B.K. Birla Centre For Education

Date: 15-12-2025 PRE BOARD EXAMINATION-II **Duration**: 3 Hrs

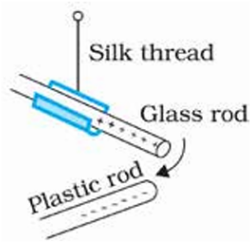
Class: XII Physics (SET-I) **Total Marks** : 70

Instructions to the Students

- Write only question numbers clearly outside the margin (1, 2, 3.i, 5.b, 4.c.ii, etc.).
- Do not write questions or any titles. (For ex. - Do not write **II. Answer the following**).
- After every answer, give a one-line space.
- For Multiple choice Questions - Both Option and Answer should be written.
- Bullet points & Sub-points should be written inside the margin.
- Do not fold / staple the paper.

Section A

1. In Figure, a positively charged glass rod is brought near a negatively charged plastic rod. What does the resulting interaction imply about the forces between them? [1]



a) The rods repel, indicating that forces between opposite charges are repulsive.
b) The rods attract, indicating that forces between opposite charges are attractive.
c) The rods do not interact, showing the forces are balanced.
d) The rods rotate, suggesting the presence of a torque but no net force.

2. If R_s and R_p are the equivalent resistances of n resistors, each of value R, in series and parallel combinations respectively, then the value of (R_s - R_p) is : [1]

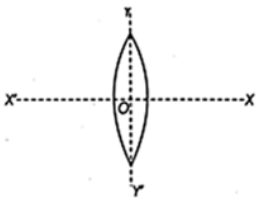
a) $\left(\frac{n^2-1}{n^2}\right)R$ b) $\left(\frac{n^2+1}{n^2-1}\right)R$ c) $\left(\frac{n^2-1}{n}\right)R$ d) $\frac{(n^2+1)R}{n^2}$

3. A bulb is rated (100 W, 110 V). It is operated by current of 1.0 A supplied by a step down transformer. If the input voltage and efficiency of the transformer are 220 V and 0.9 respectively, the input current drawn from the mains is : [1]

a) $\frac{1}{2}A$ b) $\frac{3}{8}A$ c) $\frac{5}{9}A$ d) $\frac{4}{7}A$

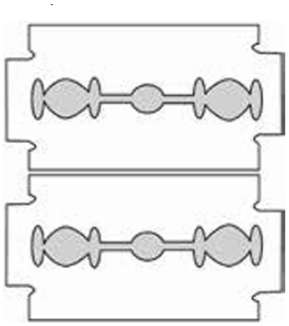
4. Which of the following statement is true for the radio waves and the gamma rays? [1]
a) The energy of gamma rays is lesser than that of the radio waves.
b) The frequency of the radio waves is higher than that of gamma rays.
c) The radio waves and the gamma rays have the same energy.
d) The energy of radio waves is lesser than that of the gamma rays.

5. An equiconvex lens of focal length 15 cm is cut into two halves vertically as shown in figure. Find the focal length of each part? [1]



a) -30cm b) -20cm c) 30cm d) -15cm

6. Figure shows a method to observe single-slit diffraction using two razor blades. To see a clear pattern, the slit formed by the blades should be held: [1]



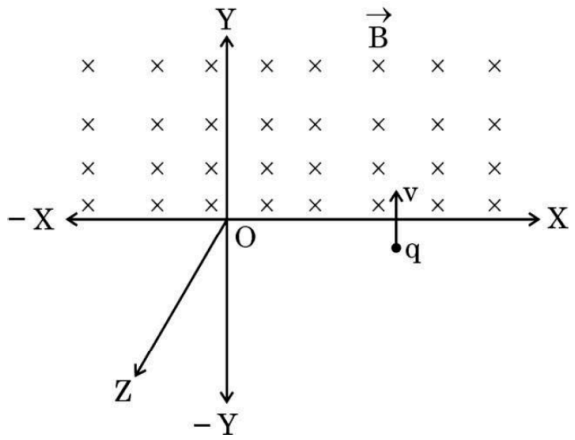
a) Perpendicular to the filament of a bulb.
b) Very far away from the eye.
c) Parallel to the filament of a bulb.
d) Very wide (several centimeters).

7. The energy of an electron in a hydrogen atom in ground state is -13.6 eV. Its energy in an orbit corresponding to quantum number n is -0.544 eV. The value of n is [1]

a) 2 b) 4 c) 3 d) 5

8. [1]

A particle having charge +q enters a uniform magnetic field $\overrightarrow{B}$ as shown in the figure. The particle will describe :



a) a circular path in XZ plane
b) a semicircular path in XY plane
c) a helical path with its axis parallel to Y-axis
d) a semicircular path in YZ plane

9. A small conducting ring is dropped from rest into a region where there is a uniform magnetic field directed vertically upward. As the ring falls, the magnetic flux through it decreases. The induced current in the ring will be [1]

a) clockwise as seen from above
b) anticlockwise as seen from above
c) zero
d) alternating between clockwise and anticlockwise

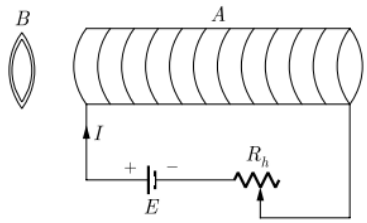
10. A voltage $v = v_o \sin \omega t$ applied to a circuit drives a current $i = i_o \sin(\omega t + \phi)$ in the circuit. The average power consumed in the circuit over a cycle is [1]

a) Zero b) $i_0 \ \nu_0 cos\phi$ c) $\frac{i_0\nu_0}{2}$ d) $\frac{i_0v_0}{2} cos\phi$

11. Two nuclei have mass numbers in the ratio 1: 2. What is the ratio of their nuclear densities? [1]

a) 1:2 b) 2:1 c) 1:1 d) 4:1

12. An aluminium ring B faces an electromagnet A. Which of the following statement is correct? [1]



a) If I increases, A will repel B
b) If I decreases, A will repel B
c) If I increases, A will attract B
d) Whether I increases or decreases B will not experience any force

13. Assertion (A): In Bohr model of hydrogen atom, the angular momentum of an electron in nth orbit is proportional to the square root of its orbit radius r [1]

Reason (R) : According to Bohr model, electron can jump to its nearest orbits only.
a) Both (A) and (R) are true and (R) is the correct explanation of (A)
b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
c) (A) is correct but (R) is wrong
d) (A) is wrong but (R) is correct

14. **Assertion (A):** Although the surfaces of a goggle lens are curved, it does not have any power. [1]
Reason (R): In case of goggles, both the curved surfaces are curved on the same side and have equal radii of curvature.
a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c) Assertion is true but Reason is false.
d) Both Assertion and Reason are false.

15. **Assertion(A) :** Thin films such a soap bubble or a thin layer of oil on water show beautiful colours when illuminated by white light. [1]
Reason(R) : It happens due to the interference of light reflected from the upper surface of the thin film
a) Both (A) and (R) are true and (R) is the correct explanation of (A)
b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
c) (A) is correct but (R) is wrong
d) (A) is wrong but (R) is correct

16. **Assertion (A):** Electric field at a point on the equatorial line of an electric dipole is directed opposite to the dipole moment. [1]
Reason (R): The potential at any point on the equatorial line of a dipole is zero.
a) Both (A) and (R) are true and (R) is the correct explanation of (A)
b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
c) (A) is correct but (R) is wrong
d) (A) is wrong but (R) is correct

Section B

17. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 V m^{-1}. [2]
(a) What is the wavelength of the wave?
(b) What is the amplitude of the oscillating magnetic field?

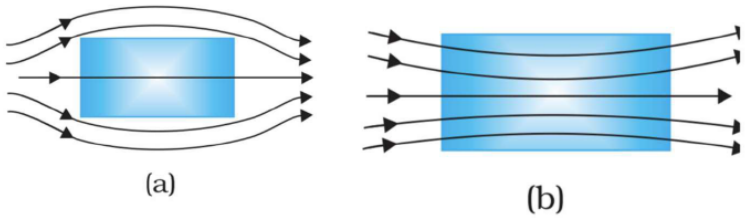
18. A battery that contains emf E and internal resistance r when connected across an external resistance of 12 ohm, produces a current of 0.5 A. When connected [2]
across a resistance of 25 ohm, it produces a current of 0.25 A. Find
(i) internal resistance and
(ii) emf of the cell.

19. A charge q is placed inside a sphere of radius r filled with a medium of dielectric constant K_1 , and another charge 2q is placed inside a cube of side 2r in a medium of dielectric constant K_2 . Find the ratio of electric flux linked with the sphere and the cube. [2]

20.I. Depict the field-line pattern due to a current-carrying solenoid of finite length. [2]
i. In what way do these lines differ from those due to an electric dipole?
ii. Why can't two magnetic field lines intersect each other?

(OR)

20.II. A uniform magnetic field gets modified as shown in figure when two specimens A and B are placed in it. [2]



(i)Identify the specimen A and B.
(ii) How is the magnetic susceptibility of specimen A different from that of specimen B?

21.I. State Bohr's quantization condition for defining stationary orbits. How does the de Broglie hypothesis explain the stationary orbits? [2]

(OR)

21.II. Draw a graph showing the variation of photoelectric current (I) with collector plate potential (V) for light of a fixed frequency but different intensities I_1 and I_2 ($I_2 > I_1$). Explain how this graph is used to define the saturation current and the stopping potential. [2]

Section C

22. With the help of circuit diagram, explain the working p-n junction diode as a full wave rectifier. Draw its input and output waveforms. [3]

23. (i) Write the condition for balance in a Wheatstone bridge. [3]
(ii) In a balanced Wheatstone bridge, if one of the resistances is increased, what happens to the galvanometer deflection?
(iii)Explain how Kichoff's voltage law is consistent with the law of conservation of energy.

24. Find the Q value of the following nuclear reaction : [3]
(${}^{12}_{6}\mathrm{C} + {}^{12}_{6}\mathrm{C} \rightarrow {}^{20}_{10}\mathrm{Ne} + {}^{4}_{2}\mathrm{He}$)
Is this reaction exothermic or endothermic ?
Given :

($\mathrm{m}\left({}^{12}_{6}\mathrm{C}\right) = 12 \cdot 000000\,\mathrm{u}$ $\mathrm{m}\left({}^{20}_{10}\mathrm{Ne}\right) = 19 \cdot 992439\,\mathrm{u}$ $\mathrm{m}\left({}^{4}_{2}\mathrm{He}\right) = 4 \cdot 002603\,\mathrm{u}$ $1\,\mathrm{u} = 931\,\mathrm{MeV}/\mathrm{c}^2$)

25. Draw a ray diagram to show the image formation of a distant object by a refracting telescope. Write the expression for its angular magnification in terms of the focal lengths of the lenses used. State the important considerations required to achieve large resolution and their consequent limitations. [3]

26. Using Huygens' principle, explain the refraction of a plane wavefront, propagating in air, at a plane interface between air and glass. Hence verify Snell's law. [3]

27.I. (a) A circular coil of 30 turns and radius 8.0 cm carrying a current of 6.0 A is suspended vertically in a uniform horizontal magnetic field of magnitude 1.0 T. The field lines make an angle of 60° with the normal of the coil. Calculate the magnitude of the counter torque that must be applied to prevent the coil from turning. [3]

(b) Would your answer change, if the circular coil in (a) were replaced by a planar coil of some irregular shape that encloses the same area? (All other particulars are also unaltered.)

(OR)

27.II. A solenoid has a core of material with relative permeability 250. The windings of the solenoid are insulated from the core and carry a current of 0.5 A. If the number of turns is 2500 per metre, calculate [3]

(A) magnetic intensity,

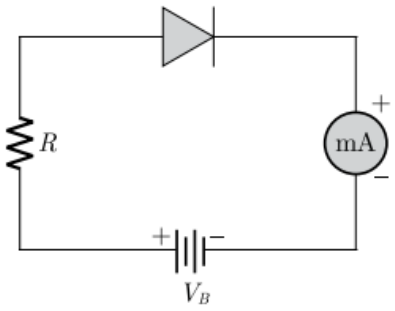
(B) magnetic field &

(C) magnetisation

28. State Lenz's law. A rod MN of length L is rotated about an axis passing through its end M perpendicular to its length, with a constant angular velocity ω in a uniform magnetic field $\overrightarrow{B}$ parallel to the axis. Obtain an expression for emf induced between its ends. [3]

Section D

29. A silicon p-n junction diode is connected to a resistor R and a battery of voltage V_B through milliammeter (mA) as shown in figure. The knee voltage for this junction diode is $V_N = 0\ 7.$ V. The p-n junction diode requires a minimum current of 1 mA to attain a value higher than the knee point on the I-V characteristics of this junction diode. Assuming that the voltage V across the junction is independent of the current above the knee point. A p-n junction is the basic building block of many semiconductor devices like diodes. Important process occurring during the formation of a p-n junction are diffusion and drift. In an n-type semiconductor concentration of electrons is more as compared to holes. In a p-type semiconductor concentration of holes is more as compared to electrons.



29.I. If $V_B = 5$ V, the value of R in order to establish a current to 6 mA in the circuit is [1]

a) 833 Ω b) 717 Ω c) 950 Ω d) 733 Ω

29.II. If $V_B = 5$ V, the maximum value of R so that the voltage V is above the knee point voltage is [1]

a) 40 kΩ b) 4 3. kΩ c) 5 0. kΩ d) 5 7. kΩ

29.III. If $V_B = 6$ V, the power dissipated in the resistor R, when a current of 6 mA flows in the circuit is [1]

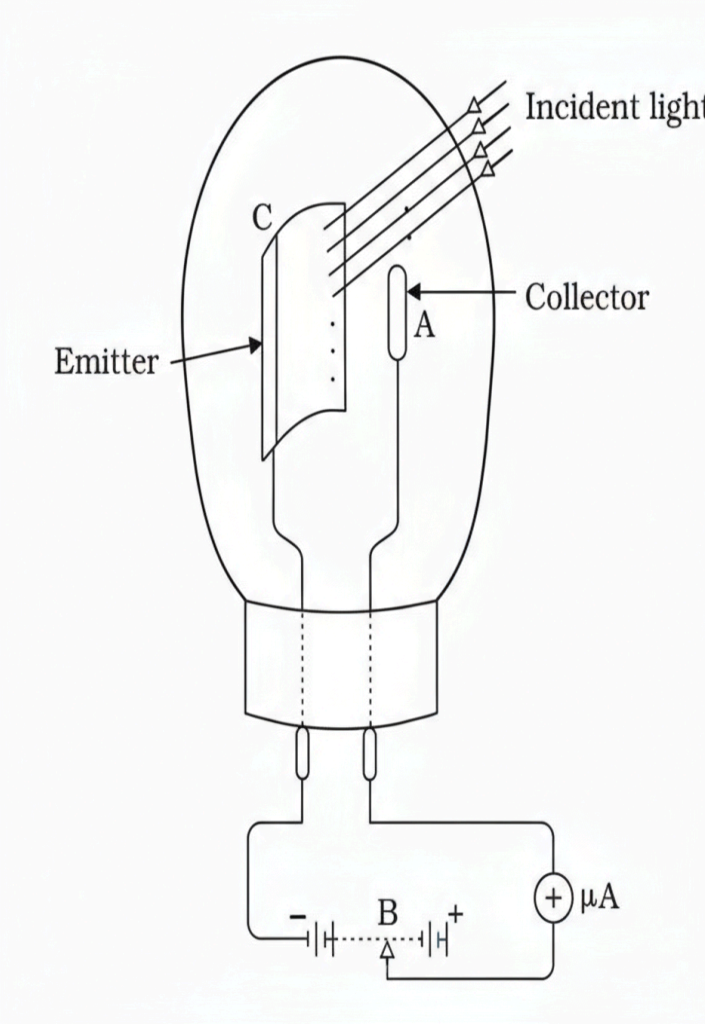
a) 0.36 W b) 36 mW c) 3.6 mW d) 60 mW

29.IV. When the diode is reverse biased with a voltage of 6 V and $V_{bi} = 0\ 63$ V . Calculate the total potential [1]

a) 9.27 V b) 6.63 V c) 5.27 V d) 0.63 V

30. The photoelectric effect is the phenomenon in which electrons are ejected from the surface of a metal when light of suitable frequency falls on it. In the given device, when light of appropriate wavelength strikes the emitter C, photoelectrons are emitted and collected by the collector A, producing a measurable photoelectric current. This current is sensitive to changes in the intensity of illumination, allowing the device to convert variations in light into electrical signals. Such a current can be used to operate control systems or in light-sensing instruments. The emitter is usually made of metals with low

work functions, which facilitates the easy emission of electrons when exposed to light of suitable frequency.The devices are made up of metals with low ionization enthalpies, for example platinum whose work function is 2.28 eV



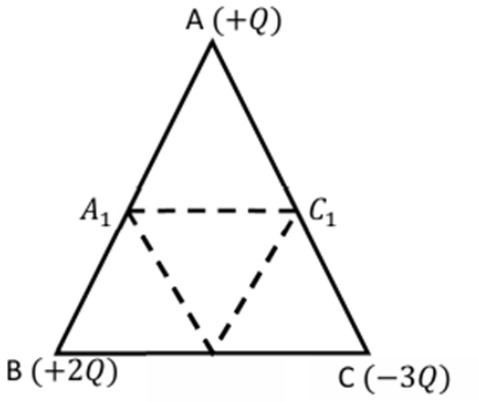
30.I. If a retarding potential is applied by moving the terminal B towards the left, how will it affect the microammeter reading? [1]

30.II. Sketch or describe the variation of microammeter current with applied voltage when B is moved from left to right. [1]

30.III. A photoelectric cell has a sodium emitter (work function ϕ=2.28 eV) and a collector connected to a microammeter. If violet light of wavelength 400 nm falls on the emitter, determine the maximum kinetic energy of the emitted electrons and the microammeter reading. [2]

Section E

31.I.A. Three-point charges, +Q,+2Q and −3Q are placed at the vertices of an equilateral triangle ABC of side *l*. If these charges are displaced to the mid-points A_1, B_1 and C_1 respectively, find the amount of the work done in shifting the charges to the new locations. [3]



31.I.B. A parallel plate capacitor C with a dielectric in between the plates is charged to a potential V by connecting it to a battery. The capacitor is then isolated. If the dielectric is withdrawn from the capacitor, [2]

(a) Will the energy stored in the capacitor increase or decrease?

(b)Will the potential difference across the capacitor plates increase or decrease ? Give an explanation.

(OR)

31.II.A. (i) How does the distance between equipotential surfaces vary with the strength of the electric field? Give reason [3]

(ii) What happens to stored energy in a capacitor when its plates are separated farther after disconnecting the battery.

(iii) If the charge on a body and the distance of a point from it are both doubled, what will be the effect on the electric potential at that point?

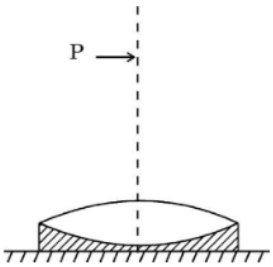
31.II.B. Two capacitors 16 micro farads develops a charge of 200 micro coulomb and if capacitor C is connected to the same battery, the charge developed is 100 micro couloumb Calculate the value of C . [2]

32. (i) Draw a ray diagram showing refraction of a ray of light through a triangular glass prism. Hence, obtain the relation for the refractive index (u) in terms of angle of prism (A) and angle of minimum deviation (δ_m). [5]

(ii) The radii of curvature of the two surfaces of a concave lens are 20 cm each. Find the refractive index of the material of the lens if its power is -5.0 D.

(OR)

32.I.A. The figure below shows an equiconvex lens (of refractive index 1.50) in contact with a liquid layer on top of a plane mirror. A small needle with its tip on the principal axis is moved along the axis until its inverted image is found at the position of the needle. The distance of the needle from the lens is measured to be 45.0 cm. When the liquid is removed and the experiment is repeated, the new distance is 30.0 cm. Find the refractive index of the liquid. [3]



32.I.B. (i) State the principle on which the working of an optical fiber is based. [2]

(ii) What are the necessary conditions for this phenomenon to occur?

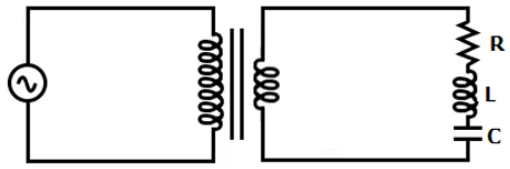
33.I.A. (i) A galvanometer of resistance $R_g = 50\Omega$ has a full-scale deflection current of $I_g = 1mA$. What series resistance should be connected to convert it into a voltmeter of range 10 V? [3]

(ii) How should this series resistance be connected to the galvanometer?

33.I.B. Why is the magnetic field radial in a moving coil galvanometer? Explain how it is achieved? [2]

(OR)

33.II.A. An ideal transformer has 800 turns in the primary coil and 200 turns in the secondary coil. The primary is connected to an AC supply of V in $= 240 \sin 200\pi t$ V. The secondary is connected to a series load consisting of $R = 8\Omega$, $X_L = 6\Omega$, and $X_C = 2\Omega$. [3]



Find:

(i) The voltage across the load

(ii) The current through the load

(iii) The power consumed by the load

33.II.B. Explain the working principle of a transformer and how it helps in long-distance power transmission. [2]

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