

SECTION 8

Part I - Typical Questions

1. For a narrow beam of photons, the relaxation length is that thickness of absorber that will result in a reduction of ___ in the initial beam intensity.

1. $1/10$.
2. $1/2$.
3. $1/\log 2$.
4. $1/n^2$.
5. $1/e$.

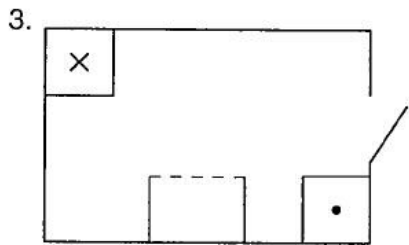
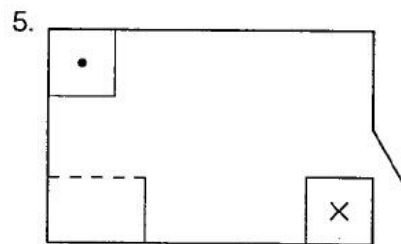
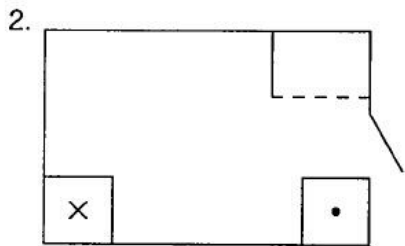
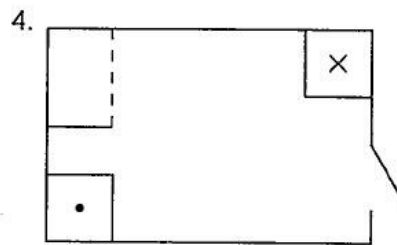
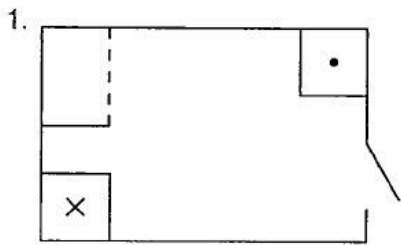
2. If the total beta count rate is 250 cpm based on a 25-minute count and the beta background is 60 cpm based on a 10-minute count, how should the sample count rate be reported at the 95 percent confidence level?

1. (190 ± 4) cpm
2. (190 ± 8) cpm
3. (190 ± 14) cpm
4. (190 ± 16) cpm
5. (190 ± 23) cpm

3. To avoid criticality when processing waste fissionable material, the size and shape of the container and the concentration are most important for:

1. a liquid slurry
2. small, dry solid pieces
3. dry powder
4. large solid pieces
5. an alloy of less dense material

4. A laboratory is being designed for performing iodine labeling experiments with activities on the order of a few millicuries. A radioisotope hood will be used for this work. Which one of the following arrangements is best?



5. An ionization chamber was exposed to $10^{-2} \text{ C kg}^{-1}$ of x-rays at a rate of $10^{-4} \text{ C kg}^{-1} \text{ s}^{-1}$. The same chamber was then exposed to $10^{-2} \text{ C kg}^{-1}$ at the rate of $10^{-2} \text{ C kg}^{-1} \text{ s}^{-1}$. If the second exposure reading was less than the first reading, the most likely cause is:

1. recombination
2. leakage
3. resolving time
4. a decrease of energy absorption
5. an increase in absorption coefficients

6. A certain radioisotope has a biological half-life in the human body which is three times as long as its physical half-life. Its effective half-life would be taken as equal to:

1. three-fourths of the physical half-life.
2. four-thirds of its physical half-life.
3. four times its physical half-life.
4. one-third of its biological half-life.
5. its biological half-life.

7. An investigator has received some ^{95}Zr (half-life = 65 days) for use in a long-term study. He finds the ^{95}Zr to be contaminated with ^{60}Co (half-life = 5.24 years) such that the ratio of ^{60}Co activity to the ^{95}Zr activity is 0.012. After the initial assay, the activities of the two emitters will become equal in:

1. 280 days.
2. 290 days.
3. 340 days.
4. 360 days.
5. 430 days.

8. All of the following are common causes of significant radiation exposure in the use of x-ray diffraction equipment except:

1. alteration or removal of shielding in order to perform a specialized analysis
2. visual alignment of the beam without using a leaded glass shield.
3. placement of fingers in the primary beam while changing samples.
4. failure to incorporate shielding in the walls of the room in which the unit is housed.
5. failure to realize that x-ray beams are emitted from exit ports other than the one of immediate concern.

9. Discs or foils of copper, cadmium, or aluminum are often incorporated into thermoluminescent dosimeters (TLDs) in order to:

1. measure neutrons via the n -alpha reaction
2. facilitate the annealing process.
3. filter out high-energy cosmic radiation.
4. filter out low-energy background radiation.
5. provide information on the energy of the photon.

10. If an airborne release occurs because of a loss of coolant accident at a light-water power reactor in which no core melt occurs, the first radioisotope of concern through the food chain is:

1. ^{90}Sr .
2. ^{137}Cs .
3. ^3H .
4. ^{135}Xe .
5. ^{131}I .

11. In branching decay, a substance may decay by two or more modes. If a radioisotope has only two modes of decay (1 and 2), the formula for its half-life $T_{1/2}$ would be:

1. $T_{1/2} = (\lambda_1 + \lambda_2)/\ln 2$
2. $T_{1/2} = (T_{1/2})_1 + (T_{1/2})_2$
3. $T_{1/2} = 1/\lambda_1 + 1/\lambda_2$
4. $T_{1/2} = \ln 2/\lambda_1 + \ln 2/\lambda_2$
5. $T_{1/2} = \ln 2/(\lambda_1 + \lambda_2)$

12. In a satisfactory “air-walled” ionization chamber, the ionization per unit volume would be:

1. inversely proportional to the density of the gas in the chamber.
2. inversely proportional to the gamma ray energy absorbed per cubic centimeter of wall material.
3. directly proportional to the stopping power of the walls for electrons.
4. independent of the density of the gas in the chamber.
5. independent of the volume of the chamber.

13. When air is sampled by being pulled through a filter paper, the radioactivity at equilibrium on the filter paper due to naturally occurring radon daughters is:

1. proportional to the flow rate of the sampler.
2. dependent only on the total volume of air sampled.
3. dependent on the time required for radioactive equilibrium on the filter paper to be established.
4. dependent on the volume of air sampled after radioactive equilibrium on the filter paper has been established.
5. independent of the flow rate of the sampler.

14. When UF_6 is released to the atmosphere, hydrolysis results in the production of hydrofluoric acid and uranyl fluoride. The primary health hazard associated with such a release is:

1. chemical toxicity of uranium.
2. radiotoxicity of uranium.
3. chemical toxicity of UF_6 .
4. chemical toxicity of HF.
5. chemical toxicity of F_2 .

15. A mono-energetic photon beam is measured to have an exposure rate of 100 mR h^{-1} at 1 meter. An absorber of 0.2 m thickness ($\mu = 6.93 \text{ m}^{-1}$) is placed in the beam. What is the shielded exposure rate at 5 meters from this source?

1. 1 mR h^{-1}
2. 4 mR h^{-1}
3. 5 mR h^{-1}
4. 20 mR h^{-1}
5. 25 mR h^{-1}

16. The *biologically most significant* type of interaction of thermal neutrons with atoms in tissue is:

1. ionization.
2. elastic scattering.
3. inelastic scattering.
4. hydrolization.
5. capture.

17. Right-angle scattered x-ray radiation exposure measured one meter from the beam of a fluoroscope will be

1. about 0.01% of the incident beam at the scatterer.
2. about 0.1% of the incident beam at the scatterer.
3. about 1% of the incident beam at the scatterer.
4. about 10% of the incident beam at the scatterer.
5. of little significance and can be ignored for all practical purposes.

18. A solution contaminated with plutonium has spilled on the ground near a facility. There are no other radioactive materials in the solution. Which one of the following is the most appropriate primary survey instrument to assess the extent of the contamination?

1. Portable thin NaI(Tl) scintillator (FIDLER).
2. Portable high purity Ge spectrometer.
3. End-window GM survey meter.
4. Air-proportional alpha survey meter.
5. Gas-proportional alpha survey meter.

19. According to ANSI Z136.1-1986 "For the Safe Use of Lasers", what Class applies to a laser which emits light in the visible portion of the spectrum such that eye protection is normally afforded by the aversion response including the blink reflex?

1. Class 1
2. Class 2
3. Class 3a
4. Class 3b
5. Class 4

20. The count rate for an effluent particulate filter is measured in a proportional counter. Which of the following system calibration parameters is most crucial in converting the result to an activity for use in airborne concentration assessment?

1. FWHM resolution.
2. Fano factor.
3. Absolute efficiency.
4. Intrinsic efficiency.
5. Signal-to-noise ratio.

Question Number	Correct Answer
1	5
2	2
3	1
4	1
5	1
6	1
7	5
8	4
9	5
10	5
11	5
12	5
13	1
14	4
15	1
16	5
17	2
18	1
19	2
20	3