

Name

Sample Test

Date

Bethlehem Steel Corporation  
Short Course in Radiation Protection

Questions 1 to 30 worth three points.

TRUE/FALSE - Indicate if the statement is true or false. IF FALSE, INDICATE WHY IT IS FALSE.

1. T At doses in the range of 5000 millirem a year, your body can repair about 99% of the radiation damage within a few months.
2. T A whole body dose of 25 Rems must be reported immediately.
3. T Gamma emission usually accompanies both beta and alpha decay.
4. T Bethlehem Steel Corporation uses a TLD badge to monitor the radiation dose of workers.
5. T As the radiation dose increases, the effect that it causes will also generally increase, in the range of doses below 1000 Rem.
6. T Radioactive contamination may enter the body by means of inhalation and ingestion.
7. T Two half-value thicknesses will stop 75% of the radiation intensity from a source.
8. T Alpha particles are of major concern once they enter the body.
9. T Pair production as a form of photon interaction becomes important only after about 2-3 Mev.
10. T The half value thickness of lead for Cobalt 60 is more than the half value thickness for cesium 137.

Matching - Choose the answer that best fits the statement.  
There is only one correct answer.

11. Which of the following effects may occur following a relatively high exposure of 300 Rem.

- (a) Skin discoloration
- (b) Genetic damage
- (c) Leukemia induction
- (d) Temporary sterility
- (e) All of the above

B/1

12. The resulting dose rate of a radiation beam after it passes through four, half-value layers of attenuation is 20 mR/hr, what was the initial intensity of the beam without any attenuation.
- (a) 20 mR/hr
  - (b) 40 mR/hr
  - (c) 80 mR/hr
  - (d) 160 mR/hr
  - (e) 320 mR/hr
13. If you are limited to a single survey meter, which is the best type of portable radiation survey meter for use with several different X-ray and gamma energies.
- (a) ionization chamber
  - (b) proportional chamber
  - (c) GM meter
  - (d) scintillation meter
  - (e) None of the above
14. An acute dose of 200 Rem, whole body, would cause which of the following:
- (a) death in all persons exposed within 30 days.
  - (b) permanent sterility in all persons exposed.
  - (c) no medical symptoms.
  - (d) nausea, vomiting in all exposed, few if any deaths.
  - (e) death to 50% of those exposed in 15 days.
15. A "high radiation area" is defined as an area having a radiation level of:
- (a) 1000 mRem in one hour
  - (b) 1 mRem in one hour
  - (c) 100 mRem in one week
  - (d) 100 mRem in one hour
  - (e) 2 mRem in one hour
16. A "radiation area" is defined as any area having a radiation level of:
- (a) 5 mRem in one hour
  - (b) 2 mRem in one hour
  - (c) 100 mRem in one hour
  - (d) 10 mRem in one hour
  - (e) 1 mRem in one hour
17. What does the average person receive from natural background radiation each year?
- (a) 10-20 millirem
  - (b) 5000-6000 millirem
  - (c) 100-150 millirem
  - (d) 350-400 millirem
  - (e) 20-35 millirem

18. If 1/4" of lead has a reduction factor of 50, what would a beam of 25 mR/hr be reduced to if you put the 1/4" lead in its path?
- (a) 1250 mR/hr
  - (b) .5 mR/hr
  - (c) 20 mR/hr
  - (d) 30 mR/hr
  - (e) .02 mR/hr
19. If you are limited to only one meter, the best choice for a single radiation survey meter for low level alpha/beta contamination surveys, unsealed (loose) radioactive material surveys and hard gamma emitters is:
- (a) ionization chamber
  - (b) proportional counters
  - (c) metal tube GM meter
  - (d) scintillation meters
  - (e) thin end window GM meter
20. Cobalt 60 has a:
- (a) deeper
  - (b) less
  - (c) same
- relative amount of penetration into the body than a 250 KVp x-ray beam.
21. If neutrons have a quality factor of 10, how many Rem are absorbed if the dose is 5 Rads?
- (a) 50 Rem
  - (b) 15 Rem
  - (c) .5 Rem
  - (d) .25 Rem
  - (e) 25 Rem
22. Which is the present annual maximum permissible dose equivalent for whole-body dose to radiation workers?
- (a) 5 Rems/year
  - (b) 500 millirems/year
  - (c) 15 Rems/year
  - (d) 25 Rems/year
  - (e) None of the above
23. If the exposure rate at 2 meters from a source is 24 R/hr, what should the exposure rate be at 16 meters from the source?
- (a) 3 R/hr
  - (b) 125 R/hr
  - (c) .375 R/hr
  - (d) 192 R/hr
  - (e) 16 R/hr

24. Which of the following are problems in making a neutron survey?
- (a) Neutron energy spectrum is not fully known
  - (b) Energy dependence of survey meters
  - (c) Variation in tissue response with neutron energy
  - (d) Availability of truly portable Rem-responding equipment
  - (e) All of the above
25. Which one of the following is the correct ranking (best to worse) of gamma or x-ray shields?
- (a) steel, lead, aluminum
  - (b) aluminum, concrete, plastic
  - (c) steel, lead, concrete
  - (d) stainless steel, uranium, concrete
  - (e) uranium, lead, steel
26. Which of the following incidents must be reported immediately to a regulatory agency?
- (a) wipe test exceeding .005 uCi
  - (b) 75 Rem extremity dose
  - (c) 5 Rems whole body dose
  - (d) Lost source
  - (e) All of the above
27. Which of the following can emit hazardous levels of ionizing radiation?
- (a) Silicon rectifier
  - (b) Atomic absorption analyzer
  - (c) Helium-Neon laser tubes
  - (d) High voltage rectifier tubes
  - (e) None of the above
28. Most of the scatter we experience from the types of sources used in the steel industry comes from which type of interaction.
- (a) Pair production
  - (b) Attenuation
  - (c) Excitation
  - (d) Compton effect
  - (e) Photoelectric effect
29. If you remain for 15 minutes in a radiation field of 300 mR/hr, you will receive a total dose of:
- (a) 20 mR
  - (b) .05 mR
  - (c) 75 mR
  - (d) 4500 mR
  - (e) 285 mR

30. Cobalt 60 has an intensity of 1.3 R/hr per curie at 1 meter, what is the intensity of a 10 curie source at .1 meter? (assume inverse square law is valid at this distance?)

- (a) .13 R/hr
- (b) 1300 R/hr
- (c) 130 R/hr
- (d) 13 R/hr
- (e) None of the above

31. A pipefitter enters a 15-foot diameter bin made of 5/8-inch steel without having the gage "turned off". The gage, located on the outside of the bin, has a 4000 millicurie Cesium 137 source. The source capsule is about 18 inches away from the inside surface of the bin. The gamma output of Cesium 137 is about 3.6 R/hr per curie at 1 foot. (5/8 inch = 1 HVL for cesium 137).

- (a) What is the maximum dose the man could receive if he were in the bin for 45 minutes? (5 POINTS). (It would help to draw a sketch and give your assumptions.)

(ASSUME DOSE TO MIDLINE OF BODY, 30 inches FROM THE SOURCE)

2.3 R/hr AT 30 inches FROM SOURCE

1.15 R/hr WITH ATTENUATION FROM STEEL

.864 total dose (R) FOR 45 MIN EXPOSURE

- (b) What would you tell him if he asked you if this was a hazardous dose? (5 POINTS).

(SINCE HE IS A PIPEFITTER, HE WOULD PROBABLY BE A NON-RADIATION WORKER.)

WOULD TELL HIM THAT DOSE IS NOT BIOLOGICALLY HAZARDOUS BUT THAT IT DOES EXCEED LIMITS (.5 R) FOR YEAR AND IS A REPORTABLE EXPOSURE.

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2. T A whole body dose of 25 Rems must be reported immediately.
3. T Gamma emission usually accompanies both beta and alpha decay.
4. T Bethlehem Steel Corporation uses a TLD badge to monitor the radiation dose of workers.
5. T As the radiation dose increases, the effect that it causes will also generally increase, in the range of doses below 1000 Rem.
6. T Radioactive contamination may enter the body by means of inhalation and ingestion.
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BETHLEHEM STEEL CORPORATION  
SHORT COURSE IN RADIATION PROTECTION

DAY 1

8:30 a.m. - 9:00 a.m. - Introduction and announcements.  
9:00 a.m. - 10:30 a.m. - Natural sources of radiation and sources in the steel industry  
10:30 a.m. - 10:45 a.m. - Break  
10:45 a.m. - 12:30 p.m. - Production and interaction of radiation  
12:30 p.m. - 1:30 p.m. - Lunch  
1:30 p.m. - 2:00 p.m. - Radiation Units  
2:00 p.m. - 2:45 p.m. - Radiation Detection Theory  
2:45 p.m. - 3:00 p.m. - Break  
3:00 p.m. - 5:00 p.m. - Photon and Contamination survey technique

DAY 2

8:00 a.m. - 8:30 a.m. - Review  
8:30 a.m. - 9:30 a.m. - Personnel Monitoring  
9:30 a.m. - 10:30 a.m. - Time and Distance Calculations for Protection  
10:30 a.m. - 10:45 a.m. - Break  
10:45 a.m. - 12:00 noon - Shielding Calculations  
12:00 noon - 1:00 p.m. - Lunch  
1:00 p.m. - 2:00 p.m. - Waste Disposal  
2:00 p.m. - 2:45 p.m. - Transportation Regulations  
2:45 p.m. - 3:00 p.m. - Break  
3:00 p.m. - 4:30 p.m. - Nuclear Regulatory Commission Regulations  
4:30 p.m. - 5:00 p.m. - OSHA and State Regulations

DAY 3

8:00 a.m. - 8:30 a.m. - Review  
8:30 a.m. - 10:00 a.m. - Emergency Procedures  
10:00 a.m. - 10:15 a.m. - Break  
10:15 a.m. - 12:15 p.m. - Bethlehem Steel Corporation policies and procedures  
12:15 p.m. - 1:15 p.m. - Lunch  
1:15 p.m. - 2:15 p.m. - Test

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10:00 a.m. - 10:15 a.m. - Break  
10:15 a.m. - 12:15 p.m. - Bethlehem Steel Corporation policies and procedures  
12:15 p.m. - 1:15 p.m. - Lunch  
1:15 p.m. - 2:15 p.m. - Test