

General Instructions

- (i) This question paper contains 30 questions. All questions are compulsory.
- (ii) It comprises 6 single-correct multiple-choice questions.
- (iii) Attempt every question; detailed solutions are provided in the companion solutions booklet.

1. If the critical angle in a medium is α , then for total internal reflection the angle of incidence β should be:

- (A) $\beta < \alpha$
- (B) $\beta > \alpha$
- (C) $\beta = \alpha$
- (D) $\beta \leq \alpha$

2. The number of electrons that must be removed from a piece of metal to give it a charge of 1×10^{-7} coulomb will be:

- (A) 10^7
- (B) 1.6×10^{19}
- (C) 6.25×10^{11}
- (D) 9×10^{12}

3. In Rutherford's scattering experiment, the path of a scattered α -particle is:

- (A) circular
 - (B) parabolic
 - (C) elliptical
 - (D) hyperbolic
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4. The unit of $\sqrt{LC}$ (where L is inductance and C is capacitance) is:

- (A) second
 - (B) henry
 - (C) farad
 - (D) ampere
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5. In the depletion layer of a p-n junction diode, there are:

- (A) only electrons
 - (B) only holes
 - (C) both electrons and holes
 - (D) neither electrons nor holes
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6. Among the following, the electromagnetic wave of minimum frequency is:

- (A) ultraviolet rays
 - (B) X-rays
 - (C) γ -rays
 - (D) microwaves
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7. An electron of energy 10 eV is revolving round a circular path in a uniform magnetic field of 10^{-5} tesla. Determine the radius of the circular path.

(Given: mass of electron $m = 9.1 \times 10^{-31}$ kg, charge $e = 1.6 \times 10^{-19}$ C)

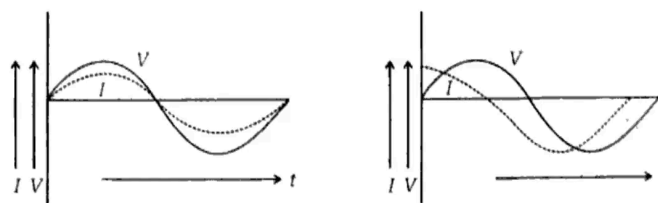
8. Write the definitions of electrical conductivity and specific conductivity.

9. The work function of a metal is 3.3 eV. Calculate the minimum frequency of photon that will emit the photoelectron.

(Given: $h = 6.6 \times 10^{-34}$ J·s, $1 \text{ eV} = 1.6 \times 10^{-19}$ J)

10. By giving the examples, explain the meaning of diamagnetic and paramagnetic materials.

11.



The variation between V and I with time (t) in two alternative circuits is shown in the above graphs. Which one of the curves of circuit is capacitive and which one is resistive?

12. In which the power of a lens will be large, in air or water?

13. Draw a graph between voltage and current of a p-n junction diode in forward bias.

14. State the working principle of a transformer and mention the energy losses occurring in it.

15. Define mass defect and binding energy.

16. Two point charges $+10\mu C$ and $-10\mu C$ are situated 2 cm apart. This dipole is placed in a uniform electric field of 1×10^5 volt/metre. Calculate the energy required to rotate the dipole from the position of 0° to 180° .

17. What are electromagnetic waves? Draw their propagation diagram. Show the electric field amplitude and magnetic field amplitude in the propagation diagram.

18. Resistance of a wire is R . If the length of the wire is stretched by n times the original length, then what will be the new resistance of the wire?

19. Explain nuclear fission and nuclear fusion with examples.

20. The focal length of a glass ($n_g = 3/2$) plano-convex lens in air is 10 cm. What will be the focal length and its nature when it is immersed in carbon disulphide ($n_c = 5/3$)?

21. Deduce the formula of force acting between two parallel current carrying conductors.

22. What do you understand by free electron and drift velocity? Deduce Ohm's law on the basis of the principle of drift velocity.

23. The distance between any two sources of light is 24 cm. Determine where a convergent lens of focal length 9 cm be placed so that the image of both sources be formed at one point.

24. Prove that the electric potential energy per unit volume of a charged condenser is $\frac{1}{2}\epsilon_0 E^2$, where symbols have their usual meaning.

25. The energy of hydrogen atom in ground state ($n = 1$) is -13.6 eV. To which highest energy-state the hydrogen atom can be made to reach by the photon of energy **12.09** eV?

OR

What is meant by interference? Write the conditions for constructive and destructive interference.

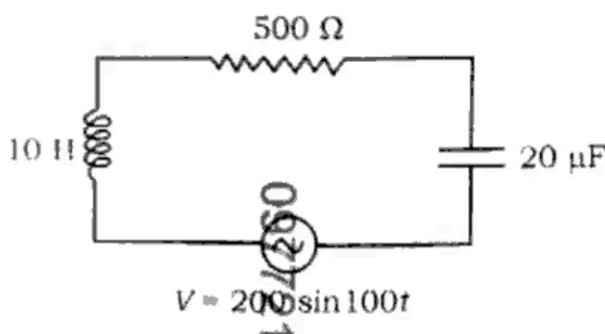
26. What is meant by mutual inductance? Define coefficient of mutual inductance and write its unit.

27. Write the Bohr's postulates for hydrogen atom. How did Bohr remove the drawbacks of Rutherford's model of atom?

OR

Derive the formula for the electric field outside a charged hollow sphere with the help of Gauss's law.

28.



What is the meaning of wavefront? Explain the laws of reflection on the basis of Huygens' principle of wavefront.

OR

Determine the following for the given A.C. circuit: (i) impedance, (ii) power factor, and (iii) phase difference between voltage and current. (Series combination of resistance $R = 500\ \Omega$, inductance $L = 10\text{ H}$ and capacitance $C = 20\ \mu\text{F}$ connected to an A.C. source $V = 200 \sin 100t$.)

29. Explain full wave rectifying action of p-n junction diode with the help of circuit diagram.

OR

Draw the diffraction pattern of light due to single slit and write the expression for position of minima. On what factors does the width of central maxima depend?

30. What do you understand by electromagnetic induction? State the Faraday's laws of electromagnetic induction.

OR

Obtain the formula for the capacitance of a parallel plate capacitor when a dielectric medium is partially filled between its plates.