

# SAMPLE PAPER 3<sup>RD</sup>

Time allowed: 3 hours

Max. Marks: 70

## General Instructions:

1. All questions are compulsory. There are 37 questions in all.
2. This question paper has four sections: Section A, Section B, Section C and Section D.
3. Section A contains twenty questions of one mark each, Section B contains seven questions of two marks each, Section C contains seven questions of three marks each, and Section D contains three questions of five marks each.
4. There is no overall choice. However, internal choices have been provided in two questions of one mark each, two questions of two marks, one question of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.
5. You may use the following values of physical constants where ever necessary.

$$c = 3 \times 10^8 \text{ m/s}$$

$$h = 6.63 \times 10^{-34} \text{ Js}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$$

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

$$\text{mass of neutron} = 1.675 \times 10^{-27} \text{ kg}$$

$$\text{mass of proton} = 1.673 \times 10^{-27} \text{ kg}$$

$$\text{Avogadro's number} = 6.023 \times 10^{23} \text{ per gram mole}$$

$$\text{Boltzmann constant} = 1.38 \times 10^{-23} \text{ JK}^{-1}$$

1. If  $\oint \mathbf{E} \cdot d\mathbf{s} = 0$ , a surface, that means:-
  - a) There is net charge present inside the surface
  - b) Uniform electric field inside the surface
  - c) Discontinuous field inside the surface
  - d) Charge present inside the surface
2. A parallel plate capacitor is charged by a battery. Once it is charged battery is removed now a dielectric material is inserted between the plates of the capacitor, which of the following does not change?
  - a) Electric field between the plates
  - b) Potential difference across the plates
  - c) Charge on the plates
  - d) Energy stored in the capacitor.
3. In a meter bridge experiment, resistance box (with  $R=2 \Omega$ ) is connected in the left gap and the unknown resistance  $S$  in the right gap. If balancing length be 40cm, calculate the value of  $S$ .
  - a)  $2 \Omega$

- b)  $3 \Omega$
  - c)  $4 \Omega$
  - d)  $2.5 \Omega$
4. For a cell of emf 2V, a balance is obtained for 50cm of the potentiometer wire. If the cell is shunted by a  $2 \Omega$  resistor and the balance is obtained across 40cm of the wire, then the internal resistance of the cell is
- a)  $1 \Omega$
  - b)  $0.5 \Omega$
  - c)  $1.2 \Omega$
  - d)  $2.5 \Omega$
5. Which of the following is weakly repelled by a magnet field:
- a) Iron
  - b) Cobalt
  - c) Steel
  - d) Copper
6. A glass lens is immersed in water. What will be the effect on the power of lens?
- a) Increase
  - b) Decrease
  - c) Constant
  - d) Not depends
7. human body radiate
- a) micro wave
  - b) X-ray
  - c) Infra red rays
  - d) Gamma rays.
8. Unpolarised beam of light intensity  $I_0$  is incident on a polariser  $P_1$ . Another polariser  $P_2$  is held parallel to it such that its pass axis is oriented at an angle  $60^\circ$ , then what percentage of light will emerge from the system:
- a) 30%
  - b) 100%
  - c) 12.5%
  - d) 37.5%
9. The photoelectric work for a metal surface is 4.14eV. the cut of wavelength for this is:
- a) 4125A

- b) 2062.5A
- c) 3000A
- d) 6000A

10. In an experiment of scattering of alpha particle showed for the first time that the atom has,

- a) Electron
- b) Proton
- c) Neutron
- d) Nucleus

11. Two coils have mutual inductance of 1.5 Henry if the current in the primary circuit is raised by 5A in one millisecond after closing the circuit, then the induced emf in secondary coil is \_\_\_\_\_

12. Self-inductance of a long solenoid (A,N,L) with core material of magnetic relative permeability  $\mu$  (where A= Area of each turn ,N=no of turns, L=length )

13. In EM waves transport both and ..... And .....takes place.

14. The velocity of photon in different media is-----

15. On diopetre is \_\_\_\_\_ of lens of focal length \_\_\_\_\_ meter.

16. Write any two characteristic properties of nuclear force.

17. What is the difference between an n-type and a p-type extrinsic semiconductor?

18. Do electromagnetic wave carry energy and momentum?

19. Why is photoelectric emission not possible at all frequencies?

20. What happens to the width of depletion layer of a p-n junction when it is

- (i) Forward biased
- (ii) Reverse biased

### Sec-B

21. Derive an expression for the current density of a conductor in terms of the drift speed of electrons.

22. An electric dipole of length 1cm when placed with its axis making an angle of  $60^\circ$  with a uniform electric field, experiences a torque of  $6\sqrt{3}$  N-m. calculate the potential energy of the dipole if it has charge of  $\pm 4$ nC.

23. Two monochromatic radiation, blue and violet of the same intensity are incident on a photosensitive surface and cause photoelectric emission.

Would (i) the number of electrons emitted per second and (ii) the maximum kinetic energy of the electrons be equal in the two cases? Justify your answer.

24. Distinguish between polarised and unpolarised light. Does the intensity of polarised light emitted by a polaroid depend on its orientation? Explain briefly.

The variation of beam polarised light makes an angle of  $60^\circ$  with the axis of the polaroid sheet. What percentage of light is transmitted through the sheet?

25. The energy of the electron in ground state of hydrogen atom is  $-13.6\text{eV}$
- What does the negative sign signify?
  - How much energy required to take an electron in this atom from the ground state to the first excited state?

26. Plot a graph showing the variation of stopping potential with the frequency of incident radiation for two different photosensitive materials having work-function  $W_1$  and  $W_2$  ( $W_1 > W_2$ ). On what factors does the

- Slope and
- Intercept of the lines depend?

Or

write the three characteristic features in photoelectric effect which cannot be explained on the basis of wave theory of light, but can be explained only using Einstein's equation.

27.

- Why are Si and GaAs preferred materials for fabrication in solar cells?
- Draw V-I characteristic of solar cell and mention its significance.

Or

How is forward biasing different from reverse biasing in a p-n junction diode?

### Sec-C

28. Using Kirchhoff's rules, determine the value of unknown resistance  $R$  in the circuit, so that no current flows through  $4\Omega$  resistance. Also, find the potential difference between points A and D.

Or

- State the working principle of a potentiometer. With the help of the circuit diagram, explain how a potentiometer is used to

- compare the emf's of two primary cells. Obtain the required expression used for comparing the emfs.
- (ii) Write two possible causes for one sided deflection in a potentiometer experiment.
- 29.
- (i) How is a toroid different from a solenoid?
- (ii) Use Ampere's circuital law to obtain the magnetic field inside a toroid.
- 30.
- (i) Define mutual inductance.
- (ii) A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil?
31. A ray of light incident on face ABC of an equilateral glass prism having prism angle A. shows minimum deviation of  $3^\circ$ . Calculate the speed of light through the prism.
32. Draw a ray diagram to show the formation of the image of an object placed on the axis of a convex refracting surface of radius of curvature 'R' separating the two media of refractive indices ' $n_1$ ' and ' $n_2$ ' ( $n_2 > n_1$ ). Use the diagram to deduce the relation  $n_2/u - n_1/v = n_2 - n_1/R$ , where u and v represent respectively the distance of the object and the image formed.
- 33.
- (i) Write the relation for Binding Energy (BE) (in MeV) of nucleus of mass  $M^A_Z$ , atomic number (Z) and mass number (A) in terms of the masses of its constituent namely neutrons and protons.
- (ii) Draw a plot of BE/A versus mass number A for  $2 < A \leq 170$ . Use this graph to explain the release of energy in the process of nuclear fusion of two light nuclei.
34. Draw the circuit diagram of a full-wave rectifier using a p-n junction diode. Explain its working and show the output and input waveforms.

### Sec-D

- 35.
- (i) Define electric flux. Write its SI unit. Gauss's law in electrostatics is true for any closed surface, no matter

what its shape or size is. Justify this statement with the help of a suitable example.

- (ii) Use Gauss' law to prove that the electric field inside a uniformly charged spherical shell is zero.

Or

- (i) Explain using suitable diagram, the difference in the behaviour of a

a) Conductor

b) Dielectric in the presence of external electric field. Define the terms polarisation of a dielectric and write its relation with susceptibility.

- (ii) A thin metallic spherical shell of radius  $R$  carries a charge  $Q$  on its surface. A point charge  $Q/2$  is placed at its centre  $C$  and an other charge  $+2Q$  is outside the shell at a distance  $x$  from the centre as shown in the figure. Find

a) The force on the charge at the centre of shell and at the point  $A$ ,

b) The electric flux through the shell.

36. A metallic rod of length  $L$  and resistance  $R$  is rotated with a frequency  $\nu$ , with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius  $L$ , about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field  $B$  parallel to the axis is present everywhere.

- (i) Derive the expression for the induced emf and the current in the rod.

- (ii) Due to the presence of the current in the rod and the magnetic field, find the expression for the magnitude and direction of the force acting on this rod.

- (iii) Hence, obtain the expression the power required to rotate the rod.

Or

- (i) Define mutual inductance and write its SI units.
- (ii) Derive an expression for the mutual inductance of two long coaxial solenoids of same length wound one over the other.
- (iii) In an experiments, two coils  $C_1$  and  $C_2$  are placed close to each other. Find out the expression for the emf induced in the coil  $C_1$  due to change in the current through the coil  $C_2$ .

37.

- (i) How does one demonstrate, using a suitable diagram, that unpolarised light when passed through a polaroid gets polarised?
- (ii) A beam of unpolarised light is incident on a glass air interface. Show, using a suitable ray diagram, that light reflected from the interface is totally polarised, when  $\mu$  is the refractive index of glass with respect to air and  $i_B$  is the Brewster's angle.

Or

Draw the labelled ray diagram for the formation of image by an astronomical telescope.

Derive the expression for its magnifying power in normal adjustment. Write two basic features which can distinguish between a telescope and a compound microscope.