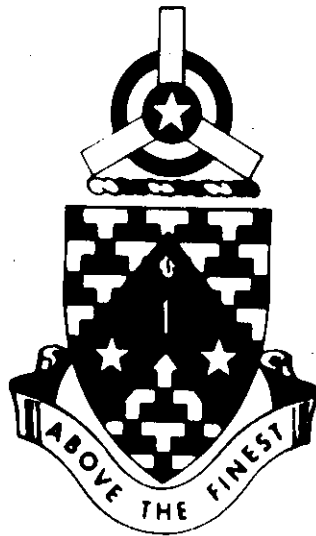


PROGRAMED TEXT

NUCLEAR EFFECTS

WD-60/OD-32



MARCH 1968

UNITED STATES ARMY
PRIMARY HELICOPTER SCHOOL
FORT WOLTERS, TEXAS

PROGRAMED TEXT

PROGRAM TEXT

FILE NO:

PROGRAM TITLE

Nuclear Effects

POI SCOPE: Description of the gross effects of nuclear explosions and the role of Army aviation during nuclear warfare, nuclear weapon effect with emphasis on physiological effects of radiation.

INSTRUCTOR REFERENCES:

FM 21-40
FM 21-41
FM 21-48
Pamphlet 21 CBR Common Subjects (Sept 67)

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NUCLEAR EFFECTS

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PREFACE

This programed self instructional text has been prepared to teach you the effect of nuclear explosions.

The history of nuclear weapons is confined to recent times. The first use of such weapons in warfare occurred in August 1945 when the United States dropped two atomic (the term now used is nuclear) bombs on Japan. The first of these was dropped on the city of Hiroshima. It devastated 10 square miles of the city and caused more than 70,000 casualties. A similar weapon was dropped on Nagasaki, Japan three days later (9 Aug 1945) with similar results.

These two nuclear explosions brought about the unconditional surrender of Japan and prevented the invasion of the Japanese mainland and therefore saved the lives of an estimated 1,000,000 U.S. soldiers.

This text is presented as teaching frames in small steps. Each frame deals with a small amount of instructional material and usually requires a response to a specific question.

The correct response (confirmation) is presented at the top of the next page. If your response is incorrect, turn back and review the item to insure you understand the correct answer.

If you have any questions during the course of this program, contact your instructor for assistance.

PERFORMANCE OBJECTIVES

Upon completion of this text you will be able to:

1. Identify the gross effects of nuclear explosions.
2. Describe the types of nuclear bursts.
3. Specify the role of Army aviation in nuclear warfare.
4. Describe the two types of aerial radiological surveys.
5. Recognize the medical aspects of nuclear radiation.

FRAME 1

GROSS EFFECTS OF NUCLEAR EXPLOSIONS

BLAST EFFECT

Blast effects create shock waves that are the most damaging of the three nuclear effects. Direct pressure from the blast can cause immediate death or injury to personnel and material.

Indirect effects are caused by flying debris and are primarily responsible for a majority of casualties.

The best effect is with a low air burst (when the fire ball does not touch ground).

Based on a 20 kiloton bomb, winds are 1,000 miles per hour at ground zero (point of detonation or directly below detonation) and 470 miles per hour one quarter mile away. It will cause moderate damage to wheeled vehicles at 0.75 statute miles. Helicopters must have 7.5 statute miles clearance to remain in flight.

****NOTE:** Blast effects killed 39,000 or 55% at Hiroshima, Japan.

(Select the correct answer)

Which effect of the blast produces the most casualties?

a) Direct

☒ b) Indirect

TURN TO PAGE 4 FOR FRAME 2.

ANSWERS: 1. a) Airburst 2. a) Airburst 3. c) Sub-surface burst
4. c) Sub-surface burst 5. b) Surface burst

FRAME 9

THE ROLE OF ARMY AVIATION IN NUCLEAR WARFARE

Prior to a friendly nuclear explosion, all Army aircraft in the area will be warned by Air Traffic Control or by the unit's command net.

Following the burst, you may be called upon to move troops and equipment or conduct an aerial radiological survey. A radiological survey is the use of area survey meters in an organized effort to determine the degree and extent of radio-active contamination on the ground.

NOTE: Army aircraft may also be used for:

- a) Aeromedical evacuation.
- b) Command, liaison courier, and communications.
- c) Aerial fire support.
- d) Observations, visual and photographic reconnaissance.

In the event monitoring reports do not give enough information to determine the degree and extent of radiological contamination, for example, contamination in enemy or unoccupied territory, radiological surveys will have to be conducted. This information is needed for:

- a) Initiating radiological defense countermeasures.
- b) Planning tactical actions.
- c) Planning troop and supply movements.

(Select the correct answer)

What are the primary uses of Army aircraft following a nuclear explosion?

- a) Attack enemy positions with gunships.
- b) Command and control for commanders and conduct aerial surveys.
- ☒ c) Movement of troop and equipment and conduct aerial surveys.
- d) Med-evac and radio relay.

Answer: b) Indirect effects

FRAME 2

HEAT EFFECT

The second effect of a nuclear explosion is in the form of heat and light, and is called thermal radiation. It is produced by the release of an enormous quantity of energy in a small place.

While the blast wave travels at the speed of sound (approximately 1/5th of a mile per second), the heat wave travels at the speed of light (approximately 186,000 miles per second). The heat waves may be scattered by any opaque object, as a building or terrain, or they may be intensified by the reflection from the ground or clouds.

***NOTE: Heat effects killed 21,000 or 30% at Hiroshima, Japan. The greatest effects are produced by a low air or surface burst.

The flash of the explosion is hazardous to aviators in that it will produce dazzle (temporary loss of vision or reduction in visual acuity) during daylight hours lasting for 2 minutes. At night the blindness will last from 3-15 minutes, depending on the direction from the burst personnel are facing.

(Select the correct answer)

While on a cross country flight, you and your co-pilot accidentally fly near an area of a friendly nuclear explosion. You have been notified by Air Traffic Control that detonation time is within 30 seconds. Which of the following would be the best measure used in preventing dazzle?

- a) Wear your aviator sun glasses.
- ☒ b) Turn the aircraft away from the blast and have one pilot cover his eyes while the other flies.
- c) Land the aircraft and assume the prone position.

TURN TO PAGE 6 FOR FRAME 3.

ANSWER: c) Army aircraft are used for the movement of troops and equipment and to conduct aerial radiological surveys.

FRAME 10

Radiological surveys may be conducted on the ground or from the air.

AERIAL SURVEY ADVANTAGES

Aerial surveys are fast and flexible in that almost any area can be surveyed. Personnel involved in aerial surveys receive a relative low dose rate compared to those on ground surveys. Less equipment and personnel are required for aerial surveys than for a ground survey.

AERIAL SURVEY LIMITATIONS

Although the aerial survey is less accurate than the ground survey, its decisive advantages make it the primary method of conducting surveys.

(Select correct response)

Which of the following statements is true concerning an aerial radiological survey?

- a) Faster but more equipment and personnel required than a ground survey.
- ☒ b) Faster but less accurate than a ground survey. ✓
- c) Faster and more accurate than a ground survey.
- d) Slower but more flexible than a ground survey.

Answer: b) Have the co-pilot take the aircraft while you cover your eyes completely.

FRAME 3

RADIATION EFFECT

Nuclear radiation consists of sub-atomic particles such as neutrons, alpha and beta particles, gamma rays, and x-rays. They cannot be detected by any of the senses, but can enter the body and destroy or damage cells. The more radiation that enters the body, the greater the number of cells that are damaged.

Initial radiation is emitted by a nuclear explosion within the first minute. Any radiation remaining in an area afterwards is known as residual radiation. It may be in a small area around ground zero (and easily avoided) or it may be the result of radioactive fallout and cover a very large area.

Fallout consists of radioactive debris picked up by the explosion, carried aloft and spread by the upper wind currents. These large areas could be difficult to avoid.

**** NOTE:** Radiation effects caused 10,000 or only 15% of the casualties at Hiroshima, Japan.

Identify each example with either an "I" (Initial Radiation) or an "R" (Residual Radiation) as to which type of radioactivity would be present:

- I a) Smoke resulting from the explosion at ground zero.
- R b) A large dust cloud moving over the area.
- A c) Debris picked up by the explosion and carried aloft.

ANSWER: b) Faster but less accurate than a ground survey.

FRAME 11

There are two types of aerial radiological surveys that can be conducted, depending on the situation.

1) HASTY SURVEY

A hasty survey is used by the commander when time does not permit a more detail survey. It only provides the minimum essential information, and is planned by the survey party after arriving in the area.

2) DETAILED SURVEY

A detailed survey is used when time permits a greater, more detailed, collection of data. Three different techniques can be used with a detailed survey:

- a) Route technique--The pilot flies between two check points, following the route of some predominant terrain feature, such as a road, which connects the two points. The monitor takes and records dose-rate readings at predetermined intervals. This method is normally used when the commander is pressed for time and plans to use the road.
- b) Course-leg technique--Requires that the pilot and monitor fly a straight line course between two check points. The pilot must maintain a constant altitude, ground speed, and course. The monitor takes and records dose-rate readings at predetermined time intervals as in the route technique.
- c) Point technique--Used to determine radiation intensity at particular points of interest. If possible, the aircraft lands and the monitor takes readings. If impossible to land, the aircraft hovers and the radiac meter is lowered as far as possible for readings.

(Select correct answers to following questions)

- 1) Following a nuclear explosion a company commander plans to airlift a demolition team to a nearby bridge site. Destruction of the bridge is necessary to slow down enemy troop and supply movement. What technique would be used to determine the radiation intensity at the site?
 - a) Route
 - b) Course-leg
 - ☒ c) Point
- 2) Following a nuclear explosion a battalion commander desires to march a company of infantry troops from its present location to reinforce another unit, three miles further down the road. What technique would he use to determine radiation intensity?
 - ☒ a) Route
 - b) Course-leg
 - c) Point

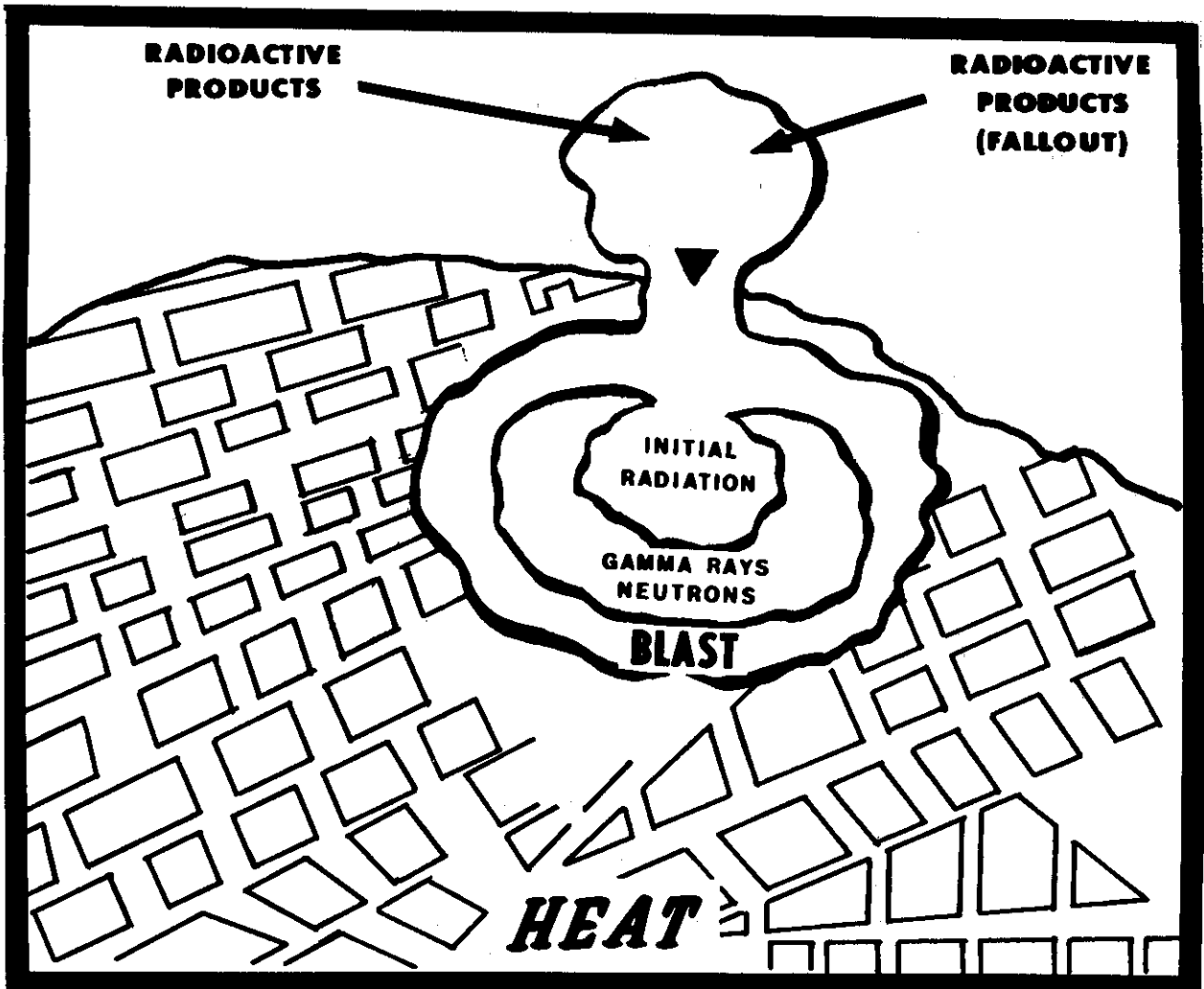
ANSWERS: a) I

b) R

c) R

FRAME 4

EFFECTS OF A NUCLEAR EXPLOSION



ANSWERS: 1. c) Point

2. a) Route

FRAME 12

While taking an aerial radiological survey you may have to act as the monitor if the situation requires. Both the pilot and the monitor are responsible for certain duties.

PILOT DUTIES

The pilot must maintain a constant:

- a) Azimuth or direction.
- b) Ground speed (less than 53 knots).
- c) Height above ground (between 100 and 500 feet)/

The monitor must:

- a) Take initial, final, and timed interval readings.
- b) Record data.
- c) Transmit data.
- d) Hold the survey meter in the same location throughout the survey.

(Select correct response)

During an aerial radiological survey the pilot must maintain a constant:

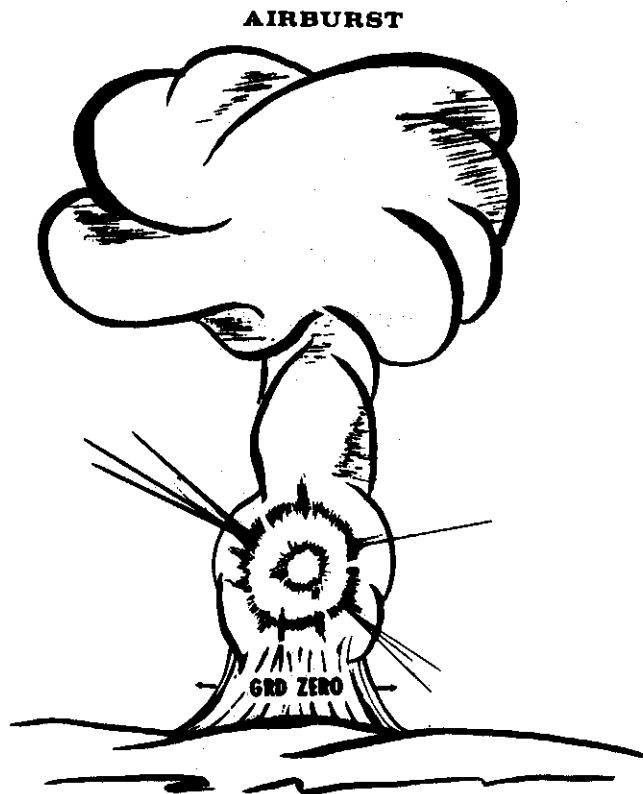
- a) Direction, meter reading, airspeed.
- b) Ground speed, altitude, transmission data.
- c) Direction, azimuth, height above survey locations.
- ☒ d) Azimuth, ground speed, height above ground.

TYPES OF BURSTS

AIRBURSTS

When the fireball does not touch the surface of the earth, the explosion is called an airburst. Blast, initial nuclear radiation, and heat effects are maximized in a low airburst.

Fallout, or residual radiation, is of little or no military significance. Since the fireball is above the earth's surface, very little debris and dirt is picked up.



(Select Correct Answer)

An airburst maximizes which effects of a nuclear explosion?

- a) Blast, heat, and residual radiation.
- b) Heat, initial and residual radiation.
- ☒ c) Blast, heat, and initial radiation.

ANSWER: d) Azimuth, ground speed, height above ground.

FRAME 13

MEDICAL ASPECTS OF NUCLEAR RADIATION

Almost 90% of all the material written about nuclear weapons has been directed toward radiation. Why is this? Probably the best answer is "fear of the unknown".

At this time you will view a film, entitled "The Medical Effects of Nuclear Radiation", which should answer any questions you have concerning radiation. This film will explain:

1. Nuclear radiation.
2. Radiation effect on the human body.
3. Protective measures to minimize its effect.
4. Systematic treatment of casualties.
5. Misleading rumors concerning radiation effects.

****NOTE:** Film MF 8-7897

ANSWER: c) Blast, heat, and initial radiation.

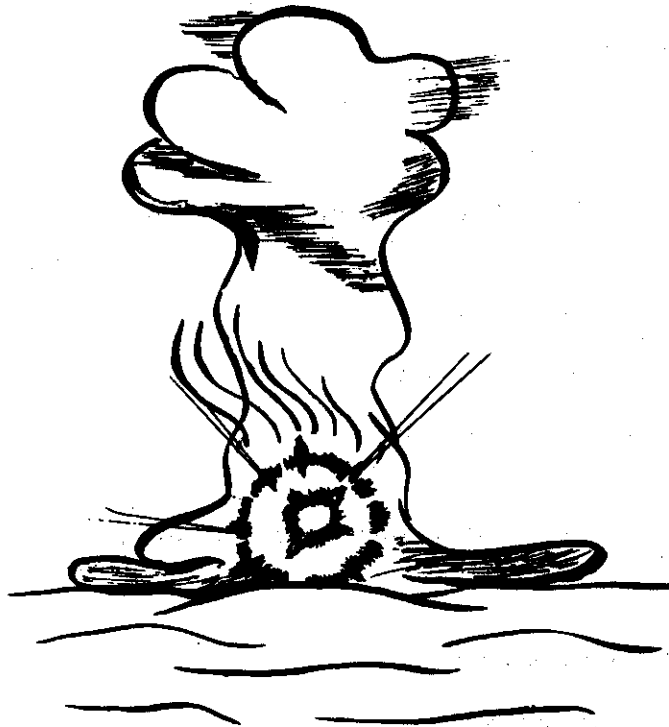
FRAME 6

SURFACE BURSTS

When the fireball touches the surface of the earth, the explosion is called a surface burst. Blast, heat, and initial nuclear radiation effects are not as widespread as in an airburst.

Residual nuclear radiation is more hazardous as fallout in areas around and downwind of ground zero. Dirt and debris from the crater are pulled up into the nuclear cloud, becomes radioactive, and falls back to the earth as fallout. The area covered will depend on the winds.

SURFACE BURST



Is residual radiation more hazardous in an airburst or a surface burst?

Answer the following questions pertaining to the film you have just viewed:

1. A large amount of radiation causes sickness and death due to:
☒ a) The halting of human cell reproduction.
☐ b) The increased rate of cell production.
☐ c) The disfiguration of cells.
2. What type material gives the best protection against radiation?
☐ a) Wood.
☐ b) Concrete.
☒ c) Steel.
3. Radioactive alpha & beta rays enter the body through the:
☐ a) Penetration of skin.
☒ b) Mouth, nose, and skin breaks.
☐ c) Do not enter the body.
4. When a patient is being treated for radiation sickness, the doctor treats the:
☒ a) Effects or symptoms.
☐ b) Causes or specifics.
☐ c) Internal organs or surgical.

ANSWER: Residual radiation is more hazardous in a surface burst.

FRAME 7

SUB-SURFACE BURSTS

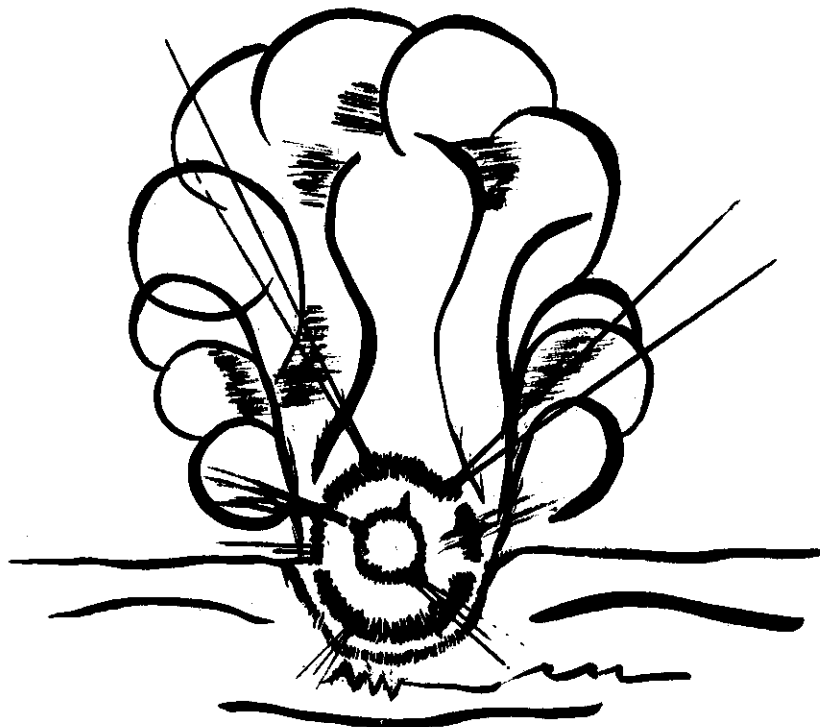
When the center of the fireball is beneath the surface of the ground (or water), the explosion is called a sub-surface burst. If the burst is near enough to the surface that the fireball breaks through, fallout will occur. The thermal radiation will not be a significant hazard since it will be almost completely absorbed by the soil material.

Airblast effects, shock waves, and initial radiation are greatly reduced and are considerably less than those from an air or surface burst.

Extremely hazardous residual radiation occurs in and around the crater, especially in the area covered by contaminated earth from the crater.

If the burst is far enough below the surface that the fireball does not break through the surface (does not vent), the only significant effect consists of shock waves passing through the ground or water.

SUB-SURFACE BURST



During a sub-surface burst, which effect has the greatest significance?

- a) Blast b) Heat c) Initial radiation ☒ d) Residual radiation

ANSWERS: 1) a 2) c 3) b 4) a

NOW TURN TO PAGE 17 AND COMPLETE THE SELF EVALUATION EXERCISE.

ANSWER: d) Residual radiation in the area of the crater.

FRAME 8

Answer the following questions based on the types of bursts you have just covered:

1. What type of explosion produces the best blast effect?

- ☒ a) Airburst
- b) Surface burst
- c) Sub-surface burst

2. In which of the following bursts is residual radiation of little or no significance?

- ☒ a) Airburst
- b) Surface burst
- c) Sub-surface burst

3. In which of the following bursts is thermal radiation (heat) of little significance?

- a) Airburst
- b) Surface burst
- ☒ c) Sub-surface burst

4. The range of initial nuclear radiation is considerably less in a:

- a) Airburst
- b) Surface burst
- ☒ c) Sub-surface burst

5. Which of the following type bursts produces the greatest amount of fallout?

- a) Airburst
- ☒ b) Surface burst
- c) Sub-surface burst

STOP. TURN BACK TO PAGE 3 FOR FRAME 9.

NUCLEAR EFFECTS
SELF EVALUATION EXERCISE

1. Which of the three gross effects of a nuclear explosion produces the most damage?

- ☒ a. Blast effect.
☐ b. Heat effect.
☐ c. Radiation.
☒ d. Shock wave.

2. Which one of the three gross effects of a nuclear explosion is particularly hazardous to aircraft?

☒ a. Blast.

- ☐ b. Heat.
☐ c. Radiation.

X ☒ d. Shock.

3. Which one of the three gross effects of a nuclear explosion is produced by the release of an enormous quantity of energy in a small place?

X ☒ a. Blast.

☒ b. Heat.

- ☐ c. Radiation.
☐ d. Shock.

4. In what type nuclear burst is the blast effect greatest?

- ☐ a. A surface burst.
☒ b. An air burst.
☐ c. An underwater burst (sub-surface).
☐ d. An underground burst (sub-surface).

5. Initial radiation is emitted by a nuclear explosion within the first:

- ☒ a. minute.
- ☐ b. 3 minutes.
- ☐ c. 5 minutes.
- ☐ d. 10 minutes.

6. Which of the following presents the greatest hazard to troops walking through an area which was the object of a nuclear attack the previous day?

- ☐ a. Flying objects and debris.
- ☒ b. Residual radiation.
- ☐ c. Fires.
- ☐ d. Initial radiation.

7. Initial radiation is:

- ☐ a. More hazardous a great distance from the crater.
- ☒ b. Sent out immediately upon explosion of a nuclear weapon.
- ☐ c. A product of fallout.
- ☐ d. The greatest hazard associated with nuclear explosions.

8. Residual radiation can best be defined as the radiation which:

- ☐ a. Is sent out immediately upon explosion of a nuclear weapon.
- ☐ b. Is militarily insignificant.
- ☒ c. Remains in an area as a product of fallout.
- ☐ d. Becomes more intense with time.

9. Which of the following are the primary uses of Army aircraft following a nuclear explosion?
- ☐ a. Conduct aerial radiological surveys and as command and control for ground commanders.
 - ☐ b. Attack and support missions.
 - ☒ c. Movement of troops and equipment and conduct aerial radiological surveys.
 - ☐ d. Med-evac and damage reports.
10. Which of the following are advantages of an aerial survey?
- ☐ a. Slow but more accurate than a ground survey.
 - ☒ b. Fast and almost any area can be surveyed.
 - ☐ c. Fast and requires less training than a ground survey.
 - ☐ d. Fast and more accurate than a ground survey.
11. When is a hasty radiological survey used instead of a detailed survey?
- ☐ a. When the situation calls for a low-level flight only.
 - ☐ b. When only a minimum of radiac equipment is available.
 - ☒ c. When the radiation is so severe that it would endanger the crew to remain airborne for a longer period.
 - ☒ d. When the commander determines that time does not permit a more detailed survey.
12. Which are the correct techniques of a detailed aerial survey?
- ☒ a. Route, course-leg, and point techniques.
 - ☐ b. Hasty, route, and terrain techniques.
 - ☐ c. Point-leg, constant altitude, and course techniques.
 - ☐ d. Road, water, and air techniques.

13. While conducting an aerial radiological survey, the pilot must maintain a constant:

- ☐ a. Monitor, altitude, airspeed.
- ☒ b. Direction, ground speed, height above ground.
- ☐ c. Airspeed, radiac-meter reading, heading.
- ☐ d. Ground speed, route, dosage chart.

14. Which of the following terms best describes proper medical treatment of radiation casualties?

- ☐ a. Surgical.
- ☒ b. Symptomatic.
- ☐ c. Specific.
- ☐ d. Psychological.

15. How do alpha and beta particles enter the body?

- ☐ a. They do not enter the body.
- ☐ b. By penetrating unbroken skin.
- ☐ c. By the air we breath and by penetrating unbroken skin.
- ☒ d. By the air we breath, the food we eat and through open wounds.

ANSWERS TO SELF EVALUATION EXERCISE

1. a

2. a

3. b

4. b

5. a

6. b

7. b

8. c

9. c

10. b

11. d

12. a

13. b

14. b

15. d

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types of bursts
survey's
radiation symptom.

any nation recon, damage reports, troop deployment.