PHYSICS 2015

Time: 20 Minutes Max. Marks: 17

SECTION "A" (MULTIPLE CHOICE QUESTION)

1. Choose the correct answer for each from the given options:

(i) An instrument which can measure and compare potentials without drawing any current from the circuit is known as a/an: • Ammeter • Voltmeter • Potentiometer • AVO-meter

(ii) In Compton's scattering experiment, the scattered photon has a:
• frequency less than that of incident photon.
• frequency greater than that of incident photon.
• same frequency as that of incident photon.
• wavelength shorter than that of incident photon.

(iii) In Laser, the life time of an electron in a metastable state is: • 10^{-8} sec • 10^{-5} sec • 10^{-3} sec • 10^{8} sec

(iv) The product of decay constant (λ) and half life ($T_{\frac{1}{2}}$) of a radioactive source is:
• 0.369 • 0.396 • 0.693 • 0.963

(v) 1 MeV, is equal to: • 1.6×10^{-19} J • 1.6×10^{-13} J • 1.6×10^{-19} J • 1.6×10^{13} J

(vi) A small quantity of radioactive Iodine $_{53}I^{131}$ is taken in food, most of it is deposited in the:
• Thyroid glands • Bones • Brain • Stomach

(vii) The rate of flow of blood in the body can be traced by using this radioisotope:
• $_{20}Ca^{45}$ • $_{6}C^{12}$ • $_{1}H^{3}$ • $_{11}Na^{24}$

(viii) Balmer series is obtained when the transitions of electrons terminate on:
• 1st orbit • 2nd orbit • 3rd orbit • 4th orbit

(ix) The rest mass of a photon is:
• -1 • zero • 1 • infinite

(x) Kinetic energy per mole of an ideal gas is:
• $\frac{3}{2}KT$ • $\frac{2}{3}KT$ • $\frac{3}{2}RT$ • $\frac{2}{3}RT$

(xi) If the number of turns in a coil is doubled its self-inductance will become:
• halved • doubled • threefold • fourfold

(xii) Donor impurities are:
• Ge and Si • In and Ga • Sb and As • Li and Ga

(xiii) If the temperature of a cold body is decreased the efficiency of Carnot engine will:
• increase • decrease • remain constant • none of these

(xiv) Decreasing the separation between two identical charges by one-half causes the repulsive force to become: • one-fourth • half • double • fourfold

(xv) Resistors of 5Ω and 10Ω are connected in parallel. If the P.D. across 5Ω resistor is 6 volts, the P.D. across 10Ω resistor will be: • 3 volts • 6 volts • 9 volts • 12 volts

(xvi) A battery of e.m.f.(E) has an internal resistance (r). If a current (I) is drawn form it, then its terminal potential drop (V) is given by:
• V = E –Ir • V = E + Ir • V = IR • V = Er

(xvii) When an electron moves in a magnetic field (B) with a velocity (V), the magnetic force acting on it is perpendicular to: • $\vec{V}$ but not on $\vec{B}$ • $\vec{B}$ but not on $\vec{V}$ • neither $\vec{V}$ nor $\vec{B}$ • both $\vec{V}$ and $\vec{B}$

PHYSICS 2015

Time: 2 Hours 40 Minutes Marks: 68

SECTION 'B' (SHORT-ANSWER QUESTIONS)(40)

NOTE: Answer any 10 questions from this section.

2.(i) On the basis KMT of gases, show that $\frac{1}{2}mv^2 = \frac{3}{2}KT$.

(ii) Explain Electric flux. Under what condition is the flux through a surface (i) Zero (ii) Maximum?

(iii) Derive an expression for the force experienced by a current-carrying conductor in a uniform magnetic field.

(iv) What will be the relativistic velocity of a particle whose kinetic energy is twice of its rest mass energy?

(v) Find the Binding energy and Packing fraction (B.E. per nucleon) of $_{52}Te^{126}$. Given that: $m_p = 1.0078$ U $m_n = 1.0086$ U $m_{Te} = 125.9033$ U IU = 931.5 MeV

(vi) A heat engine performs 200 J of work in each cycle and has an efficiency of 30 percent. For each cycle of operation, (a) how much heat is absorbed? (b) how much heat is expelled?

(vii) A 50 ohm resistor is to be wound from a platinum wire 0.1 mm in diameter. How much wire is needed? (Resistivity of the wire = p = 11 x 10^{-8} Ω.m).

(viii) A galvanometer, whose resistance is 60 ohms, deflects full scale for a potential difference of 100 millivolts across its terminals. What shunt resistance must be connected to convert it into an ammeter of 5 ampere range?

(ix) An e.m.f. of 45 millivolts is induced in a coil of 500 turns. When the current in a neighbouring coil changes from 15 amps to 4 amps in 0.2 seconds, (a) what is the mutual inductance of the coils? (b) what is the rate of change of flux in the second coil?

(x) A thin infinite sheet of uniformly distributed positive charge attracts a light sphere having a charge -5 x 10^{-6} C with a force of 1.695 N. Calculate the surface charge density of the sheet ($\epsilon_0 = 8.85 \times 10^{-12} C^2/Nm^2$).

(xi) Find the shortest wavelength of photon emitted in the Balmer series and determine its energy in eV. ($R_H = 1.097 \times 10^7 m^{-1}$)

(xii) Calculate the speed of the electromagnetic wave, given that, $\epsilon_0 = 8.85 \times 10^{-12} C^2/Nm^2$, $\mu = 4\pi \times 10^{-7}$ web/Am.

(xiii) Give construction & working of Wilson cloud chamber.

(xiv) How many electrons should be removed from each of the two similar spheres, each of mass 10 g so that electrostatic repulsion is balanced by the gravitational force? (Gravitational constant = G = 6.67 x $10^{-11} Nm^2/kg^2$ and K = 9 x $10^9 Nm^2/C^2$).

(xv) Derive the relation between the Electric intensity and Electric potential.

SECTION 'C' (DETAILED-ANSWER QUESTIONS)(28)

NOTE: Answer 2 questions from this section.

3.(a) What is the capacity of a capacitor? Define its unit. Derive an expression for the capacitance of a parallel plate capacitor when there is (i) air between the plates (ii) some dielectric medium between the plates.

(b) What is Photoelectric effect? Explain its important results. Also derive Einstein's photo-electric equation.

4.(a) State the basic postulates of Bohr's theory of atomic structure. Derive the expression for the radius of 4th orbit of a Hydrogen atom.

(b) Describe the construction and working of a moving coil galvanometer with the help of a neat diagram. Show that the current (I) is directly proportional to deflection (θ).

5.(a) State the first law of thermodynamics and explain on its basis (i) Isobaric process (ii) Isothermal process.

(b) State Ampere's law. Using it, derive an expression for the magnetic field of induction inside a long current-carrying solenoid. OR Describe the method for determining the ratio of charge to mass $\left(\frac{e}{m}\right)$ of an electron. Derive the relevant mathematical expression.