National Registry of Radiation Protection Technologists
P.O. Box 3084, Westerly, RI 02891
NRRPT@NRRPT.org
(401) 637-4811 (ofc)
(401) 637-4822 (fax)

EXAMINATION PREPARATION GUIDE

Revised - September 25, 2020

Definition of a Radiation Protection Technologist

A **Radiation Protection Technologist** is a person engaged in providing radiation protection to the radiation worker, the general public, and the environment from the effects of ionizing radiation.

The **Radiation Protection Technologist** has a basic understanding of the natural laws of ionizing radiation, the mechanisms of radiation damage, methods of detection, and hazards assessment. The **Radiation Protection Technologists'** tasks are accomplished by providing supervisory, administrative, and/or physical controls, utilizing sound health physics principles in compliance with local and statutory requirements and accepted industry practices.

The **Radiation Protection Technologist** mitigates hazards associated with radioactive materials and ionizing radiation producing devices, always adhering to the "As Low As Reasonably Achievable" philosophy.

AN IMPORTANT MESSAGE TO CANDIDATES

This guide will help you prepare for the **National Registry of Radiation Protection Technologists (NRRPT)** examination. The guide, however will not be the key to a good grade on the examination. Successful candidates generally prepare for months prior to the test. They cover the fundamental and applied aspects of radiation protection through the use of textbooks and by joining study groups. The Board cautions against approaching the exam in a casual fashion.

We believe that all applicants declared eligible to take the examination, after careful review of credentials, have a good probability of passing. You can avoid the disappointment of poor performance by recognizing at the start that the exam will be an all encompassing, rigorous test of radiation protection knowledge. Your performance will, for the most part, depend on the thoroughness of your preparation.

Now that you are aware of the key to good performance on the examination, we wish you success in achieving Registration.

CONTENTS OF THE NRRPT EXAMINATION

The examination consists of 150 multiple choice questions from three general categories: Applied Radiation Protection, Detection and Measurement, and Fundamentals. Four hours are allowed for the exam. Past examinations are not released. Typical questions are included in this guide, however the candidate needs to be aware that these questions do not represent a typical mix of questions on an actual exam.

We believe that it is advantageous to develop a plan for preparation and to approach the exam in an organized manner. Some suggestions for taking the exam are listed below.

1. Budget your time so that you are answering approximately 40 questions/hour.

2. Start at the beginning of the exam and work through it in sequential order, answering questions you are sure of. Save the difficult ones for the end, making sure you don't get your answers out of sequence on the answer sheet.

3. Read each question and each answer carefully.

4. There is no penalty for wrong answers, so make sure you answer <u>every</u> question.

Further information about the **National Registry of Radiation Protection Technologists** Examination can be obtained from:

NRRPT
P.O. Box 3084
Westerly, RI 02891
(401) 637-4811
(401) 637-4822 (fax)
nrrpt@nrrpt.org (email)

TYPICAL EXAMINATION QUESTIONS

1. In general, the body cells most susceptible to damage by radiation are those found in:
   a. rigid or semi rigid tissues
   b. muscle tissues
   c. rapidly dividing tissues
   d. highly specialized tissues
   e. nerve tissues

2. In a picocurie of any radioactive substance, the disintegration rate is:
   a. 2.22 dpm
   b. 2.22 x 10 E 6 dpm
   c. 37,000,000 dpm
   d. 3.7 x 10 E 4 dps
   e. 3.7 x 10 E 10 dps

3. Which of the following radionuclides cannot be detected by gamma spectrometry pulse height analysis?
   a. Hydrogen-3
   b. Iodine-131
   c. Cerium-144
   d. Ruthenium-106
   e. Cesium-137

4. The elemental symbols for Boron, Beryllium, Cadmium, and Calcium are:
   a. Bo, B, Ca, C
   b. B, By, Cd, Ca
   c. Bo, Be, Cd, Ca
   d. B, Be, Cd, Ca
   e. B, Br, Ca, Cl

5. Which of the following radionuclides is most suited to in-vivo measurements?
   a. Hydrogen-3
   b. Carbon-14
   c. Strontium-90
   d. Iodine-131
   e. Plutonium-239

6. How long must a sample with a count rate of 300 cpm be counted to give a total count rate standard deviation of 1%?
   a. 3.5 min
   b. 17 min
   c. 30 min
   d. 33 min
   e. 65 min

7. At what radius would you post a radiation area around an 8 curie Cesium 137 (662 Kev photon energy and a photon yield of 0.85 photons/disintegration) point source?
   a. 10 feet
   b. 74 feet
   c. 145 feet
   d. 53 feet
   e. 101 feet

8. An air filter with a collection efficiency of 99.97% is being used in a decontamination effort. Calculate the decontamination factor for this filter.
   a. 9997
   b. 0.9997
   c. 3000
   d. 10,000
   e. 3333

9. During an emergency in a DOE regulated facility, with known or potential high radiation fields, exposure to personnel must be voluntary if it is anticipated that such exposure may exceed a whole body exposure of:
   a. 5 rem
   b. 10 rem
   c. 25 rem
   d. 75 rem
   e. 100 rem

10. A worker is to perform maintenance on a Reactor Coolant pump under the following radiological conditions; Dose rate on contact with the pump - 350 mrem/hr, Dose rate at 30 cm from the pump (working area dose rate) is 85 mrem/hr, and an airborne concentration of .45 DAC. She will spend a maximum of 14 hours in this area during the week. According to 10CFR20, how is this area to be posted?
    a. Danger High Radiation Area, Airborne Radioactivity Area
    b. Caution Radiation Area, Airborne Radioactivity Area
    c. Caution High Radiation Area, Airborne Radioactivity Area
    d. Caution Airborne Radioactivity Area
    e. Caution Radiation Area

11. For an exclusive use vehicle that is transporting radioactive materials, radiation levels on contact with any external surface of the vehicle must not exceed:
    a. 0.01 mSv/hour
    b. 0.02 mSv/hour
    c. 0.1 mSv/hour
    d. 2.0 mSv/hour
    e. 10.00 mSv/hour

12. Two categories of ionization are:
    a. alpha and beta
    b. direct and indirect
    c. microwave and infrared
    d. charged and uncharged
    e. molecular and atomic

13. Intrinsic efficiency of a detector expresses the:
    a. probability that a count will be recorded if radiation enters the sensitive volume.
    b. ability of an instrument to count different energies.
    c. percent of gamma energy producing ion pairs.
    d. total detector counts minus the background.
    e. total beta/gamma counts by a tissue equivalent detector

14. The antiparticle of a positron is a:
    a. proton
    b. neutrino
    c. electron
    d. meson
    e. neutron

15. Forms of the same chemical element that contain different numbers of neutrons are called:
    a. isobars
    b. isomers
    c. radionuclides
    d. isotones
    e. isotopes

16. An atom of a radionuclide that has a low neutron to proton ratio, and an atomic rest mass energy that is 1.02 Mev greater than the product atom's rest mass energy may decay by which of the following?
    a. Either positron emission or electron capture
    b. Annihilation
    c. Beta minus emission
    d. Isomeric transition
    e. Internal conversion

17. Which radioactive decay series includes Ra-226 as one of its decay products?
    a. Thorium
    b. Uranium
    c. Actinium
    d. Neptunium
    e. Polonium

18. An individual who receives an acute, whole body (DDE) radiation exposure of approximately 8Gy will likely suffer symptoms of up to which level of the Acute Radiation Syndrome?
    a. Subclinical
    b. Hemopoietic
    c. Gastrointestinal
    d. Central Nervous System
    e. Not enough exposure to classify

19. The term "isokinetic sampling" refers to the procedure of using sampling velocity that is exactly equal to the:
    a. velocity of the gas stream at the point of sampling
    b. velocity at the center of the main gas stream corrected for temperature and pressure
    c. velocity at the center of the main gas stream
    d. velocity of the gas stream adjacent to the duct wall
    e. average velocity of the main gas stream

20. In which of the following radioactive decays will the daughter product be an isobar of the parent?
    a. alpha decay
    b. gamma decay
    c. neutron decay (elastic scatter)
    d. positron decay
    e. neutron decay (inelastic scatter)

21. The respiratory protection device of choice for entry into an atmosphere immediately dangerous to life and health is a (an):
    a. supplied air hood
    b. air-purifying respirator equipped with a high efficiency filter
    c. air-purifying respirator, full face piece, equipped with organic vapor canister
    d. self-contained breathing apparatus equipped with a pressure demand regulator
    e. self-contained breathing apparatus equipped with a demand type regulator

22. The average distance of travel in a medium between interactions, describes a photon's:
    a. mass energy absorption coefficient
    b. mean free path
    c. linear attenuation coefficient
    d. Compton cross section
    e. linear energy transfer

23. The Bragg-Gray principal is based upon the relationship of:
    a. secondary charged particle equilibrium requirements and the thickness of the wall material of the chamber.
    b. ionization in an air-filled ionization chamber to the dose in air
    c. ionization of the gas in an ionization chamber to the dose in the wall material
    d. ionization in a gas-filled ionization chamber to the dose in the gas
    e. scatter of low energy photons to the probability of ionization in the chamber

24. Given a gamma-energy value of 0.662 Mev, and a photon yield of 0.85 per decay, the exposure rate at 2 yards from an unshielded 10 mCi Cs-137 point source is:
    a. 1.10 R/hour
    b. 0.55 R/hour
    c. 5.50 R/hour
    d. 0.55 mR/hour
    e. 0.94 mR/hour

25. A radionuclide has a decay constant of 0.1314 years, a gamma energy (per disintigration) of 2.50 Mev, and will produce a dose rate of approximately 30 R/hour at one foot from a 2 Curie source. Calculate the radiological half life of this nuclide:
    a. 5.27 years
    b. 229 years
    c. 3.93 years
    d. 30.1 years
    e. 0.0231 years

ANSWERS TO EXAMPLE QUESTIONS

1. - c	6. - d	11. - d	16. - a	21. - d
2. - a	7. - b	12. - b	17. - b	22. - b
3. - a	8. - e	13. - a	18. - c	23. - c
4. - d	9. - a	14. - c	19. - a	24. - e
5. - d	10. - e	15. - e	20. - d	25. - a

SUGGESTED OUTLINE OF STUDY

The three domains previously noted were identified from a role delineation/task analysis conducted by the **NRRPT** Board and Panel. As the domains may share common "required knowledge", a general outline has been developed to assist candidates in preparation for the exam. A list of suggested study material is also attached.

Applied Radiation Protection

- Surveys and Inspections
- Emergency Preparedness
- Evaluating Internal and External Exposures and Controls
- Prescribed Dosimetry and Radiation Equipment
- Contamination Control
- Radioactive Material Control and Transportation
- Guides and Regulations
- Procedures and Programs (ALARA)

Detection and Measurement

- Analytical Methods
- Instrument Calibration and Maintenance
- Personnel Dosimetry
- Equipment Operation

Fundamentals

- Sources of Radiation
- Biological Effects
- Mathematics
- Chemistry
- Physics
- Units and Terminology

SUGGESTED STUDY MATERIAL

Cember, H. 1996. "Introduction to Health Physics," 3rd edition. McGraw-Hill

Gollnick, D. 2011. "Basic Radiation Protection Technology," 6th edition. Pacific Radiation Corp., 2945 Stonehill Dr., Altadena, CA 91001

Johnson, T. 2020. "Radiation Protection: The Essential Guide for Technologies, 1st edition, Pastime Publication.

Moe, H., et al. 1988. Department of Energy Operational Health Physics Training." National Technical Information Service, Oak Ridge, TN, ANL-88-26.

US Department of Health, Education and Welfare. 1970. "Radiological Health Handbook." US Government Printing Office.

Turner, J E. 1995. "Atoms, Radiation, and Radiation Protection," 2nd edition. John Wiley & Sons, Inc.

Shleien, B. (revised by). 1992. "The Health Physics and Radiological Health Handbook," revised edition. Scinta, Inc., 2421 Homestead Dr., Silver Spring MD 20902.

Waite, D. and J. Mayberry. 2002. "Problem Solving in Preparation for the **NRRPT** Exam," 1st edition. **NRRPT**, P.O. Box 6974, Kennewick, WA 99336.

Walker, Parrington and Feiner (revised by). 1989. "Nuclides and Isotopes," 14th edition. General Electric Company, 175 Curtner Ave, M/C 397, San Jose, CA 95125.

The most recent revisions of:
10 CFR 19, "Notices, Instructions and Reports to Workers; Inspections."

10 CFR 20, "Standards for Protection Against Radiation."

10 CFR 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material."

10 CFR 34, "Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations."

10 CFR 35, "Medical Use of Byproduct Material."

10 CFR 835, "Occupational Radiation Protection," Department of Energy

49 CFR 100-199, "Transportation."

NOTE: This is not a complete list of all reference materials for all questions in the NRRPT exam bank. It is a list of readily available material commonly used by many successful exam applicants to prepare for the exam.