FIRST TERM MODEL QUESTION PAPER 2024 WITH ANSWER KEY SET 1
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 (1 mark each)

1. The phenomenon of bending of light when it passes from one medium to another is called:
    - (a) Reflection
    - (b) Refraction
    - (c) Diffraction
    - (d) Dispersion
2. The refractive index of a medium is the ratio of:
    - (a) Speed of light in vacuum to speed of light in the medium
    - (b) Speed of light in the medium to speed of light in vacuum
    - (c) Speed of sound in vacuum to speed of sound in the medium
    - (d) Speed of sound in the medium to speed of sound in vacuum
3. A ray of light passes from glass to air. The refracted ray will:
    - (a) Bend towards the normal
    - (b) Bend away from the normal
    - (c) Not bend at all
    - (d) Reflect back into the glass
4. The critical angle for total internal reflection in water is approximately:
    - (a) 25°
    - (b) 42°
    - (c) 48°

- (d) 60°

5. Which of the following uses the principle of total internal reflection?
   - (a) Periscope
   - (b) Magnifying glass
   - (c) Optical fiber
   - (d) Convex lens

5 × 1 = 5 Marks

Section B: Short Answer Type Questions (2 marks each)

(Attempt any 4 out of 5)

6. Define refraction and explain why it occurs.
7. How does optical density differ from material density?
8. State and explain the relationship between speed of light, refractive index, and optical density.
9. Why do stars twinkle at night while planets do not?
10. What is the critical angle? Explain its significance in total internal reflection.

4 × 2 = 8 Marks

Section C: Descriptive Questions (3 marks each)

(Attempt any 4 out of 5)

11. With the help of a diagram, explain the refraction of light through a glass slab.
12. Calculate the refractive index of a medium if the speed of light in the medium is 2×10^8 m/s and the speed of light in vacuum is 3×10^8 m/s.
13. Explain the phenomenon of apparent depth with reference to a coin placed at the bottom of a container filled with water.
14. A ray of light passes obliquely from air into water. Draw the ray diagram and explain what happens to the speed and direction of the light.
15. What is total internal reflection? Explain the conditions required for it with a suitable diagram.

4 × 3 = 12 Marks

Section D: Application and Experiment Questions (4 marks each)

(Attempt any 4 out of 5)

16. A train starts from rest and attains a speed of 20 m/s in 5 seconds. Calculate the acceleration of the train. Also, determine the distance covered by the train during this time.
17. Why does a mirage occur in deserts? Explain the concept using total internal reflection.
18. Explain the application of total internal reflection in optical fibers. Include a diagram to illustrate your explanation.
19. Describe an experiment to determine the critical angle for a glass-air interface using a semicircular glass block.
20. Describe an experiment to observe the apparent bending of a pencil when placed in a glass of water. Explain the observations.

4 × 4 = 16 Marks

Total: 40 Marks

Answer Key

Section A: MCQs

1. (b) Refraction
2. (a) Speed of light in vacuum to speed of light in the medium
3. (b) Bend away from the normal
4. (c) 48°
5. (c) Optical fiber

Section B: Short Answer Type Questions

6. Refraction is the bending of light as it passes from one medium to another due to a change in speed. It occurs because light changes speed when it moves between media of different densities.
7. Optical density refers to how much a material slows down light, while material density refers to mass per unit volume. They are related but not the same.
8. The refractive index n is given by $n = \frac{c}{v}$, where c is the speed of light in a vacuum and v is the speed of light in the medium. A higher refractive index means a denser medium and slower light.

Stars twinkle because the light from them passes through multiple layers of the atmosphere, causing irregular refraction. Planets, being closer, appear as discs and do not twinkle.

9. The critical angle is the angle of incidence above which total internal reflection occurs when light passes from a denser to a rarer medium.

Section C: Descriptive Questions

11. Light bends towards the normal when entering a denser medium and away from the normal when entering a rarer medium. (Include a labeled diagram of a glass slab.)
12. $$n = \frac{c}{v} = \frac{3\times10^8}{2\times10^8} = 1.5$$
13. The coin appears raised due to the bending of light as it travels from water to air, making the coin's image appear at a shallower depth than it is.
14. As light enters water from air, its speed decreases and it bends towards the normal due to a change in optical density. (Include a ray diagram.)
15. Total internal reflection occurs when light travels from a denser to a rarer medium and the angle of incidence exceeds the critical angle. (Include a diagram showing the phenomenon.)

Section D: Application and Experiment Questions

16. Given:

    Initial velocity $u = 0$ m/s,

    Final velocity $v = 20$ m/s,

    Time $t = 5$ s

    Acceleration $a = \frac{v-u}{t} = \frac{20-0}{5} = 4$ m/s^2

    Distance covered $s = ut + \frac{1}{2}at^2 = 0 \times 5 + \frac{1}{2} \times 4 \times (5)^2 = 50$ m
17. A mirage is caused by layers of air with varying densities, leading to total internal reflection of light from the sky, giving the illusion of water.
18. Optical fibers use total internal reflection to transmit light signals over long distances without significant loss. (Include a diagram.)

19. Shine a laser beam at different angles into a semicircular glass block. Gradually increase the angle of incidence until the refracted ray no longer exits the block, indicating total internal reflection. This angle is the critical angle.
20. Place a pencil in a glass of water and observe the apparent bending due to refraction. The pencil appears bent because light from the submerged part bends as it moves from water to air.

Answer Key

Part A: Objective Type Questions (1 Mark each)

1. b) Newton
2. c) Velocity
3. b) 9.8 m/s²
4. b) Barometer
5. c) Newton's third law

Part B: Short Answer Type Questions (2 Marks each)

6. Speed is a scalar quantity and only has magnitude, while velocity is a vector quantity and has both magnitude and direction.
7. Newton's second law states that the force acting on an object is equal to the rate of change of its momentum. Mathematical expression: F = ma.
8. Acceleration is the rate of change of velocity. SI unit: m/s².
9. Inertia is the tendency of an object to resist a change in its state of motion. Example: A book lying on a table remains at rest unless pushed.
10. Distance = Speed × Time = 60 km/h × 2 h = 120 km.

Part C: Short Answer Type Questions (3 Marks each)

11. A hydraulic press works on Pascal's law, which states that pressure applied to a fluid in a confined space is transmitted equally in all directions. (Include a neat labeled diagram.)
12. Momentum is the product of mass and velocity. SI unit: kg m/s. Force = Rate of change of momentum (F = Δp/Δt).
13. Using the formula: $v^2 = u^2 - 2gh$, where $u = 20\,m/s$, $v = 0$ (at the highest point), and $g = 9.8\,m/s^2$. Height, $h = \frac{u^2}{2g} = \frac{(20)^2}{2\times 9.8} = 20.4\,m$.
14. Even though the speed is constant, the direction of motion changes continuously in circular motion, resulting in a change in velocity.
15. Using $F = ma$, $a = \frac{F}{m} = \frac{10\,N}{2\,kg} = 5\,m/s^2$.

Part D: (4 Marks each)

16. a) Using $h = \frac{1}{2}gt^2$, $t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2\times10}{9.8}} \approx 1.43\,s$.
    b) Using $v = gt$, $v \approx 9.8 \times 1.43 \approx 14\,m/s$.
17. a) Final velocity, $v = u + at = 0 + 2 \times 10 = 20\,m/s$.
    b) Distance, $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 2 \times 10^2 = 100\,m$.
18. The rocket ejects gases downward, and by the conservation of momentum, the rocket moves upward with an equal and opposite momentum, leading to its launch.
19. a) Deceleration, $a = \frac{v-u}{t} = \frac{0-72\times\frac{5}{18}}{5} \approx -4\,m/s^2$.
    b) Distance, $s = ut + \frac{1}{2}at^2 = 20 \times 5 + \frac{1}{2} \times (-4) \times 5^2 = 50\,m$.
20. a) Resultant force, $F = 5 + 10 = 15\,N$.
    b) Acceleration, $a = \frac{F}{m} = \frac{15}{3} = 5 \downarrow /s^2$.

Part E: (5 Marks each)

21. Explain how to find the density by measuring the volume displacement using a measuring cylinder and calculating mass using a balance. Include a neat labeled diagram.
22. Describe the working of a simple pendulum and the formula $T = 2\pi\sqrt{\frac{l}{g}}$ to determine g by measuring the period T and length l of the pendulum.