things that move within bodies (including the human body, as well as in organic bodies) into which we can't actually see. Here's an outline of some of the ways we use isotopes as tracers.

A. Some Uses of Isotopes as Tracers in the Field of Biology:

1. Tracing of foods we eat
2. Copper in blood formation
3. Diagnosis of brain tumors
4. Diagnosis of thyroid gland disturbances
5. Pumping action of heart
6. Restricted circulation
7. Value of certain blood preservatives
8. Average life of red blood cells
9. Total volume of blood

B. Some Uses of Isotopes as Tracers in the Field of Agriculture:

1. Photosynthesis
2. Fertilizers
3. Plant metabolism
4. Soil fertility
5. Availability of phosphorus in green manures
6. Action in insecticides
7. Pathology--leaf blight--chlorosis (blanching of green parts in plants)
8. Diet additives
9. Biochemistry of milk production

C. Some Uses of Isotopes as Tracers in the Field of Industry:

1. Trace circulatory systems for leaks
2. Follow batches of oil through pipes
3. Effects and efficiencies of detergents
4. Wear determinations
5. Diffusion in solids--alloy studies
6. Tracing sulfur in coke
7. Study of catalysis
8. Study of Fisher-Tropsch Process
9. Metallic corrosion
10. Floatation
11. Lubrication studies
12. Process control--oil refineries--distillation

Isotopes are also used to do man's work in their ways.

A. Non-Tracer Uses of Isotopes in Industry:

1. Radiographs of castings
2. Thickness gauge
3. Liquid level gauge

4. Density meter
5. Location of "Go Devil"
6. Sterilization of foods
7. Creation of cross linkages in plastics
8. Checking fire brick loss in furnace

B. Non-Tracer Use of Isotopes in Medicine

1. Hyperthyroidism and heart disorders
2. Cancer
3. Polythycemia and leukemia
4. Intracavity--irradiation of tumors
5. Prostate gland irradiation
6. Sterilization of bone graphs, etc. (i.e. homographs)
7. Teletherapy (X-ray) sources

As you can see from the above outline, we have already devised many peaceful uses of nuclear energy. But, as mentioned earlier, we've only scratched the surface of possible uses of this tremendous force. Work is progressing rapidly in many areas, research in this field continues.

PEACETIME NUCLEAR HAZARDS

In general terms, mankind faces two distinct types of hazards: Those we're all aware of and accept as a part of daily life; and those we don't understand and, therefore, fear much more than the accepted hazards. The possible hazards presented by nuclear accidents fall into this second category.

Too few people understand that nuclear accidents--while they can happen--are really less likely to cause large-scale damage, death, and injury than many conventional hazards we've faced for years. Our objective here is to tell you more about radiation hazards from peaceful use of nuclear energy so that you'll know there's a lot less danger than many people realize.

It would be unrealistic to say that nuclear hazards don't exist, especially since there'll be more and more peacetime use of this type of energy. Probably the greatest hazards lie in the transportation of radioactive materials from one location to another--especially in light of our national "batting average" on the highways! But if more people understood that the application of a little common sense could eliminate most of the dangers involved in nuclear accidents...we'd be a giant step closer to making full use of the potential of nuclear energy.

KNOWN -vs- UNKNOWN HAZARDS

We're all aware that more than 50,000 people died on our nation's highways last year (which, by the way, isn't all that far from the 66,000 people killed by the atomic bomb dropped on Hiroshima). We also accept as a fact of life the more than 6,000 annual deaths by fires; the tremendous death and destruction that can be dealt by hurricanes; and the great number of injuries--even deaths--caused by such simple accidents as falling down the stairs!

But these are accidents we can understand. We know that a fall might result in a broken bone...but we just aren't sure about what can happen if nuclear energy is unleashed by accident. For this reason--and it can be summed up by the word <u>ignorance</u>--many well-intentioned citizens are as much against peaceful uses of nuclear energy as they (and all of us) are opposed to nuclear warfare.

There is a danger, of course, when radioactive materials are mishandled, whether intentionally or by accident. The point is, this danger can be minimized in the event of nuclear accident, if everyone knows what to do and how to do it. Panic isn't the answer; nor is curtailment in the peaceful use of nuclear energy. What we must do is educate as many people as possible as to the danger that can exist...how great or small it may be... and how to handle the situation should it ever arise. In this manner, the public as a whole will come to regard the possible dangers involved in the use of nuclear energy in proper perspective.

ACCIDENTS INVOLVING RADIOACTIVE MATERIALS

The more we use radioactive materials, the greater the possibility of accidents involving them. This is especially true in the area of transporting such materials for use in industry and other peacetime applications. But past performance would indicate that the scope of the danger involved in nuclear accidents has been greatly exaggerated.

For example, during the period from 1943 to 1955, there were as many as nearly 300,000 people involved in the atomic energy field. There were 184 fatalities among this group during the period indicated--and only two of those deaths were attributed to radiation! The rest were the result of typical industrial accidents--falls (43 deaths); electrocutions (31); mobile equipment, such as cranes and bulldozers (25); motor vehicles (20); and miscellaneous accidents (63 deaths). As these figures indicate, the dangers involved in peacetime use of radioactive materials are relatively minor.

In addition, very careful records have been kept of all accidents involving nuclear weapons and radioactive materials. These records have been put to good use in taking action to reduce the possibilities of future accidents. So, it would seem that the greatest problem concerning accidents involving radioactive materials is the public's general lack of knowledge about what to do should one occur.

EMERGENCY PREPAREDNESS

As stated, the widespread and rapidly increasing industrial and commercial use and transportation of radioactive materials have increased the possibility of radiological hazards in addition to such other hazards as might result from accidents involving these materials. Accidents may occur in facilities where radioactive materials are used or processed, or during transportation.

In the event that local Emergency Services are not adequate to cope with the situation, Federal assistance can be requested by calling an Atomic Energy Commission office or Military Service installation. In accordance with an Interagency Radiological Assistance Plan, the radiological emergency response capabilities of Federal agencies can be used to protect the public health and safety or to assist organizations or individuals who need immediate radiological emergency assistance. Coordinated by the AEC, there are men and equipment available 24 hours a day on request to assist at the scene of all kinds of radiological incidents believed to require capabilities beyond those available locally. These emergency personnel (and as an RM, you might be among them) are prepared to deal with any aspects of a radiological incident.

Special emergency response capabilities have been established by the AEC and Department of Defense for coping with accidents involving nuclear weapons and so-called peaceful nuclear explosives. The locations and telephone numbers of AEC Regional Coordinating Offices for radiological assistance are printed on the last page of this section.

In the event of a radiological incident occurring in a public place, some degree of immediate response by State and local public safety personnel usually will be required. Initial action may be by local fire or police personnel first at the scene of the incident. This section suggests the general actions and responsibilities of local governments for dealing with peacetime radiological incidents.

ACTIONS FOR LOCAL PERSONNEL

In the event of a radiological accident or incident, take the following actions:

1. Notify the chief executive and civil defense director, who, if the situation warrants, will initiate activation of the local Emergency Operations Center (EOC), coordinate multiple services operations, request outside assistance as necessary, and implement emergency public information broadcasts to inform public on actions to be taken in accordance with the "Executive Leadership Actions for All Major Emergencies."

2. Notify the local government department or agency that is assigned emergency radiological monitoring responsibility. List the responsible agency and telephone numbers, day and night, in these spaces:

Organization (person)	Location	Telephone Day	Telephone Night

3. Advise the State Civil Defense Office. Request State radiological assistance. If such assistance is not available locally through normal channels, the State will notify the nearest U.S. Atomic Energy Commission Office and military installation.

In incidents involving radioactive materials spillage or leakage, local police and fire department personnel (as assigned) will take the following emergency actions at the scene of the incident pending arrival of radiological emergency experts:

1. Rescue injured or trapped persons and remove them from the area.

2. Limit first aid to those actions necessary to save life or minimize immediate injury.

3. Try to hold all people who have been involved in the incident area until the radiation monitoring team arrives. These people must be checked with a survey meter for radioactive contamination before they're allowed to leave the scene.

4. When it's necessary to send an individual to a hospital or other medical facility before a radiological emergency team or a physician knowledgeable in radiological health arrives, inform ambulance and other transporting vehicle personnel who will be in contact with the individual of the possibility of radioactive contamination. In addition, inform the hospital or medical facility that the individual may be contaminated with radioactive material.

5. Be sure no one except Emergency Service personnel are admitted into the area, and advise all persons not to handle or remove any part of the debris from the incident.

6. Fight fire, and, to the extent possible, keep upwind and avoid smoke, fumes, and dust.

7. Do not eat, drink, or smoke in the incident area, or use food or drinking water that may have been in contact with radioactive material.

8. Do not handle, use, or remove from the incident area any material, equipment, or other items suspected of being contaminated unless released by monitoring personnel.

EMERGENCY MONITORING TEAM ACTIONS

When the emergency monitoring team arrives on the scene (and this may include you, remember), it will advise and act as requested by and under the general direction of the official in charge to assume control of the technical operations, and, as necessary, perform the following operations:

1. Survey and determine the extent of radioactive contamination of facilities, equipment, area, and environment.

2. Initiate steps to minimize personnel exposure and the spread of contamination.

3. Conduct instrument check for contamination of exposed emergency workers and other persons involved in the incident area.

4. Segregate and, if necessary, have contaminated persons decontaminated.

5. Initiate or recommend other decontamination action as required.

6. Provide information to the Emergency Operating Center for release to the public, when necessary, to minimize public alarm or to assist in the conduct of emergency activities. Advice and instructions to be issued to the public would be dictated by the requirements of the developing situation. Because of this, there are no "standard" instructions as to what should be issued as public information or instructions in every case.

When decontamination is required, the emergency monitoring team should take the following actions:

1. Have the local public works department assist in decontamination and disposal of contaminated material, if the use of heavy equipment is required.

2. Have the Fire Department provide personnel and equipment (for washing down, etc.) to assist in decontamination.

3. Have the police obtain names and addresses of all persons involved; restrict access to the incident area and prevent unnecessary handling of incident debris; and, if

necessary, initiate evacuation of areas subject to contamination.

4. When a transportation incident involves radioactive material, do not move vehicles, shipping containers or wreckage, except to rescue people. Detour pedestrian and vehicular traffic. If a right-of-way must be cleared before radiological emergency assistance arrives, move vehicles and debris the shortest distance required to open a pathway. Before permitting the passage of traffic, spillage on the cleared pathway should be washed, or wetted and swept, to the edge of the pathway with a minimum dispersal of wash water and spilled material. Too little water can result in contaminated dust and particles in the air; too much can spread contaminated matter by washing it to other areas.

If no explosion has occurred and it is believed that a nuclear weapon is involved, take the following actions:

1. Restrict the area of incident and keep the public as far from the scene as practicable. Restrict the area at least 2,000 feet or more in all directions.

2. Rescue injured or trapped persons as quickly as possible--remove them and the rescue team from the incident area.

3. Evacuate all unnecessary personnel within the area as quickly as possible, except those involved in emergency operations.

4. Do not allow public entrance to the area.

5. Fight fire as though toxic chemicals were involved, keeping upwind and avoiding smoke, fumes, and dust.

If an explosion has occurred and a nuclear weapon is believed to be involved, take the following actions:

1. Restrict the area for 2,000 feet or more in all directions.

2. Rescue injured or trapped persons.

3. Evacuate all persons from the area and prevent access until advice can be obtained from appropriate radiological and ordnance experts.

4. Fight fires and handle other emergency situations that might occur as an aftermath, in accordance with appropriate Emergency Services checklists.

5. When radiological monitoring (and ordnance, if applicable) experts indicate the incident area is safe, resume normal routine, notify the EOC, and submit final reports as required.

SUMMARY

As this section indicates, plans have already been made to handle any situation that might arise in the event of an accident (or incident) involving nuclear weapons and/or radioactive materials. You've probably already spotted how you, with full knowledge of Radiological Monitoring procedures and techniques, could fit into the preparedness picture...in peacetime, as well as in the event of war. And, while we hope you never have to use your knowledge, to be unprepared would be the real disaster.

If you intend to become a qualified Radiological Monitor, you'll need additional training--experience with the instruments, familiarization with your local organization, and so on. We hope you're interested enough at this point to continue with your studies and become qualified.

In any event, you now know a great deal about radioactivity and how it's detected and measured. We haven't covered everything, of course, but we've given you exactly what the course set out to impart: An Introduction to Radiological Monitoring. We hope you have enjoyed participating in this course, and that you'll become actively involved in Civil Defense operations, if you haven't already done so.

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U.S. ATOMIC ENERGY COMMISSION

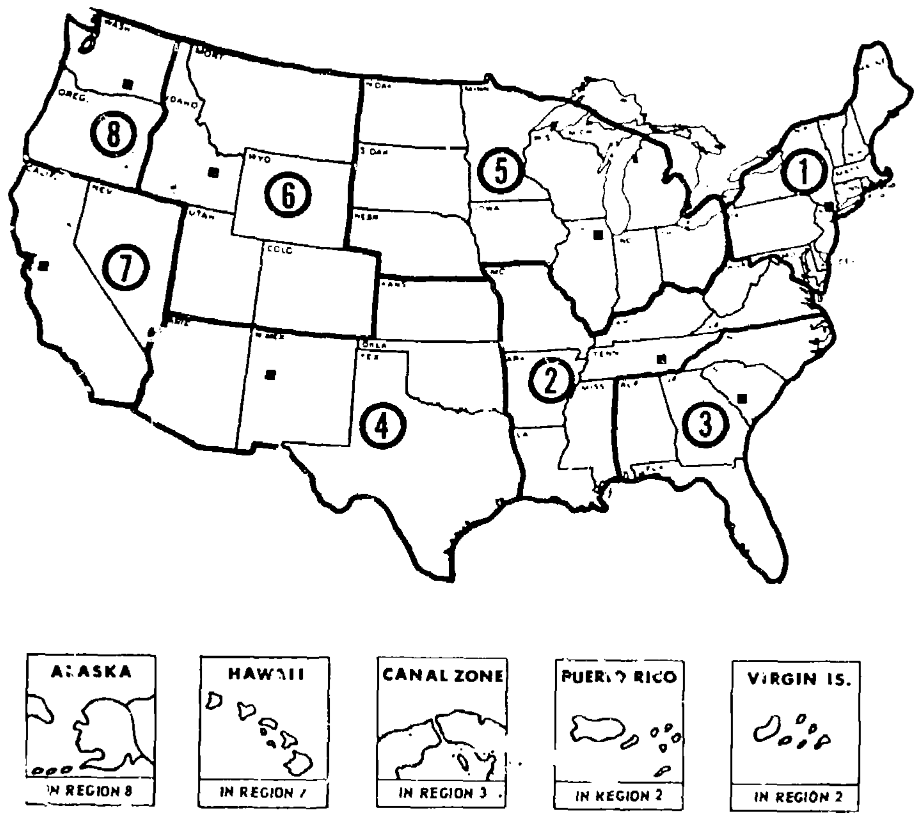
REGIONAL COORDINATING OFFICES

FOR

RADIOLOGICAL EMERGENCY ASSISTANCE

AND THEIR

GEOGRAPHICAL AREAS OF RESPONSIBILITY



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INTRODUCTION TO RADIOLOGICAL MONITORING

HOME STUDY COURSE

ANSWER KEYS
for
UNIT TESTS 1-4

UNIT 1	UNIT 2	UNIT 3	UNIT 4
1. C	1. A	1. B	1. A
2. C	2. C	2. C	2. B
3. A	3. A	3. C	3. C
4. B	4. C	4. A	4. B
5. A	5. A	5. B	5. C
6. B	6. B	6. A	6. A
7. C	7. C	7. C	7. B
8. C	8. B	8. B	8. C
9. B	9. A	9. A	9. C
10. C	10. B	10. C	10. C
11. B	11. B	11. B	11. B
12. A	12. B	12. C	12. B
13. C	13. B	13. B	13. A
14. B	14. C	14. B	14. C
15. A	15. C	15. B	15. C
16. C	16. C	16. C	16. A
17. C	17 A	17. A	17. B
18. A	18. C	18. C	18. C
19. C	19. B	19. B	19. B
20. B	20. C	20. A	20. A

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