Subject: Physics F.M.:75
Time: 3:00 hrs. P.M: 30

Candidates are required to give their answer in their own words as far as practicable. The figures in the margin indicate full marks.

Group 'A'

Rewrite the best alternative in your answer sheet. **(11 × 1 = 11)**

1. The counterpart of force in rotational motion is – a) torque b) angular momentum c) moment of inertia d) angular acceleration

2. If L represents momentum, I represents moment of inertia, then $\frac{L^2}{2I}$ represents. a) Rotational kinetic energy b) Torque c) Power d) Potential energy

3. A particle undergoes SHM having time period T. What is the time taken by it to move from mean position to half of amplitude? a) $\frac{T}{2}$ b) $\frac{T}{3}$ c) $\frac{T}{6}$ d) $\frac{T}{12}$

4. In which of the following thermodynamic process, the net work done is zero- a) isothermal process b) isochoric process c) isobaric process d) adiabatic process

5. The change in internal energy in the cyclic process of a system is a) zero b) nC_vdT c) mc_vdT d) ∞

6. In the equation, $y = A \sin 2\pi \left(\frac{t}{T} - \frac{x}{\lambda}\right)$, where A, T and λ are positive constants, represents a wave whose a) amplitude is 2A b) velocity is in negative X-axis c) period is $\frac{T}{\lambda}$ d) speed is $\frac{\lambda}{T}$

7. The angle made by a light ray with the wavefront is - a) 0° b) 90° c) 30° d) 120°

8. The Kirchhoff's current law is based on the principle of conservation of – a) energy b) charge c) mass d) momentum.

9. The wire used in the meter bridge must have- a) high resistivity b) low temperature coefficient of resistance c) uniform cross section d) all of the above

10. A long wire carrying a steady current is bent into a circular loop of one turn. The magnetic field at the centre of the loop is B. It is then bent into a circular coil of n turns. The magnetic field at the centre of this coil of n turns will be - a) 2nB b) $2n^2B$ c) nB d) n^2B

11. An electron is moving with a velocity 'v' & enters a uniform electric field perpendicularly. It's trajectory with in field will be (a) parabolic (b) circular (c) hyperbolic (d) elliptical

Group 'B'

Give answer to the following questions. **(8 × 5= 40)**

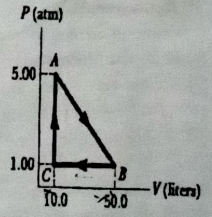
12. (a) State and explain principle of conservation of angular momentum. [2]
(b) A ballet dancer spins about a vertical axis at 1 revolution per sec with arms out stretched with her arms folded, her moment of inertia about the vertical axis decreases by 40% calculate the new rate of revolution. [3]

13. (a) Define moment of inertia. [1]
(b) Obtain an expression for the moment of inertia of a thin and uniform rod about an axis passing through the either end and perpendicular to its length. [3]
(c) What would be the radius of gyration of the rod in the case of (b)? [1]

OR

a) What is meant by angular simple harmonic motion? [1]
b) Show that motion of a simple pendulum is simple harmonic and hence calculate its time period. [2+1]
c) A pendulum clock is in an elevator that descends at constant velocity. Does it keep correct time? [1]

14. A substance undergoes the cyclic process shown in the figure. Work output occurs along path AB while work input is required along path BC, and no work is involved in the constant volume process CA. Energy transfers by heat occur during each process involved in the cycle. (i) What is the work output during process AB? (ii) How much work input is required during the process BC? (iii) What is the net energy input Q during this cycle? [2+1+2]



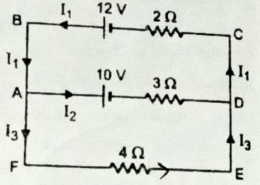
OR

(a) What is meant by adiabatic process? [1]
(b) Derive the state equation PV^γ = constant for the adiabatic process. [3]
(c) What are the necessary conditions for adiabatic process? [1]

15. (a) What do you mean by plane wavefront? [1]
(b) State Huygens's principle. Use it to verify laws of refraction of light. [1+3]

16. (a) State and explain Kirchhoff's laws. [2]
(b) Using Kirchhoff's law, find I_1,I_2 and I_3 in the given figure. [1+1+1]

17. (a) What is shunt? [1]
(b) How can you convert a galvanometer into an ammeter? [2]
(c) A moving coil meter has a resistance of 25Ω and indicates full scale deflection when a current of 4.0 mA flows through it. How could this meter be converted to an ammeter of range (0-50)mA? [2]



18. a) Show that the path of an electron moving through a transverse uniform electric field is parabolic in nature. [3]
b) Calculate the p.d in rest necessary to be maintained between two horizontal conducting plates, one 5mm above the other. So that a small oil drop of mass 1.31×10^{-14} kg with two electrons attached to it remain in equilibrium. ($g=9.8ms^{-2}$, charge of electron = 1.6×10^{-19}C) [2]

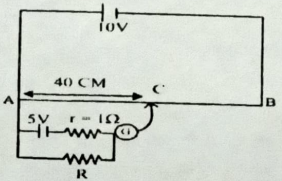
19. Millikan's oil drop experiment can be considered as the ground-breaking invention in the physics. (a) What does it measure? (b) What is the use of X-rays in this experiment? (c) Derive the expression for the charge on the oil drop. [1+1+3]

Group 'C'

Give answer to the following questions. **(3 × 8=24)**

20. (a) State the principle of superposition of waves. [1]
(b) Derive the relation for resultant amplitude of the resultant wave when two identical waves travelling in opposite direction are superimposed. [2]
(c) Show that the distance between any two consecutive nodes or antinodes is $\lambda/2$. [2]
(d) Stationary waves are set up by the superposition of two waves given by $y_1 = 0.01 \sin(10\pi t - x)$ and $y_2 = 0.01 \sin(10\pi t + x)$, where x and y are in meters and t in seconds. Find the displacement of a particle situated at a distance x = 1 m. [3]

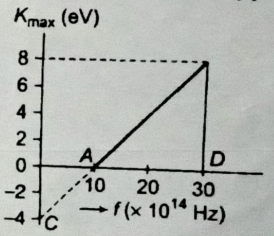
21. (a) What is the working principle of potentiometer. [1]
(b) Write down the dimensional formula of potential gradient [1]
(c) How would you use the potentiometer to compare the emf's of two cells ? [3]
(d) A potentiometer wire AB is 100 cm long and has a total resistance of 10 Ω. If the galvanometer shows zero deflection at the position C, then find the value of unknown resistance R. [3]



OR

(a) State Biot-Savart's law and write its expression in vector form. [1+1]
(b) Derive the relation for magnetic field intensity at the centre of a circular coil carrying current. [3]
(c) A straight wire of length 62.8 meter is bent to form a circular coil of diameter 5 cm. What must be the current in the coil if the magnetic field at centre of the coil is 0.016 T. ($\mu_0 = 4\pi\times10^{-7}$ TmA^{-1}) [3]

22. (a) The Einstein's Photolectric equation is given by,
$E = \phi + K.E._{max}$, where the symbols have their usual meanings.
(i) Write down the S.I. unit of ϕ ? [1]
(ii) Why the equation is valid only for surface electrons of the metal but not for inner ones? [1]
(iii) If the intensity of the incident radiation is increased, what will be its effect in the $K.E._{max}$ of emitted electrons. [1]
(iv) Why wave theory fails to explain Einstein's photoelectric equation? [1]
(b) A graph regarding photoelectric effect is shown between the maximum kinetic energy of electrons and the frequency of the incident light. On the basis of data as shown in the graph, calculate (i) threshold frequency, (ii) work- function, (iii) Planck constant. [1+1+2]



OR

(a) State Bohr's postulates of hydrogen atom. [2]
(b) Deduce an expression for the radius of an electron in n^{th} orbit of hydrogen atom. [3]
(c) Using the known values for the hydrogen atoms, calculate (i) the radius of the third orbit for He^+ (ii)speed of an electron in the fourth orbit for He^+. (iii) angular momentum of an electron in 3rd orbit of He^+.
($h=6.62\times10^{-34}$JS, $\varepsilon_0 = 8.852\times10^{-12}$Fm^{-1}) [1+1+1]

Best of Luck !