

Department of Applied Physics
Applied Physics
Question Bank
Session – 2012-13
UNIT – II - Nuclear Physics and Electron Ballistics

Multiple Choice Questions

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1. Beta ray emitted by radioactive substance is:
 - (i) An electromagnetic wave
 - (ii) An electron detached from an orbit outside the nucleus
 - (iii) An electron which was existing inside the nucleus
 - (iv) An electron emitted by the nucleus as a result of decay of a neutron inside the nucleus

2. The concept of spin is applied to
 - (i) only elementary particles with zero or non zero rest mass
 - (ii) only elementary particles with non zero rest mass
 - (iii) only elementary particles with zero rest mass
 - (iv) elementary particles with zero or non zero rest mass and also to any other body even to body like earth

3. In self sustained fission chain reaction in a reactor, which of the following statement is **FALSE?** (Where k represents reproduction constant.)
 - (i) k is just greater than 1 to compensate of loss of neutrons
 - (ii) $k \gg 1$ because of gain of neutron from surrounding
 - (iii) $k \gg 1$ because of the fast neutron generation
 - (iv) $k \ll 1$ (always)

4. In the Sun, at present most of the reactions are
 - (i) chemical
 - (ii) fission
 - (iii) fusion
 - (iv) none

5. The ratio of half life and the mean life (i.e.) is
 - (i) $(\ln 2)/2$
 - (ii) $\ln(1/2)$
 - (iii) $1/\ln 2$
 - (iv*) $\ln 2$

6. When α is emitted by an atom:
 - (i) its atomic weight increases by one unit.
 - (ii) its atomic weight decreases by one unit.
 - (iii) its atomic number decreases by one unit.
 - (iv) its atomic number increases by one unit.

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7. A particle with no charge is called
 - (i) a positron
 - (ii) an alpha particle
 - (iii) a beta-particle
 - (iv) a neutron

8. The function of moderator in a nuclear reactor is
 - (i) to slow down the neutrons
 - (ii) to absorb neutrons
 - (iii) to capture fission products
 - (iv) none

9. Dating of organic material using radioactive carbon assumes that the contents of in the atmosphere
 - (i) Remains constant in time
 - (ii) Keeps decreasing with time
 - (iii) Keeps increasing with time
 - (iv) None

10. The elementary particles electron, photon, and neutrino are (in the same order)
 - (i) boson, fermion, and fermion
 - (ii) fermion, fermion, and fermion
 - (iii) bosons, bosons, and bosons
 - (iv) fermion, boson, and fermion

11. Which of the following are different for a particle and its antiparticle?
 - (a) charge only
 - (b) Mass only
 - (c) Charge and mass
 - (d) mass and spin

12. Which conservation law is violated by particle-antiparticle annihilation
 - (a) conservation of energy
 - (b) Conservation of momentum
 - (c) conservation of charge
 - (d) None of these

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13. In case of cyclotron, what sort of particle collision would generate the maximum amount of heat?
- (a) Perfectly elastic
 - (b) Partially elastic
 - (c) Perfectly inelastic
 - (d) Partially inelastic
14. Particles which can be added to the nucleus of an atom without changing its chemical properties are called:
- (a) Electrons
 - (b) Protons
 - (c) Neutrons
 - (d) Photons
15. Electrons can be accelerated to very high energies by means of:
- (a) cyclotron
 - (b) Betatron
 - (c) Thyratron
 - (d) None of these
16. Radius R of a nucleus changes with the nucleon number A of the nucleus as:
- (a) $R=R_0A^{2/3}$ (meter)
 - (b) $R=R_0A^{1/3}$ (meter)
 - (c) $R=R_0A^{2/3}$ (meter)
 - (d) $R=R_0A$ (meter)
17. The nucleus radius is of the order of:
- (a) 10^{-10}m
 - (b) 10^{-6}m
 - (c) 10^{-12}m
 - (d) 10^{-14}m

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18. The process of fission is responsible for the release of energy:
- (a) From the Sun
 - (b) In hydrogen bomb
 - (c) In atom bomb
 - (d) In chemical reaction
19. Commonly used moderator in nuclear reactors is/are:
- (a) Heavy water
 - (b) Ordinary water
 - (c) Graphite
 - (d) all of these
20. Out of the following the one which is the best moderator in nuclear reactor is :
- (a) Ordinary water
 - (b) Heavy water
 - (c) Graphite
 - (d) Beryllium oxide
21. Control rods used in nuclear reactors is/are made of:
- (a) Plutonium
 - (b) Graphite
 - (c) Cadmium
 - (d) All of these
22. In atom bomb we use the process called:
- (a) Fission
 - (b) Fusion
 - (c) Ionization

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- (d) Electrolysis
23. The energy released per fission of a $^{235}_{92}\text{U}$ Nucleus is nearly:
- (a) 200eV
 - (b) 250eV
 - (c) 200MeV
 - (d) 2000eV
24. Fusion reaction is initiated with the help of:
- (a) Low temperature
 - (b) High temperature
 - (c) Neutrons
 - (d) Any particle
25. The radiant energy of the sun results from:
- (a) Nuclear fission
 - (b) Nuclear fusion
 - (c) Cosmic radiation
 - (d) Combustion

Short Answer Questions

1. What is a nuclear reaction?
2. Define Q-value of nuclear reaction.
3. What is chain reaction? Define controlled and uncontrolled chain reaction and give their examples.
4. What is nuclear fission? How much energy will release in the fission of 1 gm uranium.
5. What is nuclear fusion? Give C-N cycle for production of stellar energy.

Long Answer Questions

1. Describe controlled and uncontrolled chain reaction and criteria of critical mass.
2. What is nuclear reactor? Give the functioning of its each part with a well labeled diagram.
 3. Give the principle, construction and working of Aston's mass – spectrograph.
 4. Explain the construction and working of Bainbridge mass – spectrometer.

Numerical Problem

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1. An electron starts from rest and moves freely in an electric field of intensity 1500 V/m. Determine (i) force on electron (ii) acceleration of electron.
2. An electron with a velocity of 3×10^6 m/s enters into an electric field of 10^3 N/C. The field is parallel to the velocity of the electron and decelerates it. How far does the electron go before it is brought to a halt?
3. Calculate the time taken by an electron which has been accelerated through a potential difference of 1000Volts to traverse a distance of 2cm.
4. An electron with a velocity of 4.6×10^7 m/s enters a uniform magnetic field of induction 0.085 Tesla perpendicular to the field lines. Determine the Lorentz force acting on the electron and radius of the circle in which it moves.
5. What is the smallest magnetic field that can be set up at the equator to permit a proton of speed 10^7 m/s to circulate around the earth?
6. A cathode ray beam is bent in a circle of radius 2 cm by a uniform magnetic field of induction 4.5 mT. What is the speed of the electrons?
7. An electron is shot with speed 5×10^6 m/s into a magnetic field at 20° . If the strength of magnetic field is 2×10^{-3} T, describe the motion of the electron.
8. (a) A 2keV positron is projected into a uniform field of induction 0.10 Wb/m² with its velocity vector making an angle of 60° with magnetic induction. Find the period, the pitch and the radius of the helix.(b) If the angles is 240° . What changes in above parameters and in helical motion expected?
9. Determine the velocity of certain ions that pass undeflected through crossed E and B fields for which $E= 7.7$ kV/m and $B=0.14$ T.
10. In a Bainbridge mass spectrometer, the magnetic field in the velocity selector is 1.0 T and ions having a speed of 4×10^6 m/s pass through it undeflected.
 - (i) What should be the electric field between the plates?
 - (ii) If the separation of the plates is 0.5 cm, what is the potential difference between the plates?
11. The electric field between the plates of the velocity selector in a Bainbridge mass spectrometer is 1200 V/cm and the magnetic field in both regions is 0.6 T. A stream of singly charged neon ions moves in a circular path of 7.28 cm radius in the magnetic field. Determine the mass number of the neon isotope.