SHIKSHA CLASSES

Sub. : Science **Answer Paper** **Marks : 30**

Std. : Xth - CBSE **10. Light Reflection and Refraction**

SECTION (A) **(Each - 1 Mark)**

Q.1 : A ray of light that strikes a plane mirror PQ at an angle of incidence of 30^0, is reflected from the plane mirror and then strikes a second plane mirror QR placed at right angles to the first mirror. The angle of reflection at the second mirror is :

Ans : c) 60^0

OR

A ray of light is passes from a medium X to another medium Y. No refraction of light occurs if the ray of light hits the boundary of medium Y at an angle of :

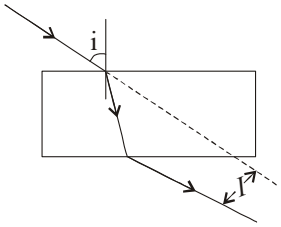
Ans : b) 90^0

Q.2 : What is the position of the object if a concave mirror produces a magnification of +4?

Ans : If a concave mirror produces a magnification of +4 then position of the object is in between focus and pole.

OR

A student traces the path of a ray of light passing through a rectangular slab for three different values of angle of incidence ($\angle$i) namely 30^0, 45^0 and 60^0. He extends the direction of incident ray by a dotted line and measures the perpendicular distance 'I'between the extended incident ray and the emergent ray.



He will observe that :

Ans. a) 'I' keeps on increasing with increase in angle of incidence

Q.3 : Assertion (A) : In the dispersion of white light by a prism, the red light bends the least.

Reason (R) : The frequency of red light is the highest.

Ans : a) Both A and R are true and R is correct explanation of the assertion.

Q.4: Assertion(A) : Light travels faster in glass than in air.

Reason (R) : Glass is denser than air.

Ans : d) A is false but R is true.

Q.5: Assertion(A) : The emergent ray is parallel to the direction of the incident ray.

Reason (R) : The extent of bending of the ray of light at the opposite parallel faces (air-glass

Ans : a) Both A and R are true and R is correct explanation of the assertion.

Q.6 : State a condition for no refraction of light entering from one medium to another.

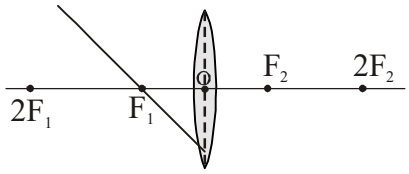
Ans : When light passes from one medium to another refraction does not happen under any one of he given conditions.

i) If the ray is incident normally then angle of incidence = angle of refraction = 0 So there will not be any refraction.

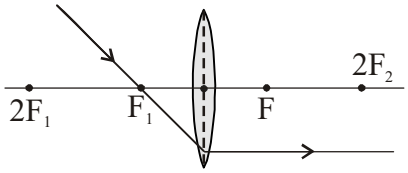
ii) If both media have the same refractive index then also refraction will not occur.

OR

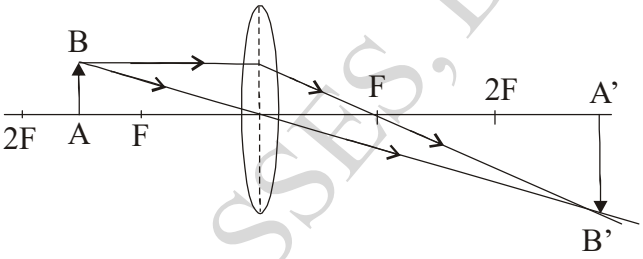
Redraw the ray diagram given below and complete the path of ray.



Ans :



Q.7: Observe the following diagram and answer any two questions from 5(i) to 5(iii) **(2 Mark)**



i) What is the position of the object?

Ans : b) Between F and 2F

ii) What is the nature of the image?

Ans : a) Real

iii) What is the position of the image?

Ans : b) Beyond 2F

a) Between F and 2F b) Beyond 2F c) Both a and b d) None of these.

Q.8: If an incident ray passes through the focus, the reflected ray will

Ans : (b) be parallel to the principal axis

Q.9: If the magnification produced by a lens has a negative value, the image will be

Ans : (b) virtual and erect

Q.10: When the object is placed between f and 2f of a convex lens, the image formed is

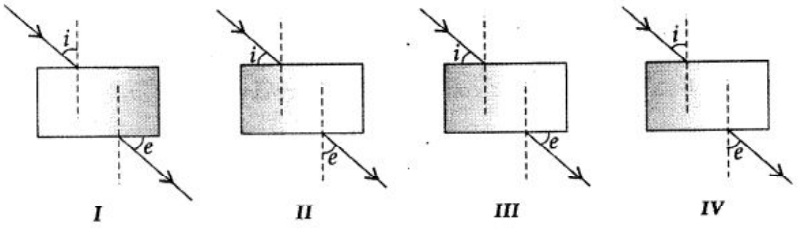
Ans : (c) beyond 2f

Q.11: A ray of light is travelling from a rarer medium to a denser medium. While entering the denser medium at the point of incidence, it

Ans : (b) bends towards the normal

Q.12: A student does the experiment on tracing the path of a ray of light passing through a

rectangular glass slab for different angles of incidence. He can get a correct measure of the angle of incidence and the angle of emergence by following the labelling indicated in figure:



Ans : (d) IV

Q.13:The unit of power of lens is

Ans : (c) Diopter

Q.14: The radius of curvature of a mirror is 20cm the focal length is

Ans : (b) 10cm

SECTION (B) **(Each - 2 Mark)**

Q.15 : The refractive index of material is 1.33. If the velocity of light in vaccum is 3×10^8 m/s. Find the velocity of light in the material.

Ans : $$\text{Refractive index} = \frac{\text{Velocity of light in vaccum}}{\text{Velocity oflight in material}}$$

$$1.33 = \frac{3\times10^8}{\text{Velocity oflight in the material}}$$

$$\text{Velocity of light in the material} = \frac{3\times10^8}{1.33}$$

$$= 2.25 \times 10^8 \text{ m/s.}$$

OR

The angle of incidence in air for a ray of light is 40^0. If the ray travels through water of refractive index 4/3 find the angle of refraction. (sin 40 = 0.6427)

Ans : $a\mu_w = \frac{\sin i}{\sin r}$ $\qquad \sin r = \frac{\sin i}{a\mu_w}$

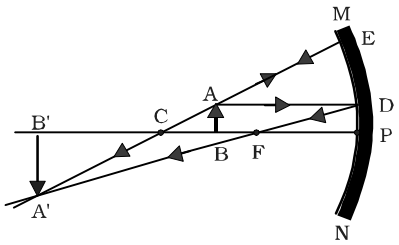
$= \frac{\sin 40}{4/3}$ $\qquad = \frac{3\times0.6427}{4}$

$\sin r = 0.4820$ $\qquad r = \sin^{-1}(0.4820)$

$= 28.82.$

Q.16 : Draw a ray diagram when the object is placed between c and f of a concave mirror.

Ans :



OR

SECTION (C) (Each - 3 Mark)

Q.17 : An object 15 cm in length is placed at a distance of 10cm in front of a convex mirror of focal length 15cm. Find the position, nature and size of the image formed.

Ans. : Distances of the object from the convex mirror (u) = -10cm

Focal length of the convex mirror (f) = 15cm

Distance of the image from the convex mirror

(v) = ? (To be calculated)

Applying,

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u},$$

$$\frac{1}{v}=\frac{1}{f}-\frac{1}{u}=\frac{1}{15}-\frac{1}{(-10)}$$

$$=\frac{1}{15}+\frac{1}{10}=\frac{2+3}{30}=\frac{5}{30}$$

$$v=\frac{30}{5}=6\text{cm}$$

$$\frac{h_i}{h_o}=-\frac{v}{u}$$

$$\therefore h_i=\frac{v\,x\,h_o}{u}=-\frac{\cancel{6}^{3}\times\cancel{15}^{3}}{\cancel{-10}_{1}^{\cancel{5}}}$$

$$=9\text{cm}$$

Thus, the image is formed at a distance of 6cm behind the mirror. The image is virtual, erect and smaller in size than object.

OR

A convex lens of focal length 40 cm and a concave lens of focal length 50 cm are placed in contact with each other.

Calculate: i) the power of the combination ,

ii) focal length of the combination.

Ans. : $f = 40\text{cm} = 0.4\text{m}$

Power of the convex lens (P_1)

$$= +\frac{1(m)}{f(m)} = +\frac{1(m)}{0.4(m)} = +2.5D$$

Now $f = 50cm = 0.5m$

Power of the Concave lens (P_2)

$$= +\frac{1(m)}{f(m)} = \frac{-1(m)}{0.5(m)} = -2D$$

$\therefore$ Power of the combination

$P = P_1 + P_2 = +2.5D - 2D = +0.5D$

$\therefore$ Focal length of the combination

$$F = \frac{1(m)}{\text{power of combination}} = \frac{1(m)}{0.5} = 2m$$

Q.18 : An object 2 cm high is placed at a distance of 16 cm from a concave mirror which produces a real image 3 cm high.

i) Find the position of the image. **ii) What is the focal length of mirror?**

Ans. Object height , h = +2 cm

Object distance, u = –16 cm

Image height, h' = –3 cm (real image hence inverted)

Image distance, v = ?

Focal length, f = ?

i) Position of image :

From the relation of magnification $m = \frac{h'}{h} = \left(-\frac{v}{u}\right)$

We have, $v = -u\ \frac{h'}{h}$

Putting values, we get $v = -(-16) \times \frac{-3}{2}$

$v = -24$ cm

The image is formed at distance of 24 cm in front of the mirror (negative sign means object and image are on the same side)

ii) Focal length of mirror

u = – 16cm

v = – 24cm

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{-24} + \frac{1}{-16} = \frac{-2-3}{48} = \frac{-5}{48} = f = \frac{-48}{5} = \boxed{F = -9.6cm}$$

SECTION (D) (5 Marks)

Q.19 : i) State Snell's Law of refraction of light.

ii) A transperant medium A floats in another travels transperant medium B. When a ray

of light tarvels obliquely from A into B, the refracted ray bends away from the normal. Which media 'A' or B is optically denser and why?

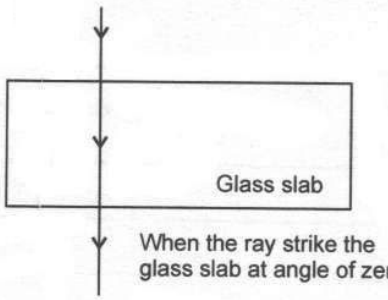
iii) Draw ray diagrams to show passage of rays of light through a rectangular glass, when angle of incidence is (a) Zero (b) Little less than 90.

Ans : i) **Snell's Law of Refraction:-** The ratio between the sine of the angle of incidence and sine of angle of refraction for two optical media is a constant quantity and is commonly called refractive index.

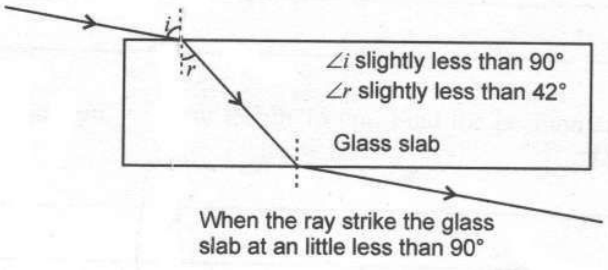
ii) The medium A is optically denser. It is because the refracted ray will bend away from the normal only, if it tarvels from denser to rarer medium.

iii)

a)



b)



OR

List the sign conventions for reflection of light by spherical mirrors.

Ans: Sign conventions for reflection of light by spherical mirror are:

1) The object is always placed to the left of the mirror.

2) All the distances parallel to the principal axis are always measured from the pole of the spherical mirror.

3) All the distances measured along the direction of incident light (along +ve x-axis), are considered to be positive.

4) Those distances measured opposite to the direction of incidence light (i.e. along -ve x-axis), are taken as negative.

5) The distances measured in upward direction, i.e. perpendicular to and above the principal axis (along +ve y-axis), are taken as positive.

6) The distances measured in the downward direction, (along -ve y-axis), i.e. perpendicular to and below the principal axis are taken as negative.

* * *