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# Radiation Safety: Physical Aspect

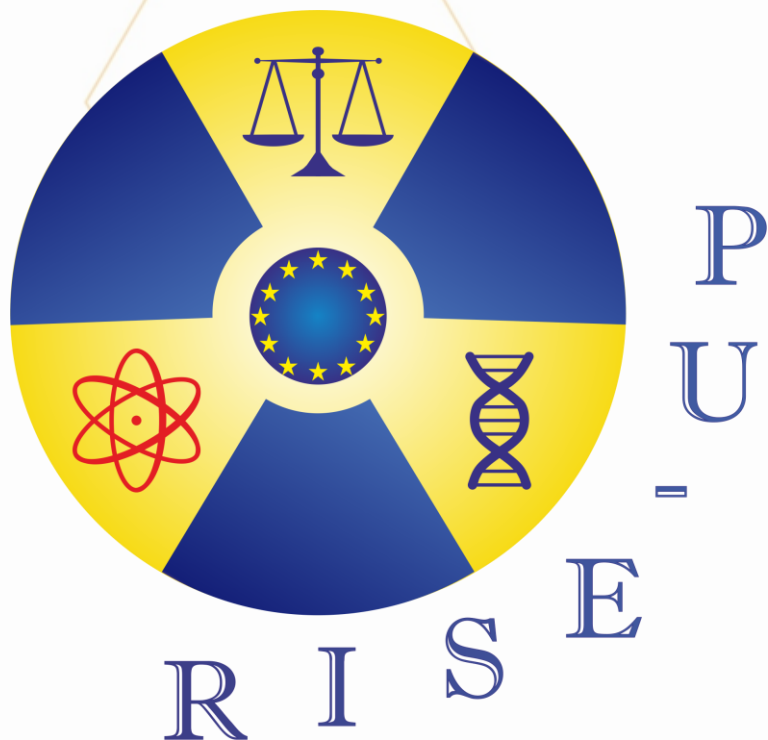
Manual for training

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2023-2026





### Radiation Safety: Physical Aspect

As a result of mastering the **lecture course**, students will gain competences:

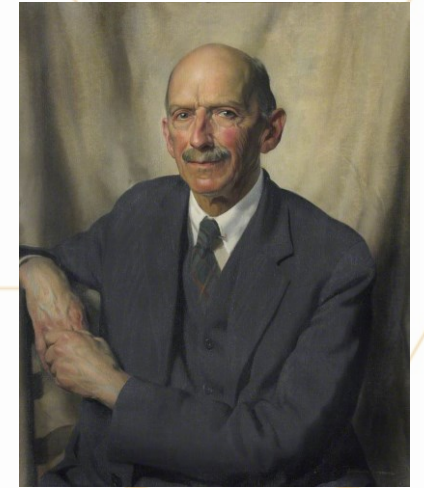
- **Instrumental competences:** basic general knowledge; ability to use knowledge in practice; information management skills (the ability to find and analyze information from various sources); problem solving.
- **Interpersonal competences:** the ability to criticize; self-criticism; ethical obligations.
- **System competences:** ability to learn; ability to generate new ideas (creativity); ability to work independently.

As a result of the **training**, students will gain competences:

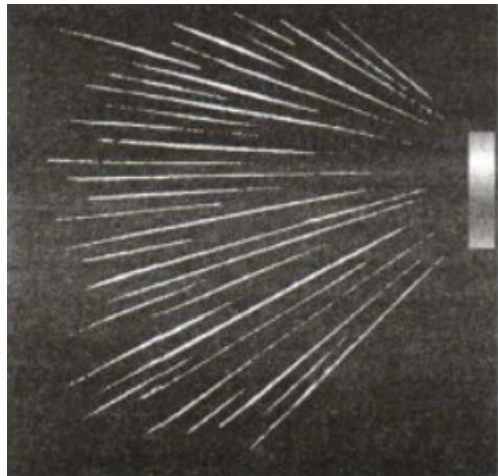
- **Instrumental competences:** ability to analyze and synthesize; ability to organize activities and manage time; ability to use knowledge in practice;
- **Interpersonal competences:** interaction (teamwork); ability to work in an interdisciplinary team; ability to communicate with experts from other fields; ability to work in an international environment; ethical obligations.
- **System competences:** research skills and abilities; ability to generate new ideas (creativity); leadership skills; ability to work independently; planning and management of projects; environmental care.

**Charles Thomson Rees Wilson**, a Scottish scientist, discovered the cloud chamber, which later became named after him, with the first cloud chamber perfected in **1911**. The original chamber had the air in the sealed device saturated with water vapor. The air inside the chamber was expanded by adiabatic expansion. The water vapor and air then began to cool and condense.

The passage of an ionizing particle through the chamber causes the water vapor to condense on the ions it has contact with and thus the particle trail carried in the vapor cloud. Wilson and Arthur Compton **won the Nobel Prize in Physics in 1927 for their work on the cloud chamber**.



**Charles Thomson Rees Wilson**

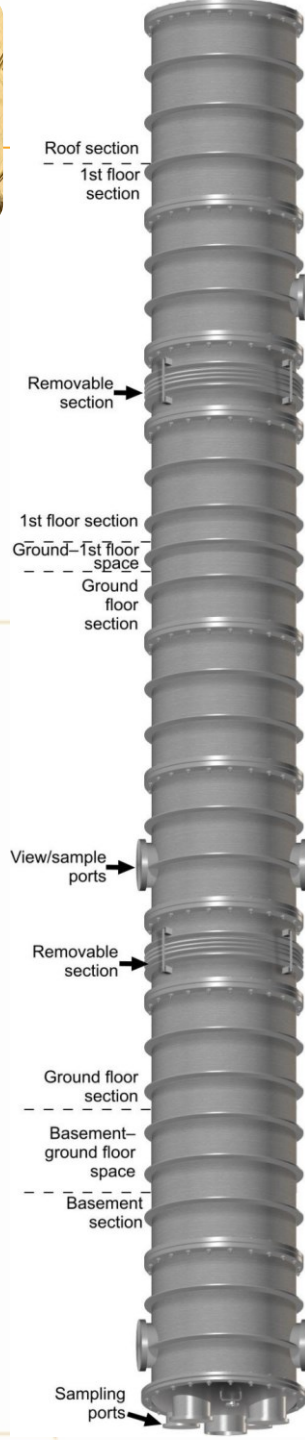


<https://artsandculture.google.com/story/the-cloud-chamber-see-the-invisible/dgVh31IaZkMGKg>



**Cloud chamber**





The new cold room facility in the Simon Building of The University of Manchester houses one of **the tallest cloud chambers in Europe at a height of 10 m**. The 1 m diameter fall tube spans 3 floors and can reach temperatures as low as  $-55^{\circ}\text{C}$ . The chamber can also be pressure sealed and evacuated to simulate conditions found in the upper troposphere. Liquid water, mixed phase, or entirely glaciated clouds can be generated in the chamber, with cloud liquid water contents ranging from zero to the highest values found in nature being reproducible.

Water clouds are typically generated in two main ways. Most commonly, a water boiler is situated at the base of the chamber and boils to produce a cloud of droplets. At sub-zero temperatures, these become supercooled. It is also possible to use atomizers to generate a cloud of water droplets. Alternatively, a high-power pump is used to rapidly evacuate the chamber, and the expansion of chamber air from ambient sources heterogeneously generates a cloud.

Ice clouds can be formed from clouds of supercooled liquid water droplets by either heterogeneously or homogeneously nucleating clouds. Homogeneous cloud nucleation when warmer than  $-40^{\circ}\text{C}$  is achieved using one of two methods. Traditionally, a liquid nitrogen-cooled rod ( $-200^{\circ}\text{C}$ ) is inserted into the cloud to cause nucleation. Alternatively, a compressor expansion technique is used in which a small volume of compressed air is adiabatically expanded to locally reduce air temperature below the homogeneous freezing temperature and force ice formation. The crystals generated then grow at the expense of the available water vapor and droplets. By varying the environmental chamber conditions and nucleation techniques, a range of habits, sizes, and number concentrations of ice crystals can be produced for experimental studies. The large height associated with the new chamber provides a longer crystal fall and growth time, and a new opportunity to grow particularly large, mm-sized, ice crystals in experiments.





- The Manchester Ice Cloud Chamber (MICC) is a fall tube 10 m tall and 1 m in diameter. It is one of the tallest such facilities in Europe.
- The chamber is located inside three cold rooms spanning three stories, and each can be independently set to reach temperatures as low as  $-55^{\circ}\text{C}$ .
- The 10 m high fall tube can be separated into three independent chambers for some experiments.
- The chamber can be sealed, and internal pressure reduced to 50 mbar to simulate upper tropospheric conditions.
- Port holes in the chamber walls allow instruments to be fed into the chamber at different heights and allow the clouds to be viewed from outside.
- A number of cloud measurement probes can be located at the base of the chamber and sample cloud as it falls through the many port holes.



## Visualizing traces of ionizing radiation using a homemade Wilson-like cloud chamber

E. Daubie, F. Defontaine, N. Demasy, S. Devouge

University of Mons, Service de Physique Nucléaire et Subnucléaire  
Av. Maistriau, 19, 7000, Mons, Belgium

The homemade cloud chamber is based on the diffusion-type cloud chamber. The components of the chamber include a rectangular aquarium-type glass container with optimal dimensions of  $23 \times 35 \times 17 \text{ cm}^3$ , a metal aluminum plate with dimensions slightly larger than the cross area of the container, and an insulating polystyrene box with dimensions slightly larger than the plate ones. In order to avoid light reverberations and to facilitate the visualization of the tracks, one side of the metal plate was covered with black adhesive tape. Finally, a 1 cm thick layer of felt was glued to the bottom of the container using "fix-all" type glue and self-adhesive ribbon tape was placed around the periphery of the container.

As a source of cold, dry ice was used, either from industrial carbon dioxide gas cylinders or in the form of dry ice cubes. The gas inside the chamber is a mixture of air and isopropyl alcohol vapor. The liquid isopropanol is of high purity (99.5%).

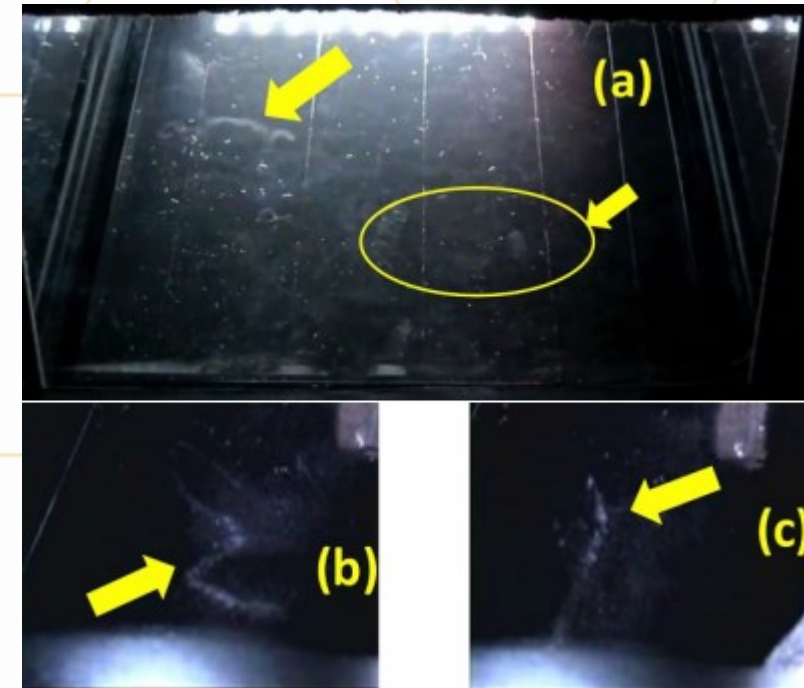
A temperature gradient of around  $80^\circ\text{C}$  ( $+20$  to  $-60^\circ\text{C}$ ) over 20 cm is sufficient.

## Radiation Safety: Physical Aspect. Self-made Cloud Chamber



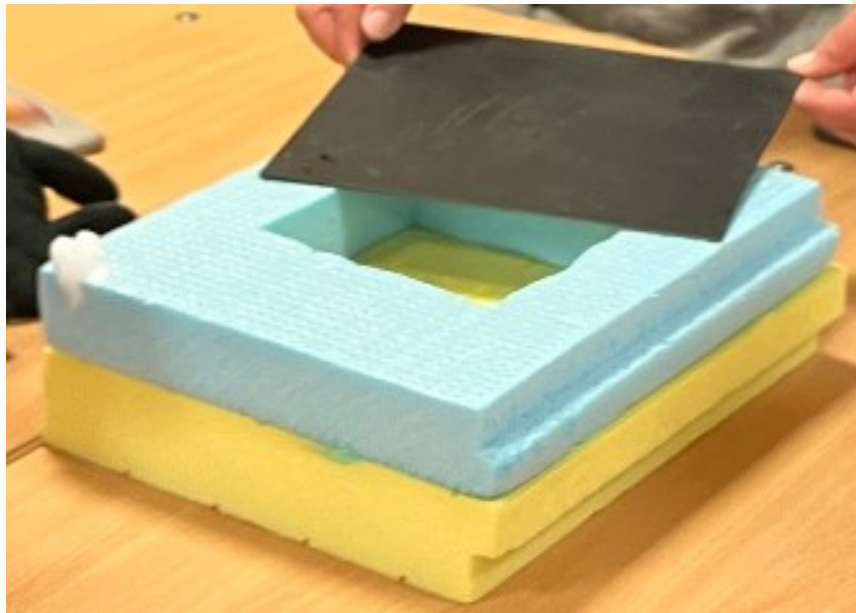
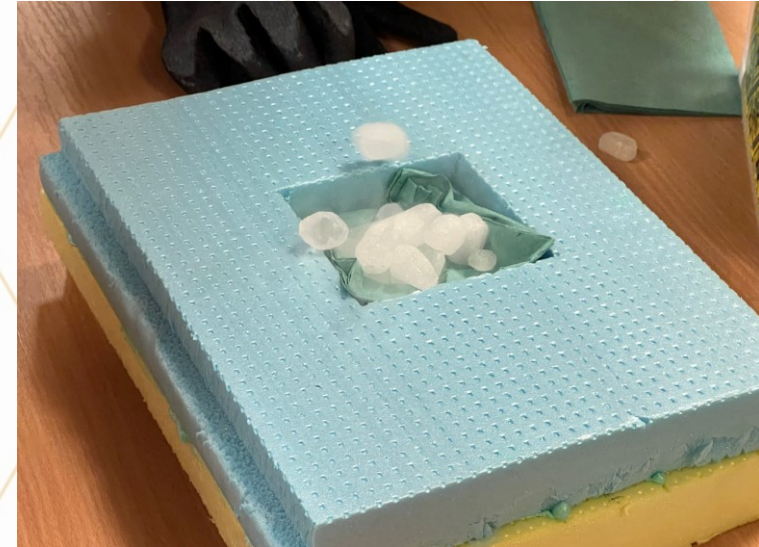
Glass container with the felt glued on the bottom and an auto-adhesive sealing joint all along the periphery; the sprayer containing liquid alcohol is seen on the left.

Trails of vapor observed with cosmic rays. (a) Curls of mist (b) Zig-zag shape due to multiple Coulomb scattering. (c) Kink due to an interaction with an atom of the sensitive medium or corresponding to a decay with a neutral particle emitted as well.



**Sequence of Execution**

1. Add dry ice to the heat-insulating material

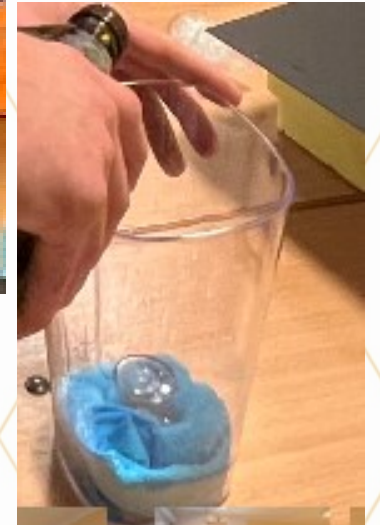


2. Cover with a plate painted in black



**Sequence of Execution**

3. Fix the fabric to the bottom of the vessel and add isopropyl alcohol

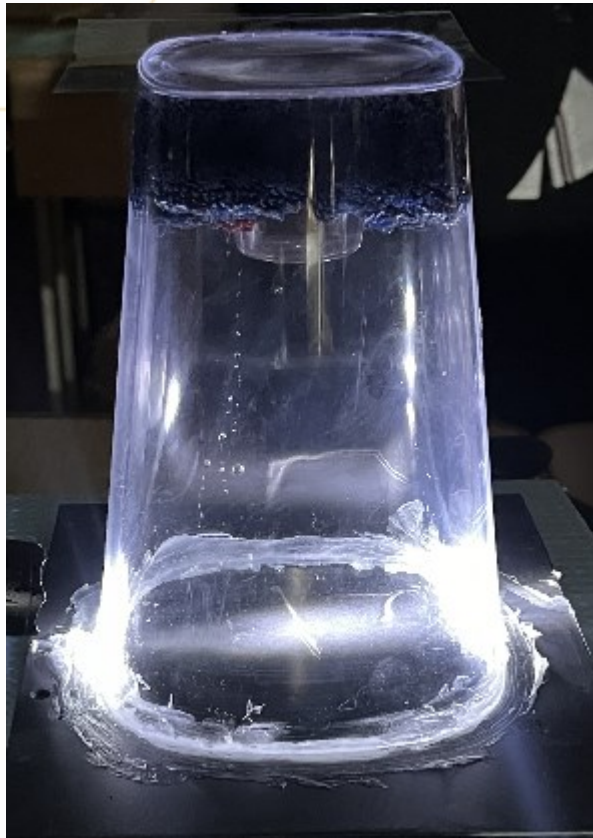


4. Glue the vessel to the plate with petroleum jelly



**Sequence of Execution**

5. After a certain time, a significant temperature gradient is established, supersaturated vapor of isopropyl alcohol is formed in the vessel



6. Illuminate with a narrow beam of light. Observe the tracks of ionization particles



**Seeing the Invisible – the Radiation Around Us**



<https://www.facebook.com/kmint.pnu/videos/923212412542354>





R I S E - P U

# Radiation Safety: Physical Aspect

Tests





## Radiation Safety: Physical Aspect. Tests

1. The spontaneous disintegration of unstable nuclei by the emission of particles is called
  - a) radioactivity
  - b) spontaneous combustion
  - c) chemical decomposition
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. 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
5. 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
6. 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
7. Nuclear bombs and atomic weapons utilize the principle of:
  - a) Nuclear fusion
  - b) Controlled nuclear fission
  - c) Uncontrolled nuclear fission
  - d) Chemical reactions
8. 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



## Radiation Safety: Physical Aspect. Tests

9. The major portion of an atom's mass consists of

- a) electrons and protons
- b) electrons and neutrons
- c) neutrons and positrons
- d) neutrons and protons

10. Which subatomic particle has no charge?

- a) Alpha particle
- b) Beta particle
- c) Neutron
- d) Electron

11. A student constructs a model for comparing the masses of subatomic particles. The student selects a small, metal sphere with a mass of 1 gram to represent an electron. A sphere with which mass would be most appropriate to represent a proton?

- a) 2 g
- b) 20 g
- c) 200 g
- d) 2000 g

12. Which statement concerning elements is true?

- a) Different elements must have different numbers of neutrons
- b) All atoms of a given element must have the same mass number
- c) All atoms of a given element must have the same atomic number
- d) Different elements must have different numbers of isotopes

13. Which two particles each have a mass approximately equal to one atomic mass unit?

- a) Electron and neutron
- b) Electron and positron
- c) Proton and electron
- d) Proton and neutron

14. Which conclusion was a direct result of the gold foil experiment?

- a) An atom is mostly empty space with a dense, positively charged nucleus
- b) An atom is composed of at least three types of subatomic particles
- c) An electron has a positive charge and is located inside the nucleus
- d) An electron has properties of both waves and particles

15. An experiment in which alpha particles were used to bombard thin sheets of gold foil led to the conclusion that an atom is composed mostly of

- a) empty space and has a small, negatively charged nucleus
- b) empty space and has a small, positively charged nucleus
- c) a large, dense, positively charged nucleus
- d) a large, dense, negatively charged nucleus

16. Experiments performed to reveal the structure of atoms led scientists to conclude that an atom's

- a) positive charge is evenly distributed throughout its volume
- b) negative charge is mainly concentrated in its nucleus
- c) mass is evenly distributed throughout its volume
- d) volume is mainly unoccupied



17. What is the term for the amount of time it takes for half of a radioactive isotope to decay?

- a) Critical mass
- b) Chain reaction
- c) Half-life
- d) Fission product

18. Which of the following atoms has the greatest nuclear charge?

- a) Carbon
- b) Nitrogen
- c) Hydrogen
- d) Lithium

19. Which statement about one atom of an element identifies the element?

- a) The atom has 1 proton
- b) The atom has 2 neutrons
- c) The sum of the number of protons and neutrons in the atom is 3
- d) The difference between the number of neutrons and protons in the atom is 1

20. Compared to a proton, an electron has

- a) greater quantity of charge and the same sign
- b) greater quantity of charge and the opposite sign
- c) the same quantity of charge and the same sign
- d) the same quantity of charge and the opposite sign

21. Every chlorine atom has

- a) 7 electrons
- b) 17 neutrons
- c) a mass number of 35
- d) an atomic number of 17

22. What can be determined if only the atomic number of an atom is known?

- a) The total number of neutrons in the atom, only
- b) The total number of protons in the atom, only
- c) The total number of protons and the total number of neutrons in the atom
- d) The total number of protons and the total number of electrons in the atom

23. What is the total number of neutrons in the nucleus of a neutral atom that has 19 electrons and a mass number of 39?

- a) 19
- b) 20
- c) 39
- d) 58

24. Nuclear fusion, a potential future energy source, involves:

- a) splitting atomic nuclei
- b) combining small nuclei to form larger ones
- c) converting chemical energy to electrical energy
- d) using solar panels to capture sunlight



25. The weighted average of the atomic masses of the naturally occurring isotopes of an element is the

- a) atomic mass of the element
- b) atomic number of the element
- c) mass number of each isotope
- d) formula mass of each isotope

26. An atom that contains 8 protons, 8 electrons, and 9 neutrons has

- a) an atomic number of 9
- b) an atomic number of 16
- c) a mass number of 17
- d) a mass number of 25

27. Compared to an atom of C-12, an atom of C-14 has a greater

- a) number of electrons
- b) number of protons
- c) atomic number
- d) mass number

28. Atoms of different isotopes of the same element differ in their total number of

- a) electrons
- b) neutrons
- c) protons
- d) valence electrons

29. What is the structure of a krypton-85 atom?

- a) 49 electrons, 49 protons, and 85 neutrons
- b) 49 electrons, 49 protons, and 49 neutrons
- c) 36 electrons, 36 protons, and 85 neutrons
- d) 36 electrons, 36 protons, and 49 neutrons

30. An atom of carbon-14 contains

- a) 8 protons, 6 neutrons, and 6 electrons
- b) 6 protons, 6 neutrons, and 8 electrons
- c) 6 protons, 8 neutrons, and 8 electrons
- d) 6 protons, 8 neutrons, and 6 electrons

31. What is the mass number of an atom that consists of 20 protons, 20 neutrons, and 18 electrons?

- a) 18
- b) 20
- c) 38
- d) 40

32. An alpha particle has

- a) 2 protons and 1 neutron
- b) 2 protons and 2 neutrons
- c) 1 proton and 2 neutrons
- d) 1 proton and 1 neutron



33. Fast moving electrons emitted by atomic nuclei are known as

- a) alpha particles
- b) beta particles
- c) gamma rays

34. When radioactive decay changes atoms of one chemical element into atoms of another element, the process is called

- a) nuclear explosions
- b) chemical decomposition
- c) transmutation

35. An alpha particle is a

- a) Be-4 nucleus
- b) He-4 nucleus
- c) C-12 nucleus

36. A thorium-232 atom undergoes alpha decay. What element will be the product of this process?

- a) radium
- b) uranium
- c) plutonium

37. An atom of H-3 undergoes beta decay. The element that will be produced is

- a) hydrogen
- b) helium
- c) lithium

38. The mass and charge of a gamma ray are

- a) mass = 1 and charge = 0
- b) mass = 0 and charge = 1
- c) mass = 0 and charge = 0

39. Alpha emission occurs in elements with an atomic number

- a) greater than 83
- b) less than 83
- c) exactly 83

40. Which of the following is an example of a natural radiation source?

- a) X-ray machine
- b) Nuclear power plant
- c) Sun
- d) Microwave oven

41. What is the primary source of natural background radiation on Earth?

- a) Cosmic rays
- b) Radon gas
- c) Medical procedures
- d) Nuclear accidents



42. Which of the following is an artificial radiation source commonly used in medical imaging?

- a) Uranium
- b) Radon gas
- c) CT scanner
- d) Granite countertops

43. What is the unit of measurement for radioactivity?

- a) Joules
- b) Watts
- c) Sievert
- d) Becquerel

44. Which of the following materials is commonly used as a shielding against gamma radiation?

- a) Lead
- b) Aluminum
- c) Plastic
- d) Wood

45. What is the main source of natural radiation exposure indoors?

- a) Building materials
- b) Radon gas
- c) Solar radiation
- d) Cosmic rays

46. Which of the following is an example of an artificial radiation source used in industrial applications?

- a) Carbon-14
- b) Cobalt-60
- c) Tritium
- d) Potassium-40

47. What is the primary source of background radiation for airline passengers?

- a) Cosmic rays
- b) Microwave ovens
- c) Radon gas
- d) Medical procedures

48. Which of the following is an example of a natural radioactive isotope found in the human body?

- a) Uranium-235
- b) Carbon-14
- c) Technetium-99m
- d) Iodine-131

49. Which type of radiation is most damaging to biological tissue when ingested or inhaled?

- a) Alpha
- b) Beta
- c) Gamma
- d) Neutron



50. What is the primary mechanism by which radon gas enters buildings?

- a) Through windows
- b) Through ventilation systems
- c) Seepage from underground
- d) Rainwater infiltration

51. What is the primary source of artificial radiation exposure to the general public?

- a) Medical imaging
- b) Nuclear accidents
- c) Consumer products
- d) Industrial activities

52. Which type of radiation is positively charged and consists of two protons and two neutrons?

- a) Alpha
- b) Beta
- c) Gamma
- d) X-ray

53. Which of the following materials is commonly used to shield against alpha radiation?

- a) Aluminum
- b) Lead
- c) Paper
- d) Plastic

54. Which of the following statements about background radiation is true?

- a) It is only present indoors
- b) It is always harmful to human health
- c) It is primarily due to human activities
- d) It is constantly present in the environment

55. Which type of radiation is emitted during nuclear fission reactions?

- a) Alpha
- b) Beta
- c) Gamma
- d) Neutron

56. Which of the following is NOT an example of artificial radiation exposure?

- a) Medical imaging
- b) Radon gas inhalation
- c) Nuclear power plant accidents
- d) Industrial radiography

57. What is the primary source of background radiation in high-altitude locations?

- a) Radon gas
- b) Cosmic rays
- c) Nuclear power plants
- d) Medical procedures



58. Which type of radiation has the lowest penetration power?
- Alpha
  - Beta
  - Gamma
  - Neutron
59. Which type of radiation has the highest penetration power?
- Alpha
  - Beta
  - Gamma
  - Neutron
60. Which of the following is a natural source of gamma radiation?
- Uranium-235
  - Radium-226
  - Tritium
  - Potassium-40
61. Which of the following statements about alpha radiation is true?
- It consists of high-energy photons
  - It can penetrate thick layers of shielding
  - It can be stopped by a sheet of paper
  - It is the most penetrating type of radiation
62. Which of the following materials is commonly used in personal radiation dosimeters?
- Lead
  - Aluminum
  - Lithium fluoride
  - Plastic
63. Which of the following is a natural source of beta radiation?
- Uranium-235
  - Radium-226
  - Carbon-14
  - Potassium-40
64. What is the primary source of background radiation in the ocean?
- Radon gas
  - Cosmic rays
  - Uranium deposits
  - Medical procedures
65. Which of the following is NOT a potential health effect of radiation exposure?
- Cancer
  - Genetic mutations
  - Enhanced immune function
  - Tissue damage



66. Which of the following is a natural source of neutron radiation?

- a) Uranium-235
- b) Radium-226
- c) Tritium
- d) Cosmic rays

67. The majority of radiation exposure for humans comes from

- a) medical procedures
- b) nuclear power plants
- c) natural sources
- d) industrial accidents

68. Isotopes of which element are commonly found in rocks and soil, contributing to natural background radiation?

- a) Hydrogen
- b) Carbon
- c) Uranium
- d) Helium

69. Radon gas, a natural radioactive element, is most concentrated in

- a) open fields
- b) well-ventilated buildings
- c) basements and crawl spaces
- d) high mountain ranges

70. The exposure to sunlight primarily involves which type of radiation?

- a) Alpha particles
- b) Ultraviolet radiation
- c) Gamma rays
- d) X-rays

71. What is the term for the spontaneous decay of an atomic nucleus, releasing energy and particles?

- a) Ionization
- b) Radioactivity
- c) Fission
- d) Half-life

72. Nuclear power plants generate electricity by utilizing the process of

- a) nuclear fusion
- b) chemical reactions
- c) nuclear fission
- d) burning fossil fuels

73. What is the main concern regarding the disposal of radioactive waste from nuclear power plants?

- a) Short half-life leading to quick decay
- b) Long half-life posing a threat for extended periods
- c) Easy biodegradability
- d) Safe absorption by the environment



74. The gold foil experiment led to the conclusion that each atom in the foil was composed mostly of empty space because most alpha particles directed at the foil

- a) passed through the foil
- b) remained trapped in the foil
- c) were deflected by the nuclei in gold atoms
- d) were deflected by the electrons in gold atoms

75. 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  $\mu$ Ci
- d) 18.3  $\mu$ Ci

76. 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<sup>2</sup> mica window
- d) Survey meter with a ZnS probe

77. What is the half-life of iodine-131?

- a) 8 days
- b) 30 years
- c) 50 days
- d) 5,730 years

78. Which component of television sets emits ionizing radiation?

- a) Cathode ray tube (CRT)
- b) Remote control
- c) LED screen
- d) Power cord

79. What is the primary mechanism of biologic action for ionizing radiation?

- a) Heating of tissues
- b) Direct DNA damage
- c) Activation of enzymes
- d) Alteration of cell membranes

80. Which radioactive isotope has a half-life of 28 years?

- a) Carbon-14
- b) Strontium-90
- c) Iodine-131
- d) Uranium-238



81. Which of the following is an example of non-ionizing radiation?

- a) X-rays
- b) Ultraviolet (UV) light
- c) Gamma rays
- d) Alpha particles

82. What is the primary purpose of radiation protection?

- a) To eliminate all sources of radiation
- b) To minimize radiation exposure to individuals and the environment
- c) To maximize radiation exposure for medical benefits
- d) To increase the use of radioactive materials

83. Which of the following organizations establishes radiation protection guidelines and standards internationally?

- a) Environmental Protection Agency (EPA)
- b) International Atomic Energy Agency (IAEA)
- c) Food and Drug Administration (FDA)
- d) Centers for Disease Control and Prevention (CDC)

84. Which of the following is a principle of radiation protection?

- a) Increase radiation exposure whenever possible
- b) Use shielding to reduce radiation exposure
- c) Minimize distance from radiation sources
- d) Ignore radiation monitoring devices

85. What is the recommended annual dose limit for occupational radiation workers, as per international standards?

- a) 1 mSv
- b) 5 mSv
- c) 50 mSv
- d) 100 mSv

86. Which of the following types of radiation monitoring devices is commonly worn by radiation workers for personal exposure monitoring?

- a) Geiger counter
- b) Dosimeter
- c) Scintillation detector
- d) Ionization chamber

87. What is the concept of ALARA in radiation protection?

- a) Acute Long-term Absorption Reduction Approach
- b) As Low As Reasonably Achievable
- c) All Levels of Activity Reduction Approach
- d) Annual Limit of Accumulated Radiation Allowance

88. Which of the following is NOT a common shielding material used for radiation protection?

- a) Lead
- b) Aluminum
- c) Concrete
- d) Water



89. What is the primary purpose of a lead apron in radiation protection?

- a) To shield against gamma radiation
- b) To shield against alpha radiation
- c) To shield against beta radiation
- d) To shield against neutron radiation

90. Which of the following factors affects the effectiveness of radiation shielding?

- a) Thickness of the shielding material
- b) Color of the shielding material
- c) Temperature of the shielding material
- d) Texture of the shielding material

91. Which of the following is a common practice to reduce radiation exposure during medical imaging procedures?

- a) Increasing the radiation dose to improve image quality
- b) Using lead shielding devices
- c) Ignoring safety protocols
- d) Performing procedures without protective clothing

92. What is the primary function of radiation monitoring and surveillance programs?

- a) To increase radiation exposure
- b) To ignore radiation hazards
- c) To track and control radiation exposure
- d) To encourage radiation exposure

93. Which of the following is a common principle of radiation protection in the workplace?

- a) Encourage unnecessary exposure
- b) Minimize distance from radiation sources
- c) Disregard safety protocols
- d) Maximize radiation exposure

94. What is the recommended annual dose limit for the general public, as per international standards?

- a) 1 mSv
- b) 5 mSv
- c) 50 mSv
- d) 100 mSv

95. The three main principles of radiation protection are

- a) minimize exposure, optimize benefit, public communication
- b) time, distance, shielding, decontamination
- c) containment, control, contamination prevention
- d) detection, monitoring, education

96. Dosimeters are used to

- a) generate radiation
- b) measure radiation exposure
- c) shield against radiation
- d) decontaminate radioactive materials



97. What type of personal protective equipment (PPE) is most effective against beta particles?

- a) Lead apron
- b) Goggles
- c) Respirator
- d) Thick gloves

98. Decontamination refers to the process of

- a) shielding against radiation
- b) removing radioactive material from surfaces or objects
- c) monitoring radiation exposure levels
- d) disposing of radioactive waste

99. Bioaccumulation of radioactive materials can occur when

- a) organisms take in more radioactive material than they can eliminate
- b) radiation exposure levels decrease over time
- c) radioactive waste is stored in secure facilities
- d) shielding materials are used effectively

100. What unit is commonly used to measure radiation dose received by individuals?

- a) Gray (Gy)
- b) Sievert (Sv)
- c) Becquerel (Bq)
- d) Curie (Ci)

101. Which of the following practices contributes to radiation safety in medical imaging?

- a) Using the highest possible radiation dose for better image quality
- b) Repeating X-ray exams unnecessarily
- c) Adjusting exposure factors based on patient size and anatomy
- d) Ignoring patient positioning guidelines

102. What is the recommended annual dose limit for occupational exposure to ionizing radiation for radiation workers?

- a) 1 mSv
- b) 20 mSv
- c) 50 mSv
- d) 100 mSv





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## Radiation Safety: Physical Aspect

Manual for training

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