Ultimate KCET Crash Course 2026

PHYSICS

DPP: 2

Ray optics and optical instruments

Q1 The refracting angle of a glass prism is 30°. A ray is incident on one of the faces perpendicular to it . The angle of deviation δ between the incident ray and that leaves the prism is (Refractive index of glass =1.5) (sin30° = 0.5,sin (48.6)° = 0.75)

(A) 17° (B) (18.6)°

(C) (12.6)° (D) 16°

Q2 Given below are two statements labelled as Statement P and Statement Q:

Statement P: A total reflecting prism is used to erect the inverted image without deviation.

Statement Q: Rays of light incident parallel to base of prism emerge out as parallel rays.

Select the most appropriate option

(A) P is true, but Q is false

(B) P is false, but Q is true

(C) Both P and Q are true

(D) Both P and Q are false

Q3 An object approaches a convergent lens from the left of the lens with a uniform speed 5 m/s and stops at the focus, the image

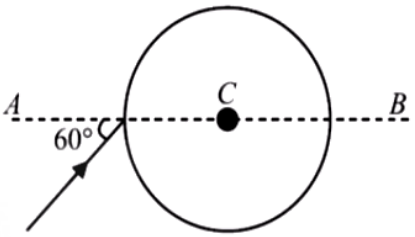
(A) Moves away from the lens with an uniform speed 5 m/s

(B) Moves away from the lens with an uniform acceleration

(C) Moves away from the lens with a nonuniform acceleration

(D) Moves towards the lens with a non-uniform acceleration

Q4 A ray of light falls on a transparent sphere with center at C as shown in figure. The ray emerges from the sphere parallel to line AB. The refractive index of the sphere is



(A) $\sqrt{2}$

(B) $\sqrt{3}$

(C) 3/2

(D) 1/2

Q5 A glass has refractive index μ with respect to air and the critical angle for a ray of light is going from glass to air is θ. If a ray of light is incident from air on the glass with angle of incidence θ, corresponding angle of refraction is

(A) 90°

(B) $\sin^{-1}\left(\frac{1}{\mu^2}\right)$

(C) $\sin^{-1}\left(\frac{1}{\mu}\right)$

(D) $\sin^{-1}\left(\frac{1}{\sqrt{\mu}}\right)$

Q6 The apparent depth of a needle lying in a water beaker is found to be 9 cm. If water is replaced by a liquid of refractive index 1.5, then the apparent depth of needle will be (m of water is 4/3)

(A) 10 cm (B) 9 cm

(C) 12 cm (D) 8 cm

Q7 What is the refractive index of a material of a plano-convex lens, if the radius of curvature of the convex surface is 10 cm and focal length of the lens is 30 cm?

(A) $\frac{6}{5}$ (B) $\frac{7}{4}$

(C) $\frac{2}{3}$ (D) $\frac{4}{3}$

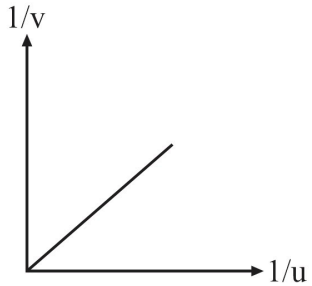
Q8 A spherical convex surface of power 5 dioptre separates object and image space of refractive indices 1.0 and $\frac{4}{3}$ respectively. The radius of curvature of the surface is

(A) 20 cm (B) 1 cm

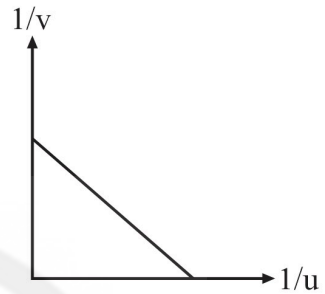
(C) 4 cm (D) 5 cm

Q9 The graph between $\frac{1}{v}$ and $\frac{1}{u}$ for a concave mirror looks like

(A)



(B)



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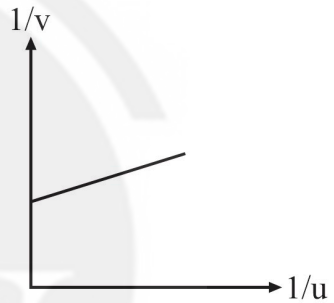
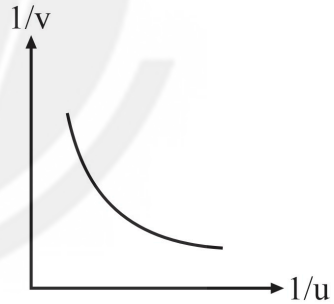


(D)



Q10 A concave mirror has a focal length of $20\ cm$. The distance between the two positions of the object for which the image size is double of the object size is

(A) 20 cm (B) 40 cm

(C) 30 cm (D) 60 cm

Q11 A mark at the bottom of a liquid appears to rise by 0.1 m. The depth of the liquid is 1 m. The refractive index of the liquid is:-

(A) 1.33 (B) $\frac{9}{10}$

(C) $\frac{10}{9}$ (D) 1.5

Q12 The relation between radius of curvature R and focal length f is given by-

(A) R=3f (B) R=f/2

(C) R=f/3 (D) R=2f

Q13 The focal length of the objective of a compound microscope is

(A) greater than the focal length of eyepiece

(B) equal to the length of its tube

(C) equal to the focal length of eyepiece

(D) lesser than the focal length of eyepiece

Q14 Given

I. Plane mirrors

II. Concave mirrors

III. Convex mirrors

Among the above choices, virtual images can be formed by

(A) I, II and III (B) I and II

(C) I and III (D) II only

Q15 An object of height 1 cm is set at right angles to the optical axis of a double convex lens of optical power 5D and 25 cm away from the lens. Determine the position of the image and the linear magnification of the lens respectively.

(A) 1 m, –4 (B) 2 m, –4

(C) 3 m, –6 (D) 1 m, –6

Q16 A point object is placed at a distance of 30 cm from a convex mirror of focal length 30 cm. The image will form at:-

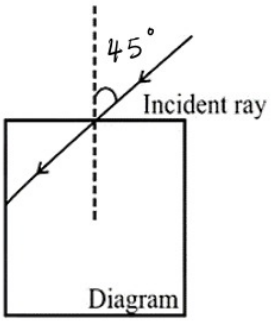
(A) Infinity

(B) Focus

(C) Pole

(D) 15 cm behind the mirror

Q17 A light ray falls on a square glass slab as show in the diagram. The index of refraction of the glass, if total internal reflection is to occur at the vertical face, is equal to



(A) $\frac{(\sqrt{2}+1)}{2}$

(B) $\sqrt{\frac{5}{2}}$

(C) $\frac{3}{2}$

(D) $\sqrt{\frac{3}{2}}$

Q18 The critical angle for diamond (refractive index =) is

(A) Above 20°

(B) 60°

(C) 45°

(D) 30°

Q19 A telescope has an objective lens of 10 cm diameter and is situated at a distance of one kilometre from two objects. The minimum distance between these two objects, which can be resolved by the telescope, when the mean wavelength of light is 5000 A, of the order of:

(A) 0.5 m (B) 5 m

(C) 5 mm (D) 5 cm

Q20 The colour of light which travels with the maximum speed in glass is

(A) Red (B) Violet

(C) Blue (D) Green

Q21 The wavelength of light in air is 6000 Å and in medium its value is 4000 Å. It means that the refractive index of that medium with respect to air is

(A) 1.2 (B) 2.4
(C) 0.66 (D) 1.5

Q22 The magnifying power of telescope is high if

(A) the objective has a long focal length and the eye-piece has a short focal length
(B) both objective and eye-piece have short focal lengths
(C) the objective has a short focal length and the eye-piece has a long focal length
(D) both objective and eye-piece have long focal length

Q23 At what angle must two plane mirrors be placed so that the incident and resulting reflected rays are always parallel to each other?

(A) 0° (B) 30°
(C) 60° (D) 90°

Q24 A certain prism is found to produce a minimum deviation of 38°. It produces a deviation of 44° when the angle of incidence is either 42° or 62°. What is the angle of incidence when it is undergoing minimum deviation?

(A) 40°
(B) 60°
(C) 30°
(D) 49°

Q25 A small source of light is 4 m below the surface of a liquid of refractive index 5/3. In order to cut off all the light coming out of liquid surface, minimum diameter of the disc placed on the surface of liquid is :

(A) 3 m (B) 4m
(C) 6 m (D) ∞

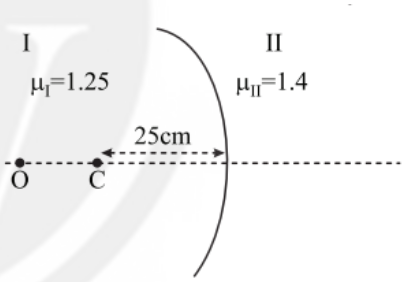
Q26 Velocity of light in air is 3×10^8 ms^{-1} and refractive index of water is 1.33. The time taken by the light to travel a distance of 500 m in water is

(A) 1.25 μs
(B) 2.22 μs
(C) 12.5 μs
(D) 22.6 μs

Q27 The largest distance of the image of a real object from a convex mirror of focal length 10 cm can be-

(A) 20 cm
(B) Infinite
(C) 10 cm
(D) Depends on the position of the object

Q28 Region I and II are separated by a spherical surface of radius 25 cm. An object is kept in region I at a distance of 40 cm from the surface. The distance of the image from the surface is:

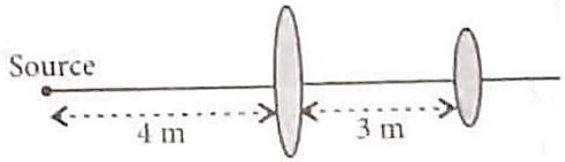


(A) 9.25 cm (B) 18.23 cm
(C) 37.58 cm (D) 55.44 cm

Q29 A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is 20 cm away from the mirror. The length of the image is

(A) 10 cm (B) 15 cm
(C) 2.5 cm (D) 5 cm

Q30 An object is located 4 m from the first of two thin converging lenses of focal lengths 2 m and 1 m respectively. The lenses are separated by 3 m . The final image formed by the second lens is located from the source at a distance of



(A) 8.0 m (B) 7.5 m
(C) 6.0 m (D) 6.5 m

Answer Key

Q1	B
Q2	C
Q3	C
Q4	B
Q5	B
Q6	D
Q7	D
Q8	D
Q9	B
Q10	A
Q11	C
Q12	D
Q13	D
Q14	A
Q15	A
Q16	D
Q17	D
Q18	D
Q19	C
Q20	A
Q21	D
Q22	A
Q23	D
Q24	D
Q25	C
Q26	B
Q27	C
Q28	C
Q29	D
Q30	B

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

Given, $A = 30°. \mu = 1.5 i_1 = 0°$

In a prism $r_1 + r_2 = A \therefore r_2 = A = 30°$

$\Rightarrow \quad 1.5 = \frac{\sin i_2}{\sin 30°} \Rightarrow \sin i_2 = 1.5 \sin 30°$

$= 1.5 \times \frac{1}{2} = 0.75$

$i_2 = \sin^{-1}(0.75) = 48.6°$

Deviation, $\delta = (i_1 + i_2) - A = (0 + 48.6°)$

$-30° = 18.6°$

Video Solution:

Q2 Text Solution:

Both P and Q are true

Video Solution:

Q3 Text Solution:

Moves away from the lens with a non-uniform acceleration.

Video Solution:

Q4 Text Solution:

Deviation by a sphere is $2(i - r)$ Here, deviation δ

$= 60° = 2(i - r)$

$\therefore r = \text{i} - 30° = 60° - 30° = 30° \therefore \mu = \frac{\text{sini}}{\sin r} = \frac{\sin 60°}{\sin 30°}$

$= \sqrt{3}$

Video Solution:

Q5 Text Solution:

$\sin\theta = \frac{1}{\mu}$

$\mu = \frac{\sin\theta}{\sin r}$

where r is the angle of refraction from (i) and (ii), we get

$\sin r = \frac{1}{\mu^2}$

$r = \sin^{-1}\left(\frac{1}{\mu^2}\right)$

Video Solution:

Q6 Text Solution:

Apparent depth $= \frac{\text{Real depth}}{\text{Refractive index}}$

$\frac{\text{apparent depth in water}}{\text{Apparent depth in liquid}} = \frac{\mu_{lq}}{\mu_{water}}$

or $\frac{9}{\text{Apparent depth in liquid}} = \frac{1.5\times3}{4}$

Apparent depth in liquid = 8cm

Video Solution:

Q7 Text Solution:

According to lens maker's formula

$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

Here, f = 30 cm, $R_1 = \infty$

(For plane surface)

R_2 = –10 cm

$\therefore \frac{1}{30} = (\mu - 1)\left(\frac{1}{\infty} - \frac{1}{-10}\right) \Rightarrow \frac{1}{30} = \frac{(\mu-1)}{10}$

$3(\mu - 1) = 1 \quad 3\mu = 4$

$\mu = \frac{4}{3}$

Video Solution:

Q8 Text Solution:

Given, Power = 5D (convex surface) and $f = \frac{100}{P} = \frac{100}{5} = 20$ cm. Here $\mu_1 = 1$ and $\mu_2 = \frac{4}{3}$

Let the radius of curvature of the surface is R.

$\frac{-\mu_1}{u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}$. $Here\ u = \infty, v = f = 20$ cm

$\therefore \frac{-1}{\infty} + \frac{4}{3\times20} = \frac{4/3-1}{R}$ or $\frac{1}{15} = \frac{1}{3R}$ $\therefore R = 5$ cm

Video Solution:

Q9 Text Solution:

It should be a straight line with negative slope.

Video Solution:

Q10 Text Solution:

$m = \frac{f}{f-u}$

For m = - 2, we get u_1 = 30cm

For m =+2, u_2 = 10 cm

$\Delta u = 30 - 10 = 20cm$

Video Solution:

Q11 Text Solution:

$$\mu = \frac{real\ \ depth}{apparent\ \ depth} = \frac{1}{0.9} = \frac{10}{9}$$

Video Solution:

Q12 Text Solution:

For a spherical mirror, the radius of curvature is twice its focal length. The focus lies in the middle of the radius of the curvature.

So, R=2f

Video Solution:

Q13 Text Solution:

(d) lesser than the focal length of eyepiece

Explanation:

lesser than the focal length of eyepiece

Video Solution:

Q14 Text Solution:

Convex mirrors always produce a virtual, erect, and diminished image, and the size of the image decreases depending on the object in front of the mirror.

Plane Mirrors always produce a virtual and erect image of the same size as the object, regardless of its position.

Depending on the position of the object on the principal axis, concave mirrors produce real and virtual images. Only when an object is placed between the Focus and the pole of the concave mirror does it form a virtual and erect image.

As a result, all three mirrors can form a virtual image.

Video Solution:

Q15 Text Solution:

$P = 5\text{D} \Rightarrow f = \frac{1}{5}\ \text{m} = 20\ \text{cm}$

By lens formula,

$\Rightarrow \frac{1}{v} = \frac{1}{20} - \frac{1}{25} \Rightarrow \frac{1}{v} = \frac{5}{20\times25}$

v=100 cm = 1 m

$m = +\frac{v}{u} = \frac{100}{-25} = -4$

Video Solution:

Q16 Text Solution:

$$v = \frac{fu}{u-f} = \frac{(30)(-30)}{-30-30} = 15cm$$

Video Solution:

Q17 Text Solution:

$$We\ have\ \sin r = \frac{1}{\sqrt{2}\ n_g}$$

$$and\ \cos(r) = \frac{1}{n_g}$$

$$On\ solving\ we\ get,$$

$$n_g = \sqrt{\frac{3}{2}}$$

Video Solution:

Q18 Text Solution:

From concept of Total internal reflection (TIR)

$$\Rightarrow \mu = \frac{1}{\sin C}$$

$$\text{Where , } \mu = \text{ refractive index}$$

$$= 2(\text{ for diamond })$$

$$C = \text{ critical Angle}$$

$$\Rightarrow C = \sin^{-1}\left(\frac{1}{2}\right) = 30^\circ$$

Video Solution:

Q19 Text Solution:

Resolving limit of telescope is

$$\theta \propto \frac{x}{D} = \frac{\lambda}{d}$$

$$\Rightarrow x = \frac{\lambda D}{d}$$

Given, λ = 5000 Å = 5000 × 10^{-10} m,

D = 1 km = 1000 m

d = 10 cm = 0.1 m

Hence, $x = \frac{5000\times10^{-10}\times1000}{0.1}$

= 5 × 10^{-3} m

= 5 mm

Video Solution:

Q20 Text Solution:

In a glass the red light travels faster. While the violet travels the slowest.

The speed is directly propotional to the wavelength. Since the red light has the most wavelength, it travels faster than the other among the all seven colours.

Video Solution:

Q21 Text Solution:

(d) 1.5

Explanation:

Refractive index = 6000/4000 = 3/2 = 1.5

Video Solution:

Q22 Text Solution:

(a) the objective has a long focal length and the eye-piece has a short focal length

Explanation:

Magnifying power of telescope is directly proportional to f_o/f_e

Hence, f_o should be large and f_e should be small.

Video Solution:

Q23 Text Solution:

$here\ deviation\ d\ = 180°$

$d\ =\ 360°\ -2\theta$

$\theta\ = 90°$

Video Solution:

Q24 Text Solution:

$\delta_{\min} = 38°$

$i = \frac{A+\delta}{2}$

$\delta \rightarrow$ Deviation

i $\rightarrow$ Angle of incidence

A $\rightarrow$ Angle of prism

δ = (i + e) –A

A = 104 – 44

A = 60°

$\Rightarrow i = \frac{60+38}{2} = 49°$

Video Solution:

Q25 Text Solution:

$$diameter = 2r = \frac{2h}{\sqrt{\mu^2 - 1}}$$

Video Solution:

Q26 Text Solution:

Velocity of light in water is,

$$v = \frac{c}{\mu} = \frac{3\times10^8}{\left(\frac{4}{3}\right)} = \frac{9}{4}\times10^8 \text{ m s}^{-1}$$

The time taken by the light to travel a distance of 500 m in water is

$$t = \frac{x}{v} = \frac{500}{\frac{9}{4}\times10^8} = 0.222\times10^{-5}s = 2.22\mu s$$

Video Solution:

Q27 Text Solution:

Largest distance of the image of a real object from a convex mirror = focal length= 10 cm

Video Solution:

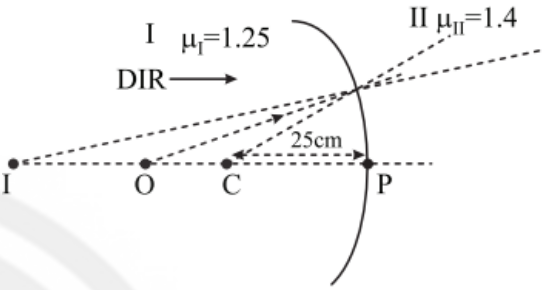
Q28 Text Solution:

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

$$\Rightarrow \frac{1.4}{v} - \frac{1.25}{-40} = \frac{1.4 - 1.25}{-25}$$

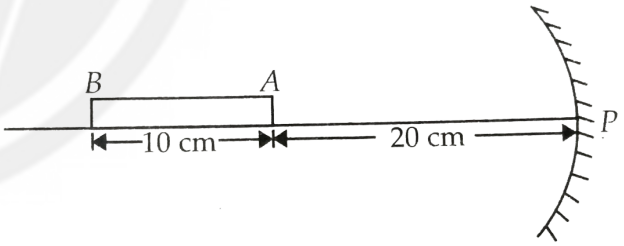
$$\Rightarrow -\frac{1.4}{v} = \frac{0.15}{25} + \frac{1.25}{40} = \frac{7.45}{200}$$

$$\Rightarrow v = -\frac{200\times1.4}{7.45} = -37.58 \text{ cm}$$



Video Solution:

Q29 Text Solution:



Here, f = –10 cm, For end A, u_A = –20 cm

Image position v_A of end A is given by

$$\frac{1}{v_A} + \frac{1}{(-20)} = \frac{1}{(-10)} \text{ or } \frac{1}{v_A} = \frac{1}{-10} + \frac{1}{20} = -\frac{1}{20}$$

$$v_A = -20 \text{ cm}$$

For end B, u_B = –30 cm

Image position v_B of B is given by

$$\frac{1}{v_B} + \frac{1}{(-30)} = \frac{1}{(-10)} \text{ or } \frac{1}{v_B} = \frac{1}{-10} + \frac{1}{30} = -\frac{2}{30}$$

$v_B = -15$ cm Length of the image

$=|v_A|-|v_B|= 20\ \text{cm} - 15\ \text{cm} = 5\ \text{cm}$

Video Solution:

Q30 **Text Solution:**

For first lens, $f_1 = 2m, u_1 = -4m, v_1 = ?$

Using lens formula,

$\frac{1}{v_1} - \frac{1}{u_1} = \frac{1}{f_1}; \frac{1}{v_1} - \frac{1}{-4} = \frac{1}{2}$

$v_1 = 4m$

For second lens, $f_2 = 1m$

Object distance, $u_2 = |v_1| - 3 = 4 - 3 = 1m$

Image distance $v_2 = ?$

$\frac{1}{v_2} - \frac{1}{1} = \frac{1}{1}\ or\ \frac{1}{v_2} = 1 + 1 = 2; v_2 = 0.5m$

So, Distance of final image from the source point

$= 4 + 3 + v_2 = 4 + 3 + 0.5 = 7.5m$

Video Solution: