CONCEPT ACADEMY

CBSE Sample Paper 2

Class XII Exam 2023-24

Physics

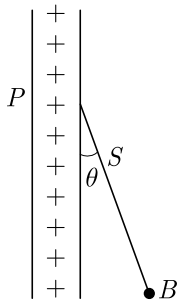
Time: 3 Hours **Max. Marks: 70**

General Instructions:

1. There are 35 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
3. Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
4. There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
5. Use of calculators is not allowed.

SECTION-A

1. A charged ball B hangs from a silk thread S, which makes an angle θ with a large charged conducting sheet P, as shown in the figure. The surface charge density σ of the sheet is proportional to



(a) $\sin\theta$ (b) $\cos\theta$

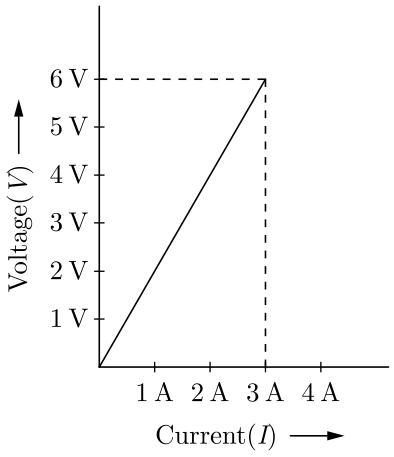
(c) $\tan\theta$ (d) $\cot\theta$

2. If 125 water drops of equal radius and equal capacitance C, coalesce to form a single drop of capacitance C' the relation between C and C' is

(a) $C' = C$ (b) $C' = 5C$

(c) $C' = 125C$ (d) $C' = 250C$

3. The variation of voltage V and current I in a conductor is given below. The resistance of the conductor is



(a) $1\,\Omega$ (b) $2\,\Omega$

(c) $3\,\Omega$ (d) $4\,\Omega$

4. Magnetic field due to a long straight conductor of length l, carrying current I, at a point, distance d from it, is given by

(a) $B = \frac{\mu_0}{4\pi} \times \frac{2I}{d}$ (b) $B = \frac{\mu_0}{4\pi} \times \frac{I}{d}$

(c) $B = \frac{\mu_0}{4\pi} \times \frac{2I}{d^2}$ (d) $B = \frac{\mu_0}{\pi} \times \frac{2I}{d}$

5. A current passing through a circular coil of two turns produces a magnetic field of 8 T at its centre. The coil is then rewound, so as to have four turns and current is passed through it is doubled. Now magnetic field at the centre of the coil will be

(a) 64 T (b) 32 T

(c) 16 T (d) 8 T

6. A wire of magnetic dipole moment M and L is bent into shape of a semicircle of radius r. What will be its new dipole moments?

(a) M (b) $\frac{M}{2\pi}$

(c) $\frac{M}{\pi}$ (d) $\frac{2M}{\pi}$

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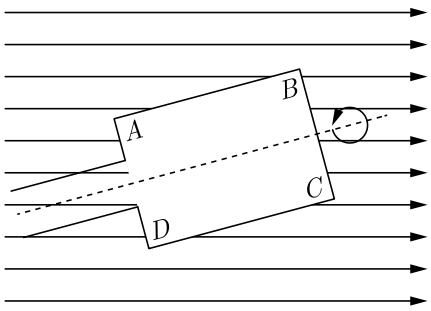
7. A rectangular coil $ABCD$ is rotated anticlockwise with a uniform angular velocity about the axis shown in the figure. Initially, the axis of rotation of the coil as well as the magnetic field B were horizontal. The induced E.M.F. in the coil would be maximum when plane of the coil



(a) is horizontal.

(b) is at right angle to the magnetic field.

(c) makes an angle of 30° with the horizontal.

(d) makes an angle of 45° with the direction of magnetic field.

8. The unit of ratio of magnetic field, B and electrical field, $E(B/E)$ is

(a) ms^{-1} (b) sm^{-1}

(c) ms (d) m^{-2}

9. The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in a time Δt. The total electric charge Q that passes any point in the circuit during the time Δt is represented by

(a) $Q = \frac{\Delta\phi}{\Delta t}$ (b) $Q = \frac{\Delta\phi}{R}$

(c) $Q = R \cdot \frac{\Delta\phi}{\Delta t}$ (d) $Q = \frac{1}{R} \cdot \frac{\Delta\phi}{\Delta t}$

10. A diffraction pattern is obtained by using a beam of red light. What happens, if the red light is replaced by blue light?

(a) no change

(b) diffraction bands disappear

(c) diffraction bands become broader and farther apart

(d) diffraction bands become narrower and crowded together

11. If an electron of mass m and charge e is accelerated from rest through a potential difference V in vacuum, then its final velocity will be

(a) $\frac{eV}{2m}$ (b) $\frac{eV}{m}$

(c) $\sqrt{\frac{2eV}{m}}$ (d) $\sqrt{\frac{eV}{m}}$

12. The energy E of a hydrogen atom with principal quantum no. n is given by $E = -\frac{13.6}{n^2}$ eV. The energy ejected when the electron jumps from $n = 3$ state to $n = 2$ state of hydrogen is approximately

(a) 0.85 eV (b) 1.5 eV

(c) 1.9 eV (d) 3.4 eV

13. M_p denotes the mass of a proton and M_n that of a neutron. A given nucleus, of binding energy B, contains Z protons and N neutrons. The mass $M(N, Z)$ of the nucleus is given by ($c =$ Velocity of light)

(a) $M(N, Z) = NM_n + ZM_p - B^2$

(b) $M(N, Z) = NM_n + ZM_p + Bc^2$

(c) $M(N, Z) = NM_n + ZM_p + \frac{B}{c^2}$

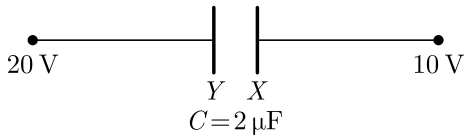
(d) $M(N, Z) = NM_n + ZM_p - \frac{B}{c^2}$

14. The algebraic sum of all currents meeting at a point in an electrical circuit is

(a) zero (b) infinite

(c) positive (d) negative

15. The charge on plate X in the given figure



(a) 20 μC (b) −20 μC

(c) zero (d) −10 μC

16. **Assertion :** The resistivity of a semi-conductor increases with temperature.
Reason : The atoms of semi-conductor vibrate with larger amplitude as higher temperatures thereby increasing its resistivity.

(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

17. **Assertion :** When tiny circular obstacle is placed in the path of light from some distance, a bright spot is seen at the centre of the shadow of the obstacle.
Reason : Destructive interference occurs at the centre of the shadow.

(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

18. **Assertion :** Kinetic energy of photo electrons emitted by a photosensitive surface depends upon the intensity of incident photon.
Reason : The ejection of electrons from metallic surface is possible with frequency of incident photon below the threshold frequency.

(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

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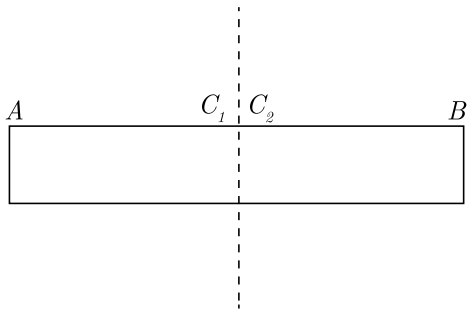
SECTION-B

19. Explain briefly how electromagnetic waves are produced by an oscillating charge. How is the frequency of electromagnetic waves produced related to that of the oscillating charge?

20. A (hypothetical) bar magnet (AB) is cut into two equal parts. One part is now kept over the other, so that pole C_2 is above C_1. If M is the magnetic moment of the original magnet, what would be the magnetic of the combination so formed?



21. Write any two properties of X-rays.

or

A nucleus $^{238}_{92}$U undergoes α-decay and transforms to thorium. What is:

1. The mass number
2. Atomic number of the nucleus produced?

22. The radii of curvature of both the surfaces of a lens are equal. If one of the surfaces is made plane by grinding then will the focal length of lens change? Will the power change?

23. What happens when a forward bias is applied to a p-n-junctions

or

Draw energy band diagram of n-typed and p-typed semiconductor at temperature $T > 0\,\text{K}$. Mark the donar and acceptor energy level with their energies.

24. Define resolving power of an optical instrument. How does it depend on wavelength?

25. Compare the electric fields due to a monopole (single charge) and dipole.

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SECTION-C

26. Define magnetic field in terms of the force on a moving charge. Hence define one tesla.

27. There are two coils A and B separated by some distance. If a current of $2A$ flows through A , a magnetic flux of 10^{-2} Wb passes through B (no current through B). If no current passes through A and a current of 1 A passes through B, What is the flux through A?

28. Write down the equation of induced current at any instant in L-C-R circuit when $X_L > X_C$ or circuit is inductive.

or

Name the factors responsible for decreasing the efficiency of a transformer.

29. Explain briefly the reasons why wave theory of light is not able to explain the observed features of photo-electric effect.

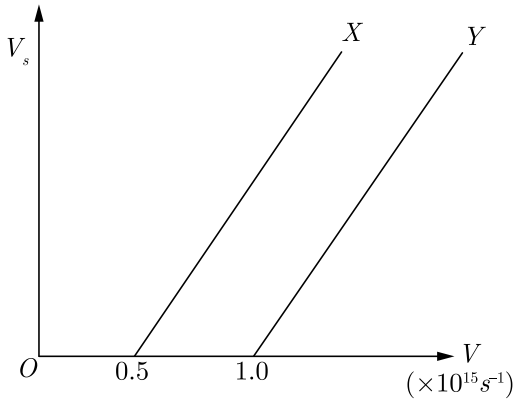
or

The following graph shows the variation of stopping potential V_s with the frequency (v) of the incident radiation for two photosensitive metals X and Y.

(i) Which of the metals has larger threshold wavelength? Give reason.

(ii) Explain giving reason which metal gives out electrons having larger kinetic energy, for the same wavelength of the incident radiation.

(iii) If the distance between the light source and metal X is halved, what will be the kinetic energy of electrons emitted due to this change? Give reason.



30. The ground state energy of hydrogen atom is -13.6 eV. If an electron makes a transition from an energy level -0.85 eV to -3.4 eV, calculate the wavelength of the spectral line emitted. To which series of hydrogen spectrum does this wavelength belong?

SECTION-D

31. Find an expression for capacity of a parallel plate capacitor with compound dielectric.

or

Derive an expression for the capacitance of a parallel plate capacitor. If a compound dielectric medium is introduced between the plates of the capacitor, how will the capacitance of the capacitor change?

32. In a metre bridge experiment, null point is contained at 20 cm from one end of the wire when resistance X is balanced against another resistance Y. If $X < Y$, then where will be the new position of the null point from the same end, if one decides to balance a resistance of 4 X against Y?

or

(i) Define the term drift velocity.

(ii) On the basis of electron drift, derive an expression for resistivity of an conductor in terms of number density of free electrons and relaxation time. On what factors does resistivity of a conductor depend?

(iii) Why alloys like constantan and manganin are used for making standard resistors?

33. How are wavefront and secondary wavelets defined? Verify laws of reflection or laws of refraction on the basis of Huygen's wave theory.

or

Explain Huygens principle of secondary wavelets and on the basis of this principle establish the law of Refraction 'OR' reflection.

SECTION-E

34. Now-a-days optical fibres are extensively used for transmitting audio and video signals through long distances. Optical fibres too make use of the phenomenon of total internal reflection. Optical fibres are fabricated with high quality composite glass/quartz fibres. Each fibre consists of a core and cladding. The refractive index of the material of the core is higher than that of the cladding. When a signal in the form of light is directed at one end of the fibre at a suitable angle, it undergoes repeated total internal reflections along the length of the fibre and finally comes out at the other end. Since light undergoes total internal reflection at each stage, there is no appreciable loss in the intensity of the light signal. Optical fibres are lubricated such that light reflected at one side of inner surface strikes the other at an angle larger than the critical angle. Even if the fibre is bent, light can easily travel along its length. Thus, an optical fibre can be used to act as an optical pipe.

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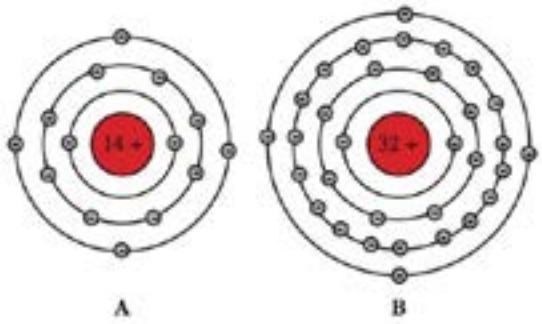
1. What is the condition for total internal reflection to occur?
2. Which signal is transmitted by optical fibres?
3. What are the necessary conditions for total internal reflection to take place ?

or

4. What is the internal reflection of light??

35. Anita was thinking that C, Si and Ge have same lattice structure, but C is insulator while Si and Ge intrinsic semiconductors. For its answer, she met her friend Parul. Parul explained him that the four bonding electrons of C, Si and Ge lie respectively in the second, third and fourth orbit. So, energy required to take out an electron from these atoms known as ionisation energy I_E will be least for Ge, followed by Si and highest for C. Hence number of free electrons for conduction in Ge and Si are significant while negligible small for C.



1. What do you mean by semiconductor ?
2. Which are the charge carriers in semiconductors?
3. Which is better silicon or germanium?

or

4. If a pure silicon crystal has 5×10^{28} atoms/m^3. It is doped by 1 ppm concentration of pentavalent arsenic.
   If $n_i = 1.5 \times 10^{16}$/m^3, then calculate the number of electrons and holes.