FIRST TERM MODEL QUESTION PAPER 2024 WITH ANSWER KEY SET 2

PHYSICS - Standard IX

Time: 1.5 hours

Max. Marks: 40

(Prepared by www.educationobserver.com)

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1. 15 minutes is given as cool-off time.
2. This time is to be used for reading the question paper.
3. You are not supposed to write anything during the cool-off time.
4. Attempt the questions according to the instructions.

Section A: Multiple Choice Questions (MCQs) [1 mark each]

1. When light travels from air into glass, which of the following occurs?
   a) Speed of light increases
   b) Speed of light decreases
   c) Light does not change direction
   d) Light continues at the same speed
2. The refractive index of a medium is 1.5. If the speed of light in a vacuum is $3 \times 10^8\ \mathrm{m/s}$, what is the speed of light in this medium? a) $2 \times 10^8\ \mathrm{m/s}$
   b) $2.5 \times 10^8\ \mathrm{m/s}$
   c) $1.5 \times 10^8\ \mathrm{m/s}$
   d) $1 \times 10^8\ \mathrm{m/s}$
3. A ray of light enters water from air at an angle of 30°. What happens to the angle of refraction?
   a) It becomes 30°
   b) It increases
   c) It decreases
   d) It remains unchanged
4. Total internal reflection occurs when:
   a) Light passes from a rarer medium to a denser medium at any angle
   b) Light passes from a denser medium to a rarer medium at an angle less than the critical angle
   c) Light passes from a denser medium to a rarer medium at an angle greater than the critical angle
   d) Light passes from a rarer medium to a denser medium at an angle greater than the critical angle

5. The speed of light is highest in:
   a) Water
   b) Glass
   c) Diamond
   d) Air

Section B: Short Answer Questions (Answer any 4 out of 5) [2 marks each]

1. Calculate the refractive index of a medium if the speed of light in that medium is $2 \times 10^8 \, \text{m/s}$.
2. A ray of light passes from glass (refractive index 1.5) to air (refractive index 1.0). Will it bend towards or away from the normal? Justify your answer.
3. Explain with an example how refraction causes objects under water to appear closer than they actually are.
4. Explain the phenomenon of total internal reflection.
5. Why does a pencil appear bent when it is partially immersed in water?

Section C: Descriptive Questions (Answer any 4 out of 5) [3 marks each]

1. A light ray passes from air into glass with an angle of incidence of 30°. If the refractive index of glass is 1.5, calculate the angle of refraction.
2. A car accelerates uniformly from rest to a speed of 20 m/s in 10 seconds. Calculate the distance covered by the car during this time.
3. Calculate the speed of light in diamond if its refractive index is 2.42. The speed of light in a vacuum is 3×10^8 m/s.
4. Explain the phenomenon of mirage using the concept of total internal reflection.
5. A ray of light traveling from air (n = 1) to water (n = 1.33) strikes the surface at an angle of incidence of 60°. Find the angle of refraction.

Section D: Application Level Questions (Answer any 4 out of 5) [4 marks each]

1. A prism has a refractive index of 1.66. If a ray of light enters the prism at an angle of 45°, calculate the angle of deviation. Assume the angle of the prism is 60°.
2. A swimmer appears to be at a depth of 2 meters when viewed from above water. If the refractive index of water is 1.33, calculate the actual depth of the swimmer.

3. A coin is placed at the bottom of a tank filled with water to a depth of 4 meters. Calculate the apparent depth of the coin when viewed from directly above. (Refractive index of water = 1.33)
4. A light ray traveling through a glass slab (n = 1.5) is incident at an angle of 30°. If the thickness of the slab is 5 cm, calculate the lateral shift of the light ray.
5. A ray of light passes from water (n = 1.33) into air (n = 1). If the critical angle is 48.75°, will total internal reflection occur at an angle of incidence of 50°? Explain and justify your answer with calculations.

Answer Key

Section A: MCQs

1. b) Speed of light decreases
2. a) 2×10^8 m/s
3. c) It decreases
4. c) Light passes from a denser medium to a rarer medium at an angle greater than the critical angle
5. d) Air

Section B: Short Answer Questions

1. $$n = \frac{3\times10^8\ \text{m/s}}{2\times10^8\ \text{m/s}} = 1.5$$
2. The light will bend away from the normal because it is moving from a denser medium (glass) to a rarer medium (air).
3. Objects under water appear closer due to refraction, where the light rays bend as they pass from water to air, making the object appear at a shallower depth than it actually is.
4. Total internal reflection is a phenomenon where a ray of light is completely reflected back into the denser medium instead of being refracted into the rarer medium.
5. The pencil appears bent due to refraction, as light bends when it passes from water to air.

Section C:

1. $n = \frac{\sin i}{\sin r}$
   $1.5 = \frac{\sin 30^\circ}{\sin r}$
   Solving gives $r \approx 19.47^\circ$.
2. Using $s = ut + \frac{1}{2}at^2$, where $u = 0$, $a = 2\,\mathrm{m/s^2}$, $t = 10\,\mathrm{s}$.
   $s = 0 + \frac{1}{2} \times 2 \times 10^2 = 100\,\mathrm{m}$.
3. $n = \frac{c}{v}$, so $v = \frac{3 \times 10^8}{2.42} \approx 1.24 \times 10^8\,\mathrm{m/s}$.
4. Mirage occurs due to total internal reflection, where light bends upwards through layers of air with varying temperatures and densities, creating an illusion of water.
5. Using Snell's Law: $1 \times \sin 60^\circ = 1.33 \times \sin r$, solving gives $r \approx 40.6^\circ$.

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Section D:

1. Use the prism formula: $\delta = (n - 1)A$, where $A = 60^\circ$.
   $\delta \approx 39.6^\circ$.
2. $\text{Actual depth} = \text{Apparent depth} \times n$, so $2 \times 1.33 \approx 2.66\,\mathrm{m}$.
3. Using the apparent depth formula: $\text{Apparent depth} = \frac{\text{Real depth}}{n} = \frac{4}{1.33} \approx 3.01\,\mathrm{m}$.
4. The lateral shift formula is $\text{Lateral shift} = t\sin(i - r)/\cos r$, where $t = 5\,\mathrm{cm}$. Solving gives a lateral shift of approximately 1.73 cm.
5. Since the angle of incidence is greater than the critical angle (50° > 48.75°), total internal reflection will occur.