RADIATION SAFETY OFFICER

APS-289

This exam tests the knowledge that is needed for an individual to serve as a radiation safety officer (RSO) at a non-medical radioactive material license facility. It focuses on the subjects required to meet the classroom provisions of 10 CFR 33.15. Topics include radiation fundamentals, health risks, regulations, licensing, regulatory enforcement, external and internal dosimetry, shielding, radiation protection, ALARA, instruments, use of x-ray equipment, radiation surveys, statistics, quality assurance, DOT shipment/receipt of radioactive materials, program management, record-keeping, emergency response, and inspections. 3 credits

This is a 2-hour examination with 70 multiple-choice questions worth 1 point each.
A passing score is **49** out of 70 points.
Test grades are transcripted on a Credit (CR)--No Credit (NC) basis.

Preparing for the exam:

This exam assesses the knowledge acquired by an individual who has taken a formal RSO training course, such as the one offered by Dade Moeller, which provides excellent preparation. The topic outline lists what will be tested and how important each specific topic is. If you have not taken a training course recently, you may want to do some additional study before testing. Since the sample questions are very similar to those on the exam, they should give you a good idea of your readiness for the exam.

This TECEP exam assesses mastery of the following outcomes. Students should be able to:

- demonstrate proficiency in radiation fundamentals
- demonstrate proficiency with the basics of radiation health effects, radiation risks, and the symptoms of such effects resulting from any high-level exposure
- demonstrate a working knowledge of the most relevant federal regulations related to radiation protection of occupational workers, the general public, and the environment
- recognize key aspects of licensing, inspections and regulatory enforcement associated with the use of radioactive materials
- demonstrate knowledge of the proper application and use of personnel dosimetry and instruments
- apply basic statistics relative to radiation measurements
- define quality assurance (QA) needs and importance of same within a radiation safety program
- demonstrate knowledge of basic requirements for shipping and receipt of radioactive material (RAM) which may be part of an RSO's function
- understand the issues associated with managing a safety program that concern the use of RAM and radiation producing machines, including recordkeeping
- define the elements of a training program and frequency of training for radiation workers/RAM Authorized Users
- demonstrate an understanding of the emergency response preparedness required for a facility with a RAM license(s)

Here are the topics covered and their approximate importance on the test:

1. RADIATION FUNDAMENTALS (15%)

1.1 Radiation and Radioactivity, Radioactive Decay
1.2 Radiation Units, Sources of Radiation, Interaction with Matter, Radon

2. REGULATIONS (20%)

2.1 Radiation Protection Standards, 10 CFR Part 19, 20
2.2 Licensing Regulations, 10 CFR Part 2, 30, 31, & 33
2.3 Sealed Sources and Industrial Gauges
2.4 Security of Radioactive Sources and Increased Controls

3. RADIATION PROTECTION (20%)

3.1 External Radiation Protection and Shielding
3.2 X-Ray Safety
3.3 Internal Radiation Protection
3.4 Radiation Health Effects and Risks

4. RADIATION INSTRUMENTATION AND SURVEYS (20%)

4.1 Radiation Survey Instruments
4.2 Radiation Safety Surveys
4.3 Instruments Lab, Applications, Troubleshooting
4.4 Laboratory Survey and Personnel Protective Equipment
4.5 Interpreting Radiation Measurements and Quality Assurance

5. TRANSPORTATION OF RADIOACTIVE MATERIALS AND WASTE MANAGEMENT (10%)

5.1 Transportation of Radioactive Materials and Package Receiving
5.2 Radioactive Waste Management, Mixed Wastes

6. RADIATION PROGRAM MANAGEMENT (15%)

6.1 Developing a Training Program
6.2 Practical Record-Keeping for RSOs
6.3 Radiation Safety Program Management, Preparing for Regulatory Inspections
6.4 Emergency Response
6.5 First Steps for New RSOs

SAMPLE QUESTIONS

1. You have 50 mCi of P-32 (half-life 14.3 days) and are ready to dispose of the remaining material. What amount of P-32 is present after 35 days if the vial has not been opened?

   A. 9.16 mCi
   B. 18.3 mCi
   C. 9.16 µCi
   D. 18.3 µCi

2. All of the following are modes of energy loss for beta particles EXCEPT

   A. annihilation
   B. excitation
   C. ionization
   D. pair production

3. The current Nuclear Regulatory Commission (NRC) regulation for occupational exposures state that persons under 18 years old may receive

   A. 100 mrem/year
   B. 5000 mrem/year
   C. one-tenth of the maximum permissible adult occupational dose limit
   D. one-half of the maximum permissible adult occupational dose limit

4. Containers of radioactive material must be labeled with which of the following information?

   A. Radionuclide(s) present, quantity, or radiation levels
   B. Instructions for handling the radioactive material
   C. Personnel authorized to use the material
   D. Instructions for decontamination procedures to follow if spilled

5. Which of the following is required for all three types of Broad Scope licenses?

   A. Establishing administrative controls over operations that involve radioactive material
   B. Naming all Authorized Users on the license
   C. Listing radioactive materials that are under the direct control of the Radiation Safety Officer
   D. Monitoring of the radiation safety program by the Radiation Safety Committee

6. For a gauge that contains radioactive materials requiring a Specific License, who is required to be included on the applicable license?

   A. Manufacturer
   B. User
   C. Manufacturer, RSO, Authorized Users
   D. Anyone who works near the device/gauge

7. What is the best recommended shielding for mixed beta and gamma emitters?

   A. Thick lead
   B. Concrete
   C. Plexiglas with lead or other high z material
   D. Aluminum foil with lead or other high z material

8. Shielding against beta radiation may be complicated because

   A. beta radiation usually cannot be completely absorbed
   B. deceleration of beta particles produces neutrons
   C. beta particles are scattered by shields
   D. deceleration of beta particles produces more penetrating x-rays

9. Which of the following is a factor in x-ray production?

   A. High voltage electrons from an anode
   B. Electrons striking a cathode, such as tungsten
   C. Electrons slowing down when they strike a target and convert to x-rays
   D. Gamma rays, which typically have energy levels less than 10 KeV

10. Some organs exhibit a threshold response to radiation effects, which is called a(n)

   A. stochastic effect
   B. non-stochastic effect
   C. genetic effect
   D. acute effect

11. Which of the following instruments would be best for quickly locating a source that contains I-125 (X-ray energies 27 to 35 keV)?

   A. Pressurized ion chamber
   B. Survey meter with a sodium iodide (NaI) detector containing a 1 mm thick crystal
   C. Survey meter with a pancake G-M probe containing a 1.7 mg/cm^2 mica window
   D. Survey meter with a ZnS probe

12. Removable radioactive contamination can be described as material which

   A. has activity that is below 2,000 dpm
   B. presents no hazard when personal protective clothing is removed
   C. can be easily decontaminated from exposed surfaces
   D. can be transferred from one location to another

13. Which type of meter is best for detecting high energy β?

   A. G-M detector
   B. Nal detector
   C. Open window gas-proportional counter
   D. ZnS scintillation detector

14. Which of the following personal protective clothing should be removed first to reduce the potential for personal contamination?

   A. Tape from pant legs and sleeves
   B. Coverall/lab coats
   C. Rubber boots
   D. Outer layer of double gloves

15. A minimum detectable activity (MDA) is the smallest activity capable of being detected at the 95% confidence level for a given sample. This allows 5% probability of making a Type 2 error. What is a Type 2 error?

A. Mistaking a low sample count as background
B. Mistaking the half-life to be an exact number for every atom in the sample
C. Making an incorrect assumption on the number of allowable standard deviations
D. Making an arithmetic error in the calculation

16. After dismantling a mixing tank, a level gauge (radioactive source) will be shipped back to the manufacturer. What is the best instrument to use to determine the transportation index for the package?

A. Any geiger counter with a pancake probe
B. A thin window NaI detector
C. An ion chamber which reads in mR/hr
D. A liquid scintillation counting unit calibrated to read in cpm per Bq

17. Which of the following defines low level radioactive waste?

A. Waste that emits low levels of ionizing radiation
B. Waste that contains less than 0.1 MBq/g of radioactive material
C. Waste that contains naturally-occurring or accelerator-produced radioactive material
D. Waste that contains source, special nuclear, or byproduct materials that are acceptable for disposal in a land disposal facility

18. Federal and State laws that govern training of workers in radioactive material license facilities generally require training for

A. all personnel who work in the vicinity of licensed materials
B. workers who are likely to receive more than 100 mrem of occupational dose
C. ancillary personnel
D. on-site contractors who are likely to receive more than 1 mrem of occupational dose

19. What signs and postings are mandatory in licensed facilities?

A. Safety posters. They generally contain all the information that is required.
B. NRC Form 3, procedures, where to find regulations and any violations must be posted conspicuously.
C. No specific postings are required, as long as workers have complete information in a format that is available to them.
D. Any of the relevant NRC forms, which can be customized in order to meet the specific needs of the facility, as long as they are posted conspicuously.

20. An EPA Action Level advises residential mitigation for radon levels that are higher than

A. 1 pCi/l
B. 4 pCi/l
C. 7 pCi/l
D. 10 pCi/l

ANSWERS TO SAMPLE QUESTIONS

1. (**A)** 2. (**D**) 3. (**C**) 4. (**A**) 5. (**A**) 6. (**C**) 7. (**C**) 8. (**D**) 9. (**C**) 10. (**B**)

11. (**B**) 12. (**D**) 13. (**A**) 14. (**D**) 15. (**A**) 16. (**C**) 17. (**D**) 18. (**B**) 19. (**B**) 20. (**B**)