# CBSE EXAMINATION PAPER-2025

## PHYSICS

## (Solved)

Time allowed : 3 hours | Maximum Marks : 37

**General Instructions :**

Read the following instructions carefully and follow them :

i. This question paper contains **17 questions.** All questions are **compulsory.**
ii. This question paper is divided into **4 sections.**
iii. **Section A** – questions number **1 to 9** are multiple choice questions Each question carries **1 marks.**
iv. **Section B** – questions number **10 to 11** are very short answer Each question carries **2 marks.**
v. **Section C** – questions number **12 to 14** are short answer Each question carries **3 marks.**
vi. **Section D** – questions number **15 to 17** are long answer Each question carries **5 marks.**
vii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.
viii. Use of calculator is NOT allowed.

## Section A

**Question 1.**

Two wires P and Q are made of the same material. The wire Q has twice the diameter and half the length as that of wire P. If the resistance of wire P is R, the resistance of the wire Q will be:

[1 Marks]

(A) 2R

(B) R/8

(C) R/2

(D) R

**Explanation:** The resistance R of a wire is given by R = ρ * (length) / (cross-sectional area). Since Q has half the length of P, length_Q = L/2. The diameter of Q is twice that of P, so radius_Q = 2 * radius_P. The cross-sectional area A is proportional to the square of the diameter, so A_Q = π * (2d)^2 / 4 = 4 * A_P. Therefore, resistance of Q is R_Q = ρ * (L/2) / (4 * A_P) = (1/8) * (ρ * L / A_P) = R / 8.

**Question 2.**

A coil has 100 turns, each of area 0.05 $m^2$ and total resistance 1.5 Ω. It is inserted at an instant in a magnetic field of 90 mT, with its axis parallel to the field. The charge induced in the coil at that instant is:

[1 Marks]

(A) 0.45 C

(B) 0.30 C

(C) 3.0 mC

(D) 1.5 C

**Explanation:** When the coil is inserted into the magnetic field, the change in magnetic flux induces an emf, which causes a current and thus a charge to flow. The total change in magnetic flux linkage is N × B × A since the coil is initially out of field (zero flux) and is instantaneously inserted (flux changes to N × B × A). Here, N = 100 turns, B = 90 mT = 0.09 T, A = 0.05 $m^2$. Change in flux linkage = 100 × 0.09 × 0.05 = 0.45 Wb. The induced emf E = -d(φ)/dt, but since insertion is instant, the charge Q induced can be found by Q = Change in flux linkage / Resistance = 0.45 / 1.5 = 0.3 C. However, since the insertion is considered instantaneous, and the calculation needs the total charge induced, correctly, the charge induced Q = emf × time / resistance, but with instantaneous insertion Q = ΔΦ / R = 0.45 / 1.5 = 0.3 C. But this corresponds to 0.3 C which is 300 mC. Considering the problem context and options, it appears there may be a miscalculation if 3.0 mC is correct. To find the precise value for the charge induced (Q), the formula is Q = N × B × A / R = 100 × 0.09 × 0.05 / 1.5 = 0.3 C. Since 0.3 C is an option, but options are 1.5 C, 3.0 mC, 0.30 C, 0.45 C, the correct answer is 0.30 C. Therefore, the correct option is 0.30 C.

**Question 3.**

Assertion (A): It is difficult to move a magnet into a coil of large number of turns when the circuit of the coil is closed.

Reason (R): The direction of induced current in a coil with its circuit closed, due to motion of a magnet, is such that it opposes the cause.

[1 Marks]

**(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).**

(B) Assertion (A) is true, but Reason (R) is false.

(C) Both Assertion (A) and Reason (R) are false.

(D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

**Explanation:** Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). When a magnet is moved into a coil with a closed circuit, an induced current is generated that creates a magnetic field opposing the motion of the magnet, following Lenz's law. This opposing force makes it difficult to move the magnet into the coil, confirming both the assertion and the reason.

**Question 4.**

The given diagram exhibits the relationship between the wavelength of the electromagnetic waves and the energy of photon associated with them. The three points P, Q and R marked on the diagram may correspond respectively to :

[1 Marks]

(A) X-rays, microwaves, UV radiation

**(B) X-rays, UV radiation, microwaves**

(C) UV radiation, microwaves, X-rays

(D) Microwaves, UV radiation, X-rays

**Explanation:** The correct option is 'X-rays, UV radiation, microwaves'. This is because, according to the electromagnetic spectrum, X-rays have a shorter wavelength and higher energy compared to UV radiation, which also has higher energy than microwaves, which possess the longest wavelength of the three. The relationship between wavelength and photon energy indicates that as wavelength decreases, energy increases.

**Question 5.**

A beaker is filled with water (refractive index 4/3) upto a height H. A coin is placed at its bottom. The depth of the coin, when viewed along the near normal direction, will be

[1 Marks]

(A) H/4

(B) 4H/3

(C) H

**(D) 3H/4**

**Explanation:** The apparent depth (h1) when viewed from above is calculated as h2 (real depth) divided by the refractive index (n) of the medium. Here, h2 is H and n is 4/3. Therefore, h1 = H / (4/3) = 3H/4. Hence, the correct answer is 3H/4.

**Question 6.**

Which of the following figures correctly represent the shape of curve of binding energy per nucleon as a function of mass number ?

[1 Marks]

(A)

**(B)**

(C)

(D)

**Explanation:** The correct figure will show that the binding energy per nucleon is nearly constant (around 8.0 MeV) for nuclei with mass numbers between 30 and 170, as mentioned in the context. It should also illustrate that the binding energy has a maximum around A = 56. This reflects the stability of medium-sized nuclei.

**Question 7.**

When a p-n junction diode is forward biased

[1 Marks]

(A) the barrier height and the depletion layer width both increase.

(B) the barrier height increases and the depletion layer width decreases.

**(C) the barrier height and the depletion layer width both decrease.**

(D) the barrier height decreases and the depletion layer width increases.

**Explanation:** When a p-n junction diode is forward biased (p-side connected to positive terminal and n-side connected to negative), the external voltage reduces the potential barrier at the junction. This decrease in barrier height allows charge carriers to cross the junction more easily, reducing the width of the depletion region. Hence, both the barrier height and the depletion layer width decrease under forward bias, resulting in increased current flow.

**Question 8.**

Assertion (A) : The deflection in a galvanometer is directly proportional to the current passing through it.

Reason (R) =: The coil of a galvanometer is suspended in a uniform radial magnetic field.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

**(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).**

(C) Assertion (A) is false and Reason (R) is also false.

(D) Assertion (A) is true, but Reason (R) is false.

**Explanation:** Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A). The deflection of the galvanometer is indeed directly proportional to the current, but this relationship arises from the principles of electromagnetism governing the galvanometer and not solely due to the coil being suspended in a magnetic field.

**Question 9.**

Assertion (A) : The potential energy of an electron revolving in any stationary orbit in a hydrogen atom is positive.

Reason (R) : The total energy of a charged particle is always positive.

[1 Marks]

**(A) Assertion (A) is false and Reason (R) is also false.**

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

**Explanation:** Assertion (A) is false because the potential energy (U) of an electron in a hydrogen atom is negative, as shown in the context where U = -e^2 / (4πε0 r). Reason (R) is also false since the total energy of the electron in a hydrogen atom is also negative (E = -e^2 / (8πε0 r)). Therefore, both the assertion and reason are incorrect.

## Section B

**Question 10.** A battery of emf E and internal resistance r is connected to a resistor. When a current of 2A is drawn from the battery, the potential difference across the resistor is 5V. The potential difference becomes 4V when a current of 4A is drawn from the battery. Calculate the value of E and r.

[2 Marks]

**Answer:** The emf (E) of the battery can be calculated using the formulas derived from Ohm's law and circuit principles. For 2A current, V = E - Ir gives E = 5V + (2A)(r). For 4A current, V = E - Ir gives E = 4V + (4A)(r). From these, we can find two equations. Solving these equations yields E = 10V and r = 2.5Ω.

**Question 11.**

In a diffraction experiment, the slit is illuminated by light of wavelength 600 nm. The first minimum of the pattern falls at an angle of 30°. Calculate the width of the slit.

[2 Marks]

**Answer:** To find the width of the slit (a), we use the formula for the angle of the first minimum in single slit diffraction: a sin(θ) = nλ, where n=1 for the first minimum. Here, λ = 600 nm = 600 x 10^-9 m and θ = 30°. Thus, a sin(30°) = 1(600 x 10^-9). Since sin(30°) = 0.5, we have a x 0.5 = 600 x 10^-9. Therefore, the width of the slit a = (600 x 10^-9) / 0.5 = 1.2 x 10^-6 m or 1.2 µm.

## Section C

**Question 12.**

Two batteries of emfs 3V & 6V and internal resistances 0.20**Ω** & 0.4**Ω** are connected in parallel. This combination is connected to a 4**Ω** resistor. Find :

i) the equivalent emf of the combination

ii) the equivalent internal resistance of the combination

iii) the current drawn from the combination

[3 Marks]

**Answer:** To find the equivalent emf (E_eq) and internal resistance (r_eq) of two batteries in parallel, we can use the formulas:\n\n1. **Equations for equivalent emf and internal resistance**: \n 1/E_eq = 1/E_1 + 1/E_2 \n E_eq = (E_1*r_2 + E_2*r_1) / (r_1 + r_2)\n\n2. For the given values, \n E_1 = 3V, r_1 = 0.2Ω; E_2 = 6V, r_2 = 0.4Ω.\n \nFinding E_eq: \nE_eq = (3*0.4 + 6*0.2) / (0.2 + 0.4) = (1.2 + 1.2) / 0.6 = 4V.\n\nFinding r_eq: \n1/r_eq = 1/r_1 + 1/r_2 = 1/0.2 + 1/0.4 = 5 + 2.5 = 7.5 \n=> r_eq = 1/7.5 = 0.133Ω\n\nTo find current (I) through the 4Ω resistor, we use Ohm's Law: \nI = E_eq / (R + r_eq) = 4V / (4Ω + 0.133Ω) = 4 / 4.133 ≈ 0.967A.

**Question 13.**

Answer the following giving reason :

(a) All the photo electrons do not eject with the same kinetic energy when monochromatic light is incident on a metal surface.

(b) The saturation current in case (a) is different for different intensity.

(c) If one goes on increasing the wavelength of light incident on a metal

surface, keeping its intensity constant, emission of photo electrons

stop at a certain wavelength for this metal.

[3 Marks]

**Answer:** When monochromatic light strikes a metal surface, photoelectrons are emitted with varying kinetic energy because they absorb photons of energy that can slightly differ due to their interactions with the metal lattice. The saturation current varies with intensity because a higher intensity means more photons are available, leading to more emitted photoelectrons. Moreover, as the wavelength increases (and frequency decreases), fewer electrons can absorb sufficient energy to escape. Beyond a certain wavelength, no photoemission occurs as the energy of incoming photons falls below the threshold energy required to free electrons.

**Question 14.**

(a) Draw circuit arrangement for studying V-I characteristics of a p-n junction diode.

(b) Show the shape of the characteristics of a diode.

(c) Mention two information that you can get from these characteristics.

[3 Marks]

**Answer:** To study the V-I characteristics of a p-n junction diode, a circuit arrangement is made which includes a power source, a diode, a voltmeter, and an ammeter connected in series. In forward bias, when the voltage is applied in the direction of conventional current, the current increases exponentially after reaching the threshold (cut-in) voltage. In reverse bias, the current is almost negligible until breakdown occurs, at a much higher voltage. Typical V-I characteristics exhibit a steep rise in forward bias while showing very little current in reverse bias. From these characteristics, we can glean information about the forward and reverse breakdown voltages, as well as the ideality factor of the diode, which indicates its efficiency.

## Section D

**Question 15.**

(i) Consider three metal spherical shells A, B and C, each of radius R. Each shell is having a concentric metal ball of radius R/10. The spherical shells A, B and C are given charges +6q, —4q, and 14q respectively. Their inner metal balls are also given charges —2q, +8q and —10q respectively. Compare the magnitude of the electric fields due to shells A, B and C at a distance 3R from their centres.

(ii) A charge —6 μC is placed at the centre B of a semicircle of radius 5 cm, as shown in the figure. An equal and opposite charge is placed at point D at a distance of 10 cm from B. A charge +5 μC is moved from point 'C' to point 'A' along the circumference. Calculate the work done on the charge.

[5 Marks]

**Answer:** To determine the electric fields at a distance of 3R from the centers of the shells, we can use the principle that the electric field produced by a charged spherical shell outside its surface acts as if all the charge were concentrated at its center. For shell A, the net charge is +6q; thus, the electric field $E_A$ at 3R is $k(6q)/(3R)^2$. For shell B, the net charge is -4q, giving $E_B = k(-4q)/(3R)^2$. Shell C has a net charge of 14q, resulting in $E_C = k(14q)/(3R)^2$. The ordering of the magnitudes of E will be $E_C > E_A > E_B$ due to their respective charges. For the semicircle, the work done can be derived from the concept of electric potential energy. Given the symmetrical nature and the charges involved, the work done is calculated as the potential difference multiplied by the charge moved, implying that the calculation must take into account the original configuration of the system with respect to potential.

**Question 16.**

(i) (1) What are coherent sources ? Why are they necessary for observing a sustained interference pattern?

(2) Lights from two independent sources are not coherent. Explain.

(ii) Two slits 0.1 mm apart are arranged 1.20 m from a screen. Light of wavelength 600 nm from a distant source is incident on the slits.

(1) How far apart will adjacent bright interference fringes be on the screen ?

(2) Find the angular width (in degree) of the first bright fringe.

[5 Marks]

**Answer:** Coherent sources are light sources that emit waves with a constant phase difference and the same frequency. They are critical for observing interference patterns because they maintain a stable phase relationship, allowing for consistent constructive and destructive interference. In contrast, lights from independent sources are incoherent as they might have varying phase relationships and different frequencies, leading to unpredictable interference patterns. For the two-slit arrangement, using the formula for fringe separation, the distance between adjacent bright fringes can be calculated as 1.5 mm, while the angular width of the first bright fringe is approximately 0.043 degrees.

**Question 17.**

(i) Define a wavefront. An incident plane wave falls on a convex lens and gets refracted through it. Draw a diagram to show the incident and refracted wavefront.

(ii) A beam of light coming from a distant source is refracted by a spherical glass ball (refractive index 1.5) of radius 15 cm. Draw the ray diagram and obtain the position of the final image formed.

[5 Marks]

**Answer:** A wavefront is defined as the surface formed by connecting all points that are in the same phase of a wave, such that all points on the wavefront vibrate together. When an incident plane wave strikes a convex lens, the central part of the wavefront is delayed more than its edges due to varying thickness of the lens. As the light passes through, the wavefront transforms from a planar shape to a spherical shape, converging at the focus point F. The diagram shows the incident planar wavefront approaching the lens, and the refraction creates a new wavefront that curves towards the focal point.\n\nFor the spherical glass ball, considering a distant light source, the incoming rays can be approximated as parallel. The glass ball refracts these rays according to the lens-maker's formula: $1/f = (n-1)(1/R1 - 1/R2)$. For a radius of 15 cm and a refractive index of 1.5, the effective focal length f can be calculated. A ray diagram will show these incoming parallel rays converging, forming a real image on the opposite side of the ball. The exact image position can be determined from the geometry of the setup. Overall, the incident rays converge at a point determined by the properties of the lens.