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

Name _____

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 <u>whole-body</u> 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
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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

Name _____

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 (mR) 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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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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1:15 p.m. - 2:15 p.m.	-	Test