# CLASS TEST



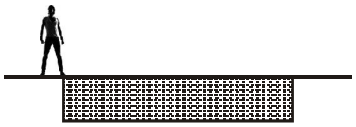
## SECTION-I

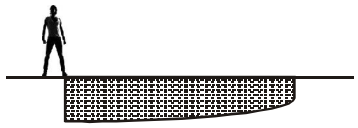
**Single Correct Answer Type** **6 Q. [3 M (–1)]**

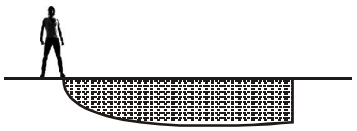
**1.** A concave mirror is placed on a horizontal surface and two thin uniform layers of different transparent liquids (which do not mix or interact) are formed on the reflecting surface. The refractive indices of the upper and lower liquids are $\mu_1$ and $\mu_2$ respectively. The bright point source at a height 'd' (d is very large in comparison to the thickness of the film) above the mirror coincides with its own final image. The radius of curvature of the reflecting surface therefore is :

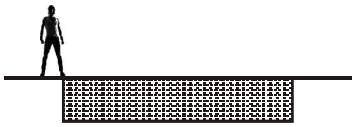
(A) $\frac{\mu_1 d}{\mu_2}$ (B) $\mu_1\mu_2 d$ (C) $\mu_1 d$ (D) $\mu_2 d$

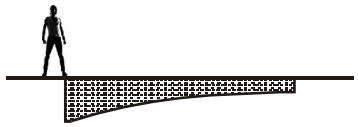
**2.** An observer stands at the edge of a swimming pool, as sketched in the figure below. This observer will perceive the pool as :-



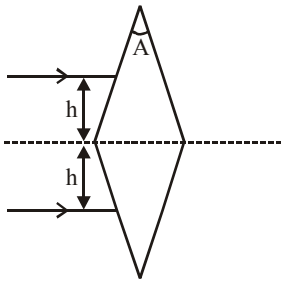
(A) 

(B) 

(C) 

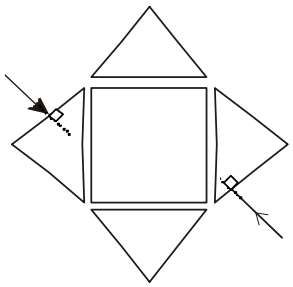
(D) 

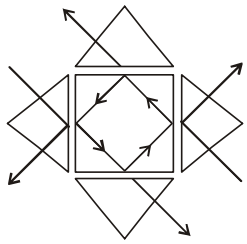
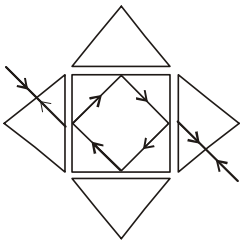
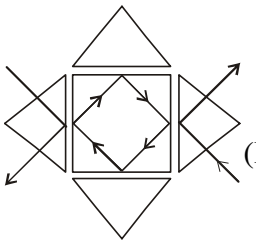
**3.** Two identical isosceles thin prisms of prism angle A and refractive index μ are placed with their bases touching each other. This system acts as a converging lens. What is the focal length of this system for parallel rays at a distance h from the base of the prism ?




(A) $\frac{2h}{(\mu-1)A}$ (B) $\frac{h}{(\mu-1)A}$ (C) $\frac{h}{2(\mu-1)A}$ (D) None of these

**4.** Figure shows a glass cube surrounded by four glass prisms in very close proximity to its sides. The path that will be taken by the two rays incident normally on the sides of the prisms is:



(A)  (B)  (C)  (D) None of these

**5.** Three point charge q, –2q and –2q are placed at the vertices of an equilateral triangle of side a. The minimum work done by some external force to increases their separation to 2a will be

(A) $\frac{1}{4\pi \in_0}\frac{2q^2}{a}$ (B) negative (C) zero (D) $\frac{1}{4\pi \in_0}\frac{3q^2}{a}$

**6.** A charge of 6μC is fixed at the origin. Another identical charge is placed at a distance of 2 m from the fixed charge and is released. The charges have a mass of 0.1 kg each. Then choose the correct statement:-

(A) The maximum speed achieved by the 2nd charge will be 1.8 m/sec

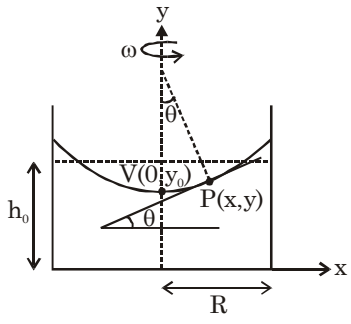
(B) The maximum speed achieved by the 2nd charge will depend on the direction of its motion

(C) As time passes, potential energy of the system increases.

(D) The 2nd charge will achieve a maximum velocity of $0.9\sqrt{2}$ m/s

## Multiple Correct Answer Type 3 Q. [4 M (–1)]

**7.** Consider mercury (Hg) rotating about a vertical axis with uniform angular velocity ω filled in a cylindrical container. The liquid surface is curved. The figure shows a cross sectional view of the curved surface. Ignore surface tension and viscosity. [**Hint** : coordinates of focus for parabola $x^2 = 4ay$ is given by (0,a)] Mark the **CORRECT** statement(s) :



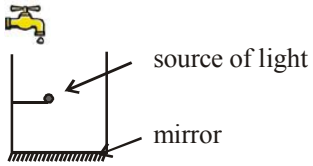

(A) Steady state angle θ made by tangent to the surface at P(x, y) with the horizontal is given by $\tan^{-1}\left(\frac{\omega^2 x}{g}\right)$

(B) Steady state angle θ made by tangent to the surface at P(x, y) with the horizontal is given by $\sin^{-1}\left(\frac{\omega^2 x}{g}\right)$

(C) If the focal length of the mirror formed by shiny liquid surface is 20 cm then ω is 5 rad/s

(D) If the focal length of the mirror formed by shiny liquid surface is 20 cm then ω is 10 rad/s

**8.** A small source of light is mounted inside a cylindrical container of height h. The bottom of the container is covered with a mirror. Initially, the container is empty. Then a clear liquid with the index of refraction n is slowly poured into the container. The level of liquid H rises steadily, reaching the top of the container in time T. Let $h_1$ be the distance of source of the light from the bottom of the container. Consider paraxial ray approximation.




Consider two cases in which the observer is in the air observing the image of the source in the mirror.
(1) $H \le h_1$ (2) $h_1 \le H \le h$

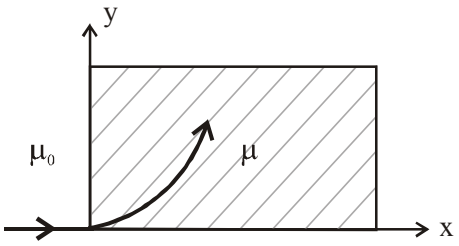
(A) The speed of the image of the source in case (1) during this process is $\frac{2h}{T}\left(1-\frac{1}{n}\right)$.

(B) The speed of the image of the source in case (2) during this process is $\frac{h}{T}\left(1-\frac{1}{n}\right)$.

(C) The speed of the image of the source in case (1) during this process is $\frac{h}{2T}\left(1-\frac{1}{n}\right)$.

(D) The speed of the image of the source in case (2) during this process is $\frac{h}{2T}\left(\frac{1}{n}\right)$.

**9.** The refractive index of the medium with a certain region, $x > 0$, $y > 0$, changes with y. A thin light ray travelling in the x-direction in medium having refractive index $\mu_0 = 1$ strikes another medium of refractive index $\mu$ at right angles and moves through the medium along a circular arc of radius R as shown in the figure. The material with the greatest known refractive index is diamond, but even the refractive index of this material does not reach the value $\mu_{max} = 2.5$. It is this limit that sets the maximum angular size of the arc the light ray can cover. Angular size of arc is the angle subtended by the arc at the centre.




(A) The variation of refractive index $\mu$ with y is given as $\mu = \frac{R}{R-y}$

(B) The unit vector in the direction of refracted light at $y = \frac{R}{2}$ is $\frac{1}{2}\hat{i} + \frac{\sqrt{3}}{2}\hat{j}$

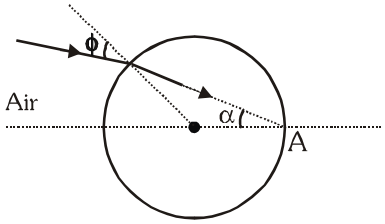
(C) If the maximum angular size of the arc of light is $\theta_{max}$ then $\sin\theta_{max} = 2/5$

(D) If the maximum angular size of the arc of light is $\theta_{max}$ then $\cos\theta_{max} = 2/5$

## Linked Comprehension Type (1 Para × 3Q.) [3 M (-1)]
## (Single Correct Answer Type)

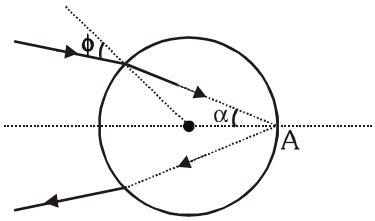
**Paragraph for Question 10 to 12**

A ray of light enters a spherical drop of water of refractive index μ as shown in the figure.




**10**. Selct the correct statement
(A) Incident rays are partially reflected at point A
(B) Incident rays are totally reflected at point A
(C) Incident rays are totally transmitted through point A
(D) None of these

**11**. An expression of the angle between incident ray and emergent ray (angle of deviation) as shown in the figure is




(A) 0° (B) ϕ (C) α–ϕ (D) π–4α+2ϕ

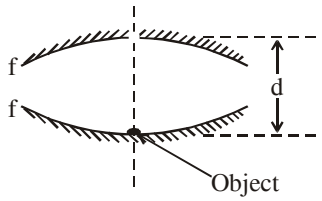
**12**. The angle ϕ for which minimum deviation is produced will be given by

(A) $\cos^2\phi = \frac{\mu^2+1}{3}$ (B) $\cos^2\phi = \frac{\mu^2-1}{3}$ (C) $\sin^2\phi = \frac{\mu^2+1}{3}$ (D) $\sin^2\phi = \frac{\mu^2-1}{3}$

## Linked Comprehension Type (1 Para × 2 Q.) [4 M (–1)]
## (Multiple Correct Answer Type)

**Paragraph for Questions 13 and 14**

Two concave mirrors with equal forcal length f, are placed one above other at a seperation of d. Upper mirror has a small hole at its centre as given. A small object is placed at centre of lower mirror. Take first reflection at above mirror and second at lower and answer the given questions for these two reflections only.




For final image to be at the hole of the upper mirror

**13.** Value of d for given possitility

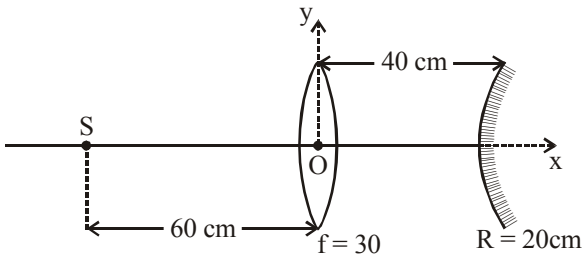
(A) f (B) 2f (C) 3f (D) $\frac{f}{3}$

**14.** Nature of image
(A) Erect with equal size (B) Erect with uneual size
(C) inverted with equal size (D) inverted with unequal size

## SECTION-III

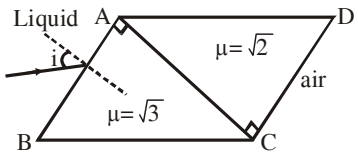
**Numerical Grid Type (Ranging from 0 to 9)** **4 Q. [4 M (0)]**

**1.** In the shown arrangement a point source of light S is placed 60 cm left to a convex lens of focal length 30 cm and 2 cm above the common principal axis of the convex lens and a convex mirror of focal length 10 cm. Consider optical centre of the lens to be the origin, the x-coordinate of the final image of the source S for the viewer left of the lens, is equal to –10K cm. Calculate the value of K.

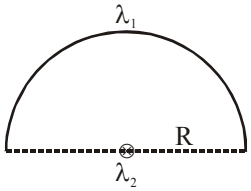



**2.** A man of height 2 m stands on a straight road on a hot day. The vertical temperature in the air results in a variation of refractive index with height y as $\mu = \mu_0\sqrt{(1+ay)}$ where $\mu_0$ is the refractive index of air near the road and $a = 2 \times 10^{-6}$/m. What is the actual length of the road (in km), man is able to see

**3.** A ray of light from a liquid ($\mu = \sqrt{3}$) is incident on a system of two right angled prism of refractive indices $\sqrt{3}$ and $\sqrt{2}$ as shown. The ray suffers zero deviation when emerges into air from CD. The angle of incidence i is $\pi/n$. Find the value of n.



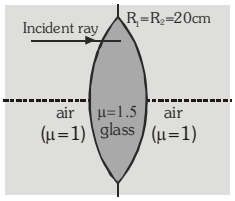

**4.** An infinite long uniformly charged wire is kept along axis of a uniformly charged semi circular ring of radius R as shown. Linear charge density of ring and wire are respectively $\lambda_1$ and $\lambda_2$. Net electrostatic force on wire due to ring is $\frac{4k\lambda_1\lambda_2}{R^{n-1}}$ value of n is



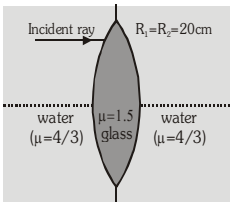
## SECTION-IV

**Matrix Match Type (4 × 5)** **2 Q. [8 M (for each entry +2(0)]**

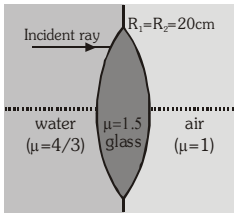
**1.** **Column I (optical system)** **Column II (focal length)**

(A) 

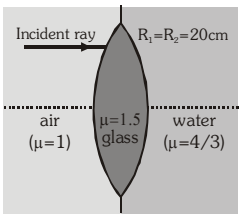

(P) 80 cm

(B) 


(Q) 40 cm

(C) 


(R) 30 cm

(D) 


(S) 20 cm

**2.** The greatest thickness of a plano convex lens when viewed normally through the plane surface appears to be 3 cm & when viewed normally through the curved surface it appears to be 3.6 cm. Actual thickness of lens is 4.5 cm.

| | **Column–I** | | **Column–II** |
|---|---|---|---|
| (A) | The refractive index of the material of the lens in multiple of $10^{-1}$ is | (P) | 9 |
| (B) | The radius of curvature of lens in cm | (Q) | 3 |
| (C) | The focal length if its plane surface is silvered in cm | (R) | 16 |
| (D) | The focal length if its curved surface is silvered in cm | (S) | 15 |

**CLASS TEST # 12 (TNAS)** **ANSWER KEY**

## SECTION-I

**Single Correct Answer Type** **6 Q. [3 M (–1)]**

**1. Ans. (D)** **2. Ans. (A)** **3. Ans. (B)** **4. Ans. (A)**

**5. Ans. (C)** **6. Ans. (A)**

**Multiple Correct Answer Type** **3 Q. [4 M (–1)]**

**7. Ans. (A,C)** **8. Ans. (A,B)** **9. Ans. (A, B, D)**

**Linked Comprehension Type** **(1 Para × 3Q.) [3 M (-1)]**

**(Single Correct Answer Type)**

**10. Ans. (A)** **11. Ans. (D)** **12. Ans. (B)**

**Linked Comprehension Type** **(1 Para × 2 Q.) [4 M (–1)]**

**(Multiple Correct Answer Type)**

**13. Ans. (A,C)** **14. Ans. (A,C)**

## SECTION-III

**Numerical Grid Type (Ranging from 0 to 9)** **4 Q. [4 M (0)]**

**1. Ans. 6** **2. Ans. 2** **3. Ans. 4** **4. Ans. 1**

## SECTION-IV

**Matrix Match Type (4 × 5)** **2 Q. [8 M (for each entry +2(0)]**

**1. Ans. (A) S; (B) P; (C) R; (D) Q** **2. Ans. (A) S; (B) P; (C) P; (D) Q**