Total number of printed pages : 5 *NB/XII/PHY/1*

2024
PHYSICS

Total marks : 70 Time : 3 hours

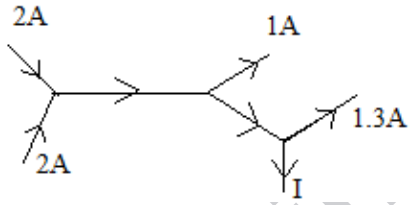
General instructions:

i) Approximately 15 minutes is allotted to read the question paper and revise the answers.
ii) The question paper consists of 34 questions. All questions are compulsory.
iii) Marks are indicated against each question.
iv) Internal choice has been provided in some questions.

N.B: Check that all pages of the question paper is complete as indicated on the top left side.

1. A test charge is moved from lower potential point to a higher potential point. The potential energy of a test charge will **1**
   (a) remain the same (b) increase
   (c) decrease (d) becomes zero.

2. The current I in the following circuit given below is **1**



   (a) 1.7 A (b) 3.7 A
   (c) 1.3 A (d) 1A

3. A magnetic needle is placed in a non-uniform magnetic field, it experiences **1**
   (a) a force and a torque (b) a force but not torque
   (c) a torque but not a force (d) neither a torque nor a force

4. Eddy currents are produced in **1**
   (a) induction furnace (b) electromagnetic brakes
   (c) speedometer (d) all of these.

5. Which one among the following does not represent Maxwell's equation? **1**
   (a) $\oint \vec{E}.d\vec{A} = \frac{q}{\epsilon_0}$ (b) $\oint \vec{B}.d\vec{A} = 0$
   (c) $\oint \vec{E}.\vec{dl} = \frac{-d\vec{B}}{dt}$ (d) $\oint \vec{B}.\vec{dl} = \mu_0 I_C + \mu_0 E_0 \frac{d\oint_E}{dt}$.

6. When a ray of light enters a glass slab, then **1**
   (a) its frequency and velocity change.
   (b) only frequency changes
   (c) its frequency and wavelength changes
   (d) its frequency does not change.

7. If we consider electrons and photons of same wavelength, then they will have same **1**
   (a) energy (b) velocity
   (c) momentum (d) angular momentum

8. Two nuclei have mass numbers in the ratio 1:3, the ratio of the nuclear densities are **1**
   (a) 3:1 (b) 1:1 (c) 1:9 (d) 1:3

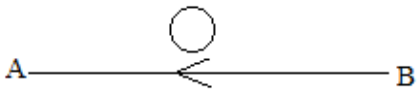
9. In an insulator, the forbidden energy gap between the valence band and conduction band is of the order of **1**
   (a) 5 eV (b) 1 eV (c) 2 MeV (d) 10^{-3}eV

10. Which of the following is not a transducer? **1**
   (a) Loudspeaker (b) Amplifier
   (c) Microphone (d) All of these.

11. What does $q_1 + q_2 = 0$ signify in electrostatics? **1**

12. How can a resistance of $3700\Omega \pm 10\%$ be represented by colour code? **1**

13. The electric current in a wire in the direction from B to A is increasing. What is the direction of induced current in the metallic loop kept above the wire as shown in figure? **1**



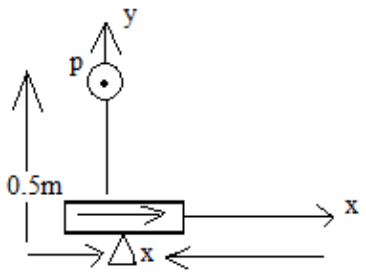
14. Define binding energy of a nucleus. **1**

15. Pure Si at 300K has equal electron (n_e) and hole (n_h) concentration of $1.5 \times 10^{16}\, m^{-3}$. Doping by indium increases n_h *to* $4.5 \times 10^{22}\, m^{-3}$. Calculate n_e in the doped silicon. **1**

16. What is meant by bandwidth in communication ? **1**

17. Give two properties of equipotential surface. **2**

18. **a.** An element $\Delta\vec{l} = \Delta x\hat{i}$ is placed at the origin and carries a large current $I = 10A$. What is the magnetic field on the y-axis at a distance of $0.5m.\Delta x = 1cm$.



Or **2**

b. A 100 turn closely wound circular coil of radius 10cm carries a current of 3.2A. The coil is placed in a uniform magnetic field of 2T in the direction of the field. The coil rotates through an angle 90° under the influence of the field. What is the magnetic moment of the coil and the magnitude of the torque acting on the coil?

19. Prove Ampere's circuital law for a circular path around a long current carrying conductor. **2**

20. **a.** Show that the ratio of electric and magnetic fields is always constant and is equal to the speed of electromagnetic waves.

Or **2**

b. What is electromagnetic spectrum? Name the electromagnetic waves that have frequencies greater than those of ultra-violet light but less than those of gamma rays.

21. Calculate the shortest wavelength present in the Paschen series of spectral lines. **2**

22. The audio signal cannot be transmitted directly into the space. Why? **2**

23. **a.** Find the electric potential at any point due to an electric dipole.

Or **3**

b. Obtain the capacitance of a parallel plate capacitor. What is the function of a dielectric in a capacitor?

24. An electric dipole of dipole moment $20\times10^{-6}\,cm$ is enclosed in a Gaussian surface. What is the net charge enclosed by the surface? If the radius of the Gaussian surface is doubled, how much flux would pass through the surface? Give the SI unit of electric flux. **3**

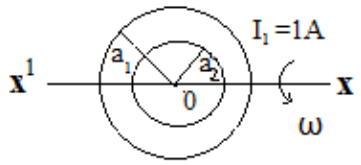
25. **a.** Find the drift velocity of free electrons in a conductor when an electric field is applied across the ends of the conductor. What happens to drift velocity, if length of the conductor is doubled?

Or **3**

b. Deduce the expression for equivalent *emf* of two cells connected in parallel having different *emfs* and different internal resistances.

26. Derive an expression for the force experienced by a current carrying conductor placed in a magnetic fields. Under what condition this force is zero? **3**

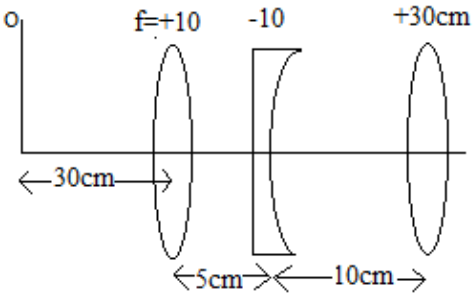
27. A very small circular loop of area $5\times10^{-4}\,m^2$, resistance 2Ω and negligible inductance is initially coplanar and concentric with a much larger fixed circular loop of radius 0.1m. A constant current of 1A is passed in the bigger loop and the smaller loop is rotated with angular velocity $\omega rads^{-1}$ about a diameter. Calculate
i) the flux linked with the smaller loop ii) induced emf and
iii) induced current in the smaller loop, as a function of time. **3**



28. **a.** A tank is filled with water to a height of 12.5 cm. The apparent depth of the needle lying at the bottom of the tank is measured by a microscope to be 9.4 cm. What is the refractive index of water? If water is replaced by a liquid of refractive index 1.63 upto the same height, by what distance would the microscope have to be moved to focus on the needle again?

Or **3**

b. Find the position of the image formed by the lens combination given in the figure.



29. Derive a relation between focal length of a double convex lens and its radii of curvature. **3**

30. Draw a graph to show the variation of stopping potential with frequency of radiations incident on a metal plate. How can the value of Plank's constant be determined from this graph? **3**

31. Using postulates of Bohr's theory of H-atom, show that the radii of the orbits in hydrogen atom varies as n^2, where n is the principal quantum number of the atom. **3**

32. **a.** Explain the principle and construction of an AC generator with a labelled diagram. Also, find the expression for the instantaneous emf produced by it.

Or **5**

b. With the help of a phasor diagram, obtain the relation for impedance and phase angle of an AC series LCR circuit.

33. Draw a ray diagram of a compound microscope when the image is formed at near point of the eye. Deduce an expression for its magnifying power. How can the magnifying power be increased? **5**

34. **a.** What is an intrinsic semiconductor?
Explain, how an intrinsic semiconductor can be converted into
i) n-type and ii). p-type semiconductor with a diagram.
How does the addition of impurity affect the energy band gap in a semi-conductor?

Or **5**

b. Explain the working of an n-p-n transistor as an amplifier in common emitter configuration with a circuit diagram. Also, find the power gain of the amplifier.

****