

UNIT 7:NUCLEAR PHYSICS WORKSHEET 1

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1. Which one of the following statement is not true in an α scattering experiment
   A. Only a few α particles had shown maximum scattered which was unexpected
   B. α scattering experiments lead to a discovery of nucleons
   C. This experiment suggest that all the charges were concentrated at the center of an atom
   D. By tracing the trajectory of scatted α particles we had estimated effective charge radius of an atom
2. What are the limitations of Rutherford's model of an atom?
   A. Most of the mass of an atom is at center
   B. The nucleus is at the center of an atom
   C. The electron revolving nucleus loses energy and fall
   D. Most of the space in an atom is empty
3. Rutherford scattering experiment is based on:
   A. Alpha particle scattering from gold foil
   B. Beta particle scattering from gold foil
   C. Beta particle scattering from Zn foil
   D. Gamma rays from aluminium foil
4. Which of the following statements is incorrect?
   A. Mass defect is the amount of matter that would be converted into energy if a nucleus were formed from initially separated protons and neutrons.
   B. Nuclear binding energy is the energy released in the formation of an atom from subatomic particles.
   C. Nuclei with highest binding energies are the most stable nuclei.
   D. Einstein postulated the Theory of Relativity in which he stated that matter and energy are equivalent.
   E. Mass number is the sum of all protons and electrons in an atom.
5. Emission of which one of the following leaves both atomic number and mass number unchanged?
   A. Positron B. Neutron C. Alpha particle D. gamma radiation E. Beta particle
6. Which of the following describes what occurs in the fission process?
   A. A heavy nucleus is fragmented into lighter ones.
   B. A neutron is split into a neutron and proton.
   C. Two light nuclei are combined into a heavier one.
   D. A proton is split into three quarks.
   E. A particle and anti-particle appear in an area of high energy density.
7. Which of the following statements about nuclear fission is always correct?
   A. Very little energy is released in fission processes.
   B. Nuclear fission is an energetically favorable process for heavy atoms.
   C. Due to its instability, ^{56}Fe readily undergoes fission.
   D. In fission reactions, a neutron is split into a proton and an electron.
   E. All nuclear fission reactions are spontaneous.
8. Hydrogen bomb is based on which of the following phenomenon?
   A. Nuclear fission B. Nuclear fusion C. Radioactive decay D. Nuclear explosion
9. The example of nuclear fusion is
   A. Formation of barium and krypton from uranium
   B. Formation of helium from hydrogen
   C. Formation of plutonium 235 from uranium 235
   D. Formation of water from hydrogen and oxygen
10. The formation of uranium-236 from plutonium-240 occurs by :
    A. Neutron decay B. Beta decay C. Proton decay D. Alpha decay
11. ___ is the phenomenon of splitting up of a heavy nucleus, on bombardment with slow speed neutrons, into fragments of comparable mass, with the releasing of a large amount of energy.
    A. Nuclear fission B. Nuclear fusion C. Thermal fusion D. Radiation
12. The radius of the two nucleus are in the ratio of 1:2, then the ratio of their mass numbers is:
    A. $\frac{1}{6}$ B. $\frac{1}{8}$ C. $\frac{1}{4}$ D. $\frac{1}{16}$

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13. The ratio of the nuclear radii of elements with mass numbers 216 and 125 is

A. $\frac{6}{5}$ B. $\frac{\sqrt{216}}{\sqrt{125}}$ C. $\frac{216}{125}$ D. $\frac{16}{1}$

14. Which of the following statements is incorrect?

A. Mass defect is the amount of matter that would be converted into energy if a nucleus were formed from initially separated protons and neutrons.
B. Nuclear binding energy is the energy released in the formation of an atom from subatomic particles.
C. Nuclei with highest binding energies are the most stable nuclei.
D. Mass number is the sum of all protons and electrons in an atom.

15. Emission of which one of the following leaves both atomic number and mass number unchanged?

A. Beta decay B. Gamma decay C. Alpha decay D. Neutron radiation

16. The mass defect for an isotope was found to be 0.410 amu/atom. Calculate the binding energy in kJ/mol of atoms.

A. $3.69x10^{10}\ \frac{kJ}{mol}$ B. $3.69x10^{13}\ \frac{kJ}{mol}$ C. $1.23x10^{20}\ \frac{kJ}{mol}$ D. $1.23x10^{3}\ \frac{kJ}{mol}$

17. What is the primary use of technetium-99m in medical imaging?

A. To treat cancer
B. To diagnose heart disease
C. To diagnose bone fractures
D. To sterilize surgical instruments

18. Calculate the binding energy per nucleon (in units of MeV) for9Be, for ${}^{9}_{4}Be$ for which the atomic mass is 9.01219 amu. Particle masses in amu are: proton = 1.007277; neutron = 1.008665; electron = 0.0005486. Conversion factor for $E = mc^2$ is 931 MeV/amu.

A. 6.33Mev B. 6.46Mev C. 6.23Mev D. 11.39Mev

19. A positron has a mass number, a charge, and a mass equal to that of a(an) _____ respectively.

A. 0, 1, proton B. 0, 1, electron C. 0, 2, proton D. 0, 2, electron

20. Which type of radiation is the least penetrating?

A. Beta B. Gamma C. Alpha D. X-ray

21. The half-life of ${}^{131}_{91}Pa$ is $3.25x10^{4}$ years. How much of an initial 10.4 microgram sample remains after $3.25x10^{5}$ years.

A. 0.240 microgram B. 0.0240 microgram C. 0.0102 microgram D. 0.218 microgram

22. Carbon -11 is a radioactive isotope of carbon. Its half-life is 20 minutes. What fraction of the initial number of Carbon -11 atoms in a sample will have decayed away after 80 minutes?

A. $\frac{1}{16}$ B. $\frac{1}{8}$ C. $\frac{1}{4}$ D. $\frac{15}{16}$

23. A Geiger-Muller tube is a _____.

A. Gas ionization detector B. Fluorescence detector C. Cloud chamber D. Spectrophotometer

24. Which of the following describes what occurs in the fission process?

A. A heavy nucleus is fragmented into lighter ones.
B. A neutron is split into a neutron and proton.
C. Two light nuclei are combined into a heavier one.
D. A proton is split into three quarks

25. Which one of the following would be most likely to undergo thermonuclear fusion?

A. ${}^{2}_{1}H$ B. ${}^{4}_{2}He$ C. ${}^{56}_{26}Fe$ D. ${}^{141}_{56}Ba$

26. When ${}^{235}_{92}U$ is bombarded with one neutron, fission occurs and the products are three neutrons, ${}^{94}_{36}Kr$, and _____.

A. ${}^{139}_{56}Ba$ B. ${}^{141}_{56}Ba$ C. ${}^{139}_{58}Ce$ D. ${}^{139}_{54}Xe$

27. Beta radiation is

A. Transmutation of a neutron into a proton and electron. The electron is emitted.
B. Transmutation of a neutron into a proton and electron. The proton is emitted.
C. Transmutation of a proton into a neutron and electron. The electron is emitted.
D. Transmutation of a proton into a neutron and electron. The proton is emitted.

28. The atomic number decreases by two during what type of radiation?

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A. Beta decay B. Gamma decay C. Alpha decay D. Neutron radiation

29. The source of energy produced by the sun is the
    A. burning of fossil fuel B. fission of uranium C. fusion of hydrogen D. fission of hydrogen
30. What was the first particle discovered inside an atom?
    A. Proton B. Neutron C. Electron D. Nucleus
31. The gold foil experiment _____.
    A. Confirmed the plum-pudding model of the atom
    B. Led to the discovery of the atomic nucleus
    C. Was the basis for Thomson's model of the atom
    D. Utilized the deflection of beta particles by gold foil
32. What happens to the mass number and the atomic number of an element when it emits alpha radiation?
    A. The mass number remains unchanged while the atomic number decreases by one.
    B. The mass number decreases by four and the atomic number decreases by two.
    C. The mass number increases by four and the atomic number increases by two.
    D. The mass number remains unchanged while the atomic number increases by one.
33. The half-life of radium-224 is 3.5 days. What fraction of the sample remains undecided after fourteen days? (If needed use $ln2 = -ln(\frac{1}{2}) = 0.693$) **(UEE:2006)**
    A. $\frac{1}{2}$ B. $\frac{1}{4}$ C. $\frac{1}{8}$ D. $\frac{1}{16}$
34. When the radioactive element $^{144}_{60}Nd$ decays to $^{140}_{58}Ce$, which none of the following particles is emitted? **(UEE :2007)**
    A. A beta particle B. An alpha particle C. A proton D. A gamma ray
35. Which statement is NOT correct about emissions from radioactive isotopes? **(UEE: 2008)**
    A. Alpha particles are positively charged and less penetrating than beta and gamma
    B. Beta particles are negatively charged and more penetrating than alpha particle.
    C. Alpha emissions are least influenced by magnetic field.
    D. The most penetrating emissions are gamma particles.
36. A common unit of energy in atomic physics is: **(UEE:2008)**
    A. Plank's constant. B. Electron volt C. De Broglie wave length D. uncertainty principle
37. The activity of radioactive substance reduces from 2000Bq to 1000Bq in 106 seconds. What is the decay constant? **(UEE:2009)**
    A. $6.93\ x\ 10^{5}\ \frac{decay}{s}$ B. $6.93\ x\ 10^{-7}\ \frac{decay}{s}$ C. $2\ x\ 10^{6}\ \frac{decay}{s}$. D. $5\ x\ 10^{-7}\ \frac{decay}{s}$
38. Which of the following has an electron volt unit **(UEE: 2010)**.
    A. Charge. B. Potential difference C. Energy D. Electromagnetic intensity
39. In Rutherford experiment, a beam of positively charged alpha particles was projected into a thin piece of gold foil. One of the observations of this experiment is that same charged particles deflected through a large angle (100 to 900) are those concentrated in one place. What conclusion can be drawn from this observation? **(UEE: 2010)**
    A. Most of the atom is empty space.
    B. All the atom is positive charge.
    C. Most of the mass and all positive charge is in tiny central nucleus.
    D. All the atom's negative charge.
40. Complete the following equation which represents a nuclear fission reaction. What is the particle represented by X? **(UEE: 2011)**

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{95}_{37}\mathrm{Rb} + {}^{139}_{55}\mathrm{Cs} + 2\mathrm{X} + \mathrm{Energy}$$

    A. Electron B. proton. C. neutron. D. alpha particle
41. The graph of nuclear binding energy per nucleon (BEN) versus mass number A has its peak near an atomic weight $A = 56$. Which of the following statement is **TRUE** about the graph? **(UEE: 2015)**

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A. For heavier nuclei ($A > 56$), the binding energy per nucleon decreases with the increase of mass number; implying that heavier atoms can increase their stability by increasing their photons's number.
B. For small atoms ($A < 56$), the binding energy per nucleon decreases with the increase of mass number; indicating that lighter atoms can increase stability through nuclear fission.
C. Uranium ($A = 56$), which has larger binding energy than iron ($A = 56$), is more stable than iron.
D. Nucleus with larger number of neutron is more stable than nucleus of the same atom with smaller number of neutron.

42. What is the primary application of nuclear medicine?
A. Energy production
B. Medical diagnosis and treatment
C. Chemical synthesis
D. Environmental protection

43. Which one of the following statement is not correct about activity (A)?
A. The shorter the half-life, the more decays per unit time, for a given number of nuclei.
B. The activity of a source to depend on the amount of the radioactive substance present, and its half-life.
C. The greater the number of radioactive nuclei present in the sample, the more will decay per unit of time.
D. Activity should be proportional to the number of radioactive nuclei (N) and directly proportional to their half-life

44. What was the fissionable material used in bomb dropped at Nagasaki of Japan in the year 1945
A. Uranium B. Beryllium C. Neptunium D. Plutonium

45. What fraction of radioactive sample has decayed after two half-lives have elapsed
A. $\frac{1}{2}$ B. $\frac{1}{8}$ C. $\frac{1}{4}$ D. $\frac{1}{16}$

46. Which one of the following is not a radioactive element?
A. Uranium B. Cadmium C. Thorium D. Radium

47. Which among the following is a radioactive element?
A. Sodium B. Calcium C. Magnesium D. Uranium

48. An unknown source of radiation is blocked by 5 mm of aluminium but not blocked by paper. What kind of radiation is present?
A. Alpha B. Beta C. X-ray D. Gamma

49. What is the absorbed dose of a 2 kg piece of tissue exposed to 500 mJ of energy?
A. 0.25 Gy B. 0.5 Gy C. 1 Gy D. 2 Gy

50. Which of the following is NOT an application of radioactivity and nuclear reactions?
A. Energy source of stars
B. Nuclear medicine
C. Radiation hazard awareness
D. Chemical bonding

51. A substance has a half-life of 60 seconds. How long will it take for its activity to decrease from 20 kBq to 2.5 kBq?
A. 120 seconds B. 180 seconds C. 240 seconds D. 450 seconds

52. A student in a classroom measures 450 counts on a Geiger-Muller tube in 5 minutes. What is the background radiation in the classroom?
A. 90 Bq B. 2250 Bq C. 1.5 Bq 3.8 Bq

53. What type of energy is released by the reactions inside a nuclear reactor?
A. Heat energy B. Light energy C. Electrical energy D. Chemical energy

54. What steps should be taken when dealing with radioactive sources?
A. Maintain a safe distance and store the material in an appropriate lead lined container
B. Wear appropriate footwear so that you don't slip
C. Make sure that you are wearing a hard hat at all times
D. Handled the source with bare hand

55. A Geiger Muller detector is not used to detect one of the following. Which one?
A. Alpha B. Beta C. Gamma D. Radio wave

56. The three best ways to protect yourself from radiation exposures are:
A. Meditate, focus, breathe
B. Paper, plastic, lead
C. Distance, ear-plugs, shielding
D. Time, distance, shielding

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57. One of the following actions not used to protect you from the internal radiation exposure. Which one?
    A. You should not eat and drink in the lab
    B. You should not store empty cups/containers/utensils in the lab or near radioactive materials
    C. You should not store food and/or drink in the lab
    D. You can store food and/or drink in the lab
58. Which of the following is a drawback of Rutherford's atomic model?
    A. It did not include neutrons
    B. It did not account for the existence of electrons
    C. It assumed atoms were indivisible
    D. It could not explain the stability of electrons in their orbits
59. What is the role of neutrons in the nucleus?
    A. They provide a positive charge to balance the electrons
    B. They mediate the electromagnetic force
    C. They contribute to the strong nuclear force and add to the mass of the nucleus
    D. They determine the chemical properties of the element
60. Which of the following best describes how PET (Positron Emission Tomography) scans work?
    A. They use X-rays to create images of the body's structures
    B. They detect gamma rays emitted by a radioactive tracer in the body
    C. C) They use magnetic fields to produce detailed images of the body
    D. D) They measure electrical activity in the brain
61. How does nuclear radiation help in archaeological dating?
    A. By providing energy for excavation tools
    B. By measuring the carbon-14 content in organic materials
    C. By illuminating ancient artifacts
    D. By imaging underground structure
62. How does brachytherapy utilize nuclear radiation for medical treatment?
    A. By using external beams of radiation
    B. By placing radioactive sources inside or near the tumor
    C. By ingesting radioactive pills
    D. By injecting radioactive tracers into the bloodstream

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