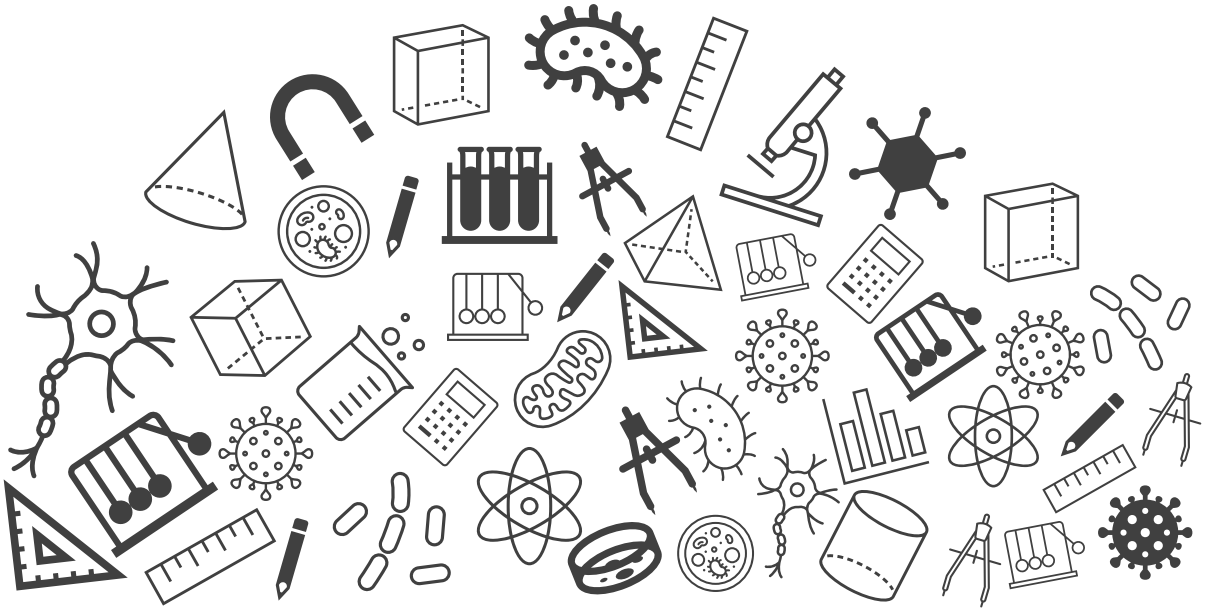
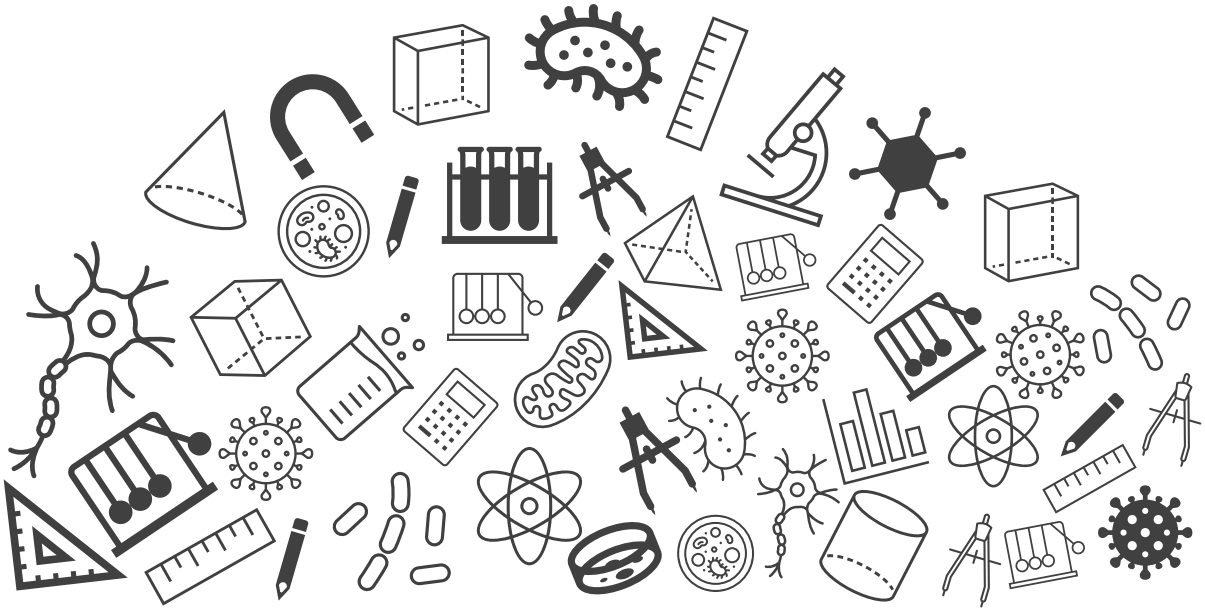
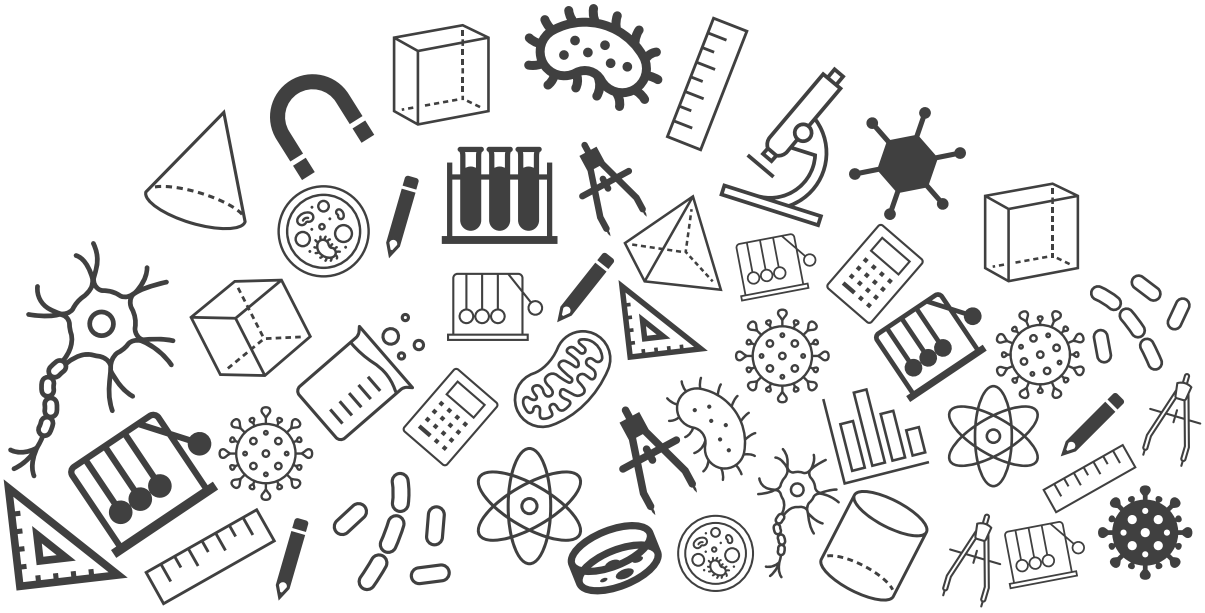
Grade 10: Science
Exam Important Questions



PHYSICS



Light: Reflection and Refraction



1. The magnification produced by a plane mirror is +1. What does this mean?
[2 marks]
[NCERT Exercise]
[Magnification in Mirrors and Lenses]

Solution:

Magnification produced by a plane mirror,

$$\text{Magnification}(m) = \frac{\text{Image height}(h_i)}{\text{Object height}(h_o)}$$

For $m = +1 = \frac{\text{Image height}(h_i)}{\text{Object heigh}(h_o)}$

[1 mark]

Image height = Object height

Thus, the image formed by a plane mirror is of the size of the object.

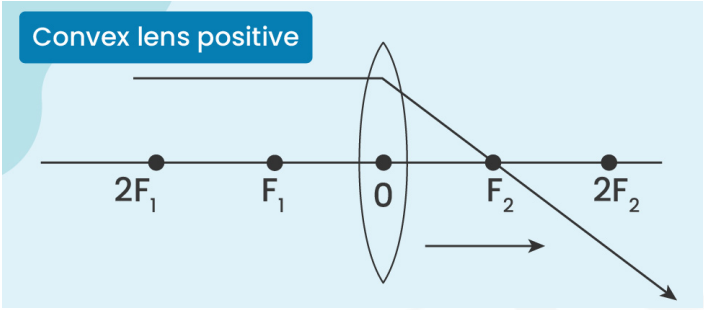
The positive sign indicates that image formed is virtual and erect.

[1 mark]

2. A doctor has prescribed a corrective lens of power $+1.5\ D$. Find the focal length of the lens. Is the prescribed lens diverging or converging?
[2 marks]

Solution:

Given:
Power of lens, $P = +1.5\ D$
To find:
Focal length of the lens, $f = ?$
Nature of lens $\rightarrow$ Converging or diverging ?



[1 mark]

Since,

$$\text{power of lens, } P = \frac{1}{\text{focal lenght (in } meter)}$$

$$\Rightarrow f = \frac{1}{\text{power of lens}}$$

$$= \frac{1}{(1.5\ D)}$$

$$\Rightarrow f = \frac{10}{15} = 0.67\ m$$

Thus, the focal length of the lens is $+0.67\ m$.

Since the focal length of the lens is positive, it is a convex or converging lens.

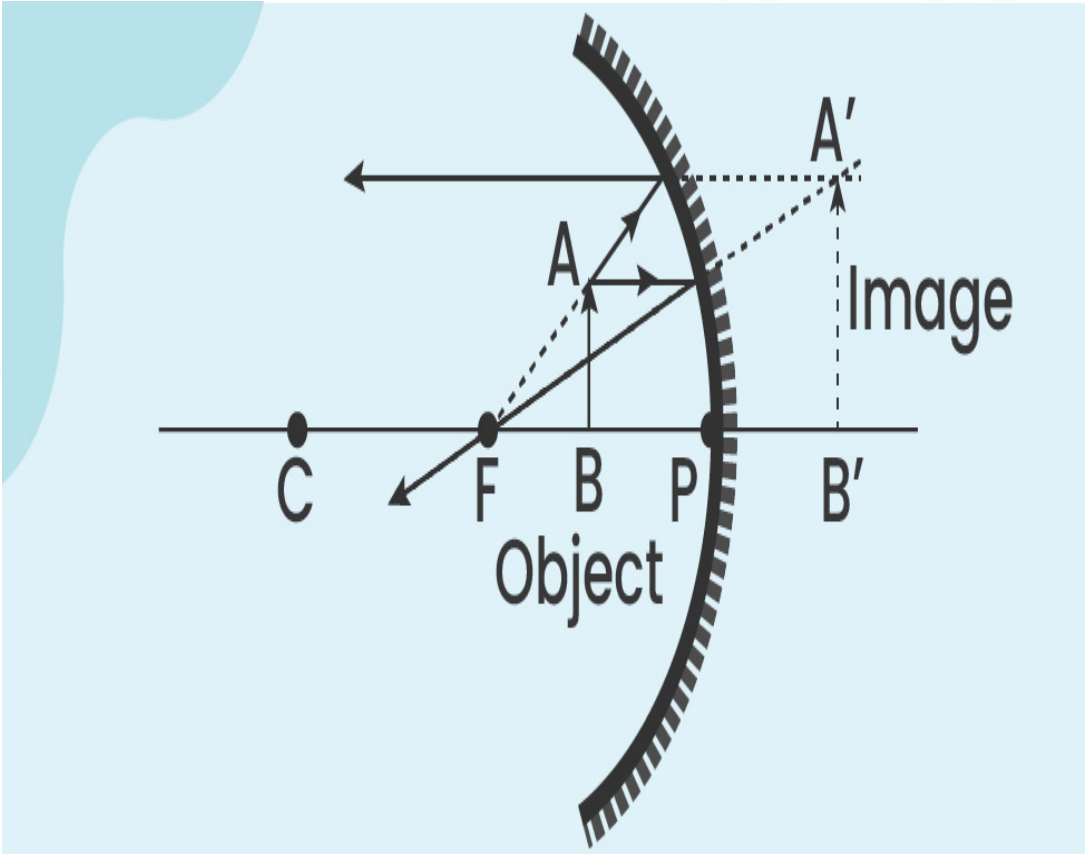
[1 mark]

3. We wish to obtain an erect image of an object, using a concave mirror of focal length $15\ cm$. What should be the range of distance of the object from the mirror? What is the nature of the image? Is the image larger or smaller than the object? Draw a ray diagram to show the image formation in this case.
[3 Marks]
[NCERT Exercise]
[Image Formation in Spherical Mirrors]

Solution:

Given, a concave mirror of focal length $15\ cm$.

The nature of image formed by a concave mirror depends on the position of the object.



[2 Marks]

Image formed by a concave mirror is virtual, erect and magnified when the object is placed between the pole and principal focus of the mirror.

The image will be erect if the object distance is between $0\ cm$ and $15\ cm$ from the mirror.

[1 Mark]

4. An object 5 cm in length is held 25 cm away from a converging lens of focal length 10 cm. Draw the ray diagram and find the position, size and the nature of the image formed.
[3 marks]
[NCERT Exercise]
[Lens Formula]

Solution:

Object distance, u = - 25 cm
focal length, f = 10 cm
height of the object, h_0 = 5 cm
Substituting in the lens formula,

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$

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

$$\frac{1}{v}=\frac{1}{10}-\frac{1}{25}$$

$$\frac{1}{v}=\frac{3}{50}$$

$v=\frac{50}{3}cm$ = 16.7 cm

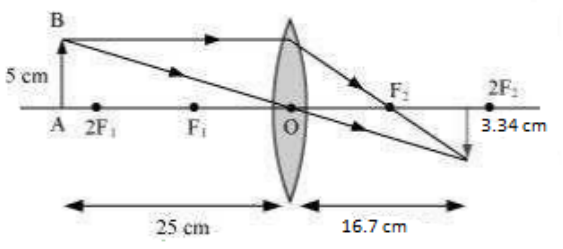
The image is real and inverted at a distance of 16.7 cm from the lens on the opposite side.

Magnification, $m=\frac{h_i}{h_0}=\frac{v}{u}$

$$\frac{h_i}{5}=\frac{16.7}{-25}$$

$h_i=\frac{16.7}{-25}\times 5$= -3.34 cm [2 marks]

The image is formed at a distance 16.7 cm from the lens on the other side of the lens. The image is inverted and diminished. [1 mark]



[1mark]

5. An object of 5.0 cm height is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position of the image, its nature and size.
[5 marks]

Solution:

Radius of curvature (R) = 30 cm
$f = \frac{R}{2} = \frac{30}{2} = 15\ cm$
Object distance, $u = -20\ cm$
Height of the object, $h = 5\ cm$
According to mirror formula,
$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$
$\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$
$\frac{1}{v} = \frac{1}{15} + \frac{1}{20} = \frac{7}{60}$
Image distance, $v = \frac{60}{7} = 8.6\ cm$
[3 marks]
Image is virtual and erect and formed behind the mirror.
$\frac{h_i}{h_0} = -\frac{v}{u}$
$\frac{h_i}{5} = \frac{-8.6}{-20}$
$h_i = 2.15\ cm$
Size of image is 2.15 cm.
[2 marks]

6. a) State the characteristics of the image formed in a plane mirror.

b) What is a virtual image? How is it different from a real image?

[4 marks]

Solution:

a) The image formed by a plane mirror is always virtual, upright, and of the same shape and size as the object it is reflecting.
[2 marks]

b) A virtual image is a copy of an object formed at the location from which the light rays appear to come. The main difference between real and virtual images lies in the way in which they are produced. A real image is formed when rays converge and actually meet, whereas a virtual image occurs where rays only appear to meet.

[2 marks]

7. **A concave mirror produces three times magnified (enlarged) real image of an object placed at 10 cm in front of it. Where is the image located?**
[2 marks]
[NCERT Exercise]
[Magnification in Spherical Mirrors]

Solution:
Given,
object distance, $u = 10$
image distance $= v$
magnification, $M = 3$
we have, $M = -\frac{v}{u}$
$\Rightarrow 3 = -\frac{v}{10}$
$\Rightarrow v = -30\ cm$
Therefore, the image is formed at 30 *cm behind the mirror. The negative sign shows that the image is behind the mirror*

[2 marks]

8. The refractive index of glass is 1.5. Calculate the speed of light in glass. The speed of light in air is 3.0 x $10^8\ ms^{-1}$.
[2 marks]

Solution:

given

μ = refractive index = 1.5,

c = velocity of light in vaccum = 3×10^8

$\mu = \frac{C}{V}$

V = speed of light in glass

$V = \frac{C}{\mu}$

$V = \frac{3 \times 10^8}{1.5}$

$= 2 \times 10^8 \frac{m}{s}$

so velocity of light in glass = $2 \times 10^8 \frac{m}{s}$

[2 marks]

9. Where should an object be placed in front of a convex lens so as to obtain its real, inverted and magnified image ?
[1 mark]
[S Chand lakhmir singh]
[Image formation in spherical lenses]

Solution:

Object should be placed between center (C or 2F) and focus. Image will be formed on the other side.

10. Define the terms pole, principal axis and centre of curvature with reference to a spherical mirror.
[3 marks]

Solution:

Pole: The geometric centre of the spherical surface of mirror is called the pole of mirror. [1 Mark]

Principal axis: It is the straight line joining the pole of the mirror to its centre of curvature. [1 Mark]

Centre of curvature: The centre of curvature of a mirror is the centre of the sphere of which the mirror is a part.
[1 Mark]

11. A concave lens of focal length 15 cm forms an image 10 cm from the lens. How far is the object placed from the lens? Draw the ray diagram.
[3 marks]

Solution:
Given,
focal length of the lens, $f = -15\ cm$ (concave lens)
Image distance, $v = -10\ cm$ (concave lens always forms image on the left side of the lens, irrespective of the position of the object)

To find: Position of the object, $u = ?$

According to the lens formula:

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

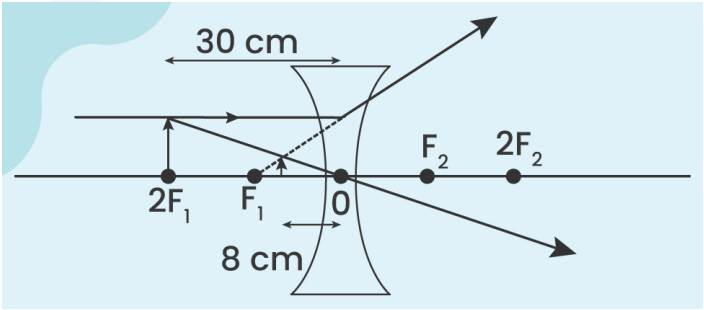
$$\frac{1}{u} = \frac{1}{v} - \frac{1}{f}$$

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

$$\Rightarrow \frac{1}{u} = -\frac{5}{100}$$

$$\Rightarrow u = -30\ cm$$

Thus, the object should be placed at a distance of 30 cm in front of the lens.
[2 marks]



[1 mark]

12. For the same angle of incidence, the angles of refraction in media P, Q and R are 35^0, 25^0, 15^0 respectively. In which medium will the velocity of light be minimum?
[2 marks]
[Snell's law]

Solution:

$\eta = \frac{c}{v} = \frac{\sin i}{\sin r}$ [1 Mark]

$\Rightarrow$ v is directly proportional to r

Since r is minimum in medium R, therefore sin r is also minimum in medium R

Hence, velocity is minimum in medium R
[1 Mark]

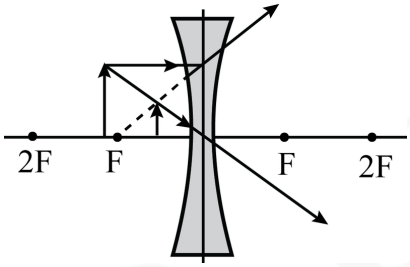
13. Draw ray diagrams showing the image formation by a concave lens when an object is placed

(a) at the focus of the lens
(b) between focus and twice the focal length of the lens
(c) beyond twice the focal length of the lens

[5 marks]
[Image formation in lenses]

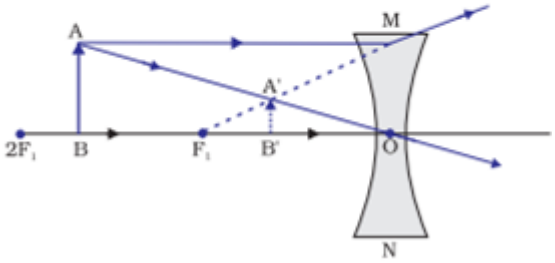
Solution:

(a) at the focus of the lens



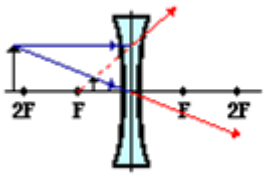
(2 marks)

(b) between focus and twice the focal length of the lens



(2 marks)

(c) beyond twice the focal length of the lens



(1 mark)

14. A 2 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 10 cm. The distance of object from the lens is 15 cm. Find the position, nature and size of the image. Calculate the magnification of the lens. [4 marks]

Solution:

Given

Object distance, $u = -15\ cm$

Focal length, $f = +10\ cm$

Object height, $h = +2\ cm$

Image distance, $v = ?$

Image height, $h^{'} = ?$

Using the lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} - \frac{1}{-15} = \frac{1}{+10}$$

$v = 30\ cm$ [1.5 Mark]

Positive sign of v shows that the image is formed at a distance of 30 cm on the right side of the lens. Therefore, the image is real and inverted.

From the formula of magnification,

$$m = \frac{v}{u} = \frac{30}{-15} = -2$$

Again, from the formula of magnification,

$$m = \frac{h'}{h} = \frac{v}{u}$$

$$\frac{h^{'}}{2} = \frac{+30}{-15} = -2$$

$h' = -2 \times 2 = -4\ cm$ [1.5 Marks]

Negative sign with the magnification and height of the image shows that the image is inverted and real. Thus, a real image of height 4 cm is formed at a distance of 30 cm on the right side of the lens. Image is inverted and twice the size of the object.

15. Define 1 dioptre of power of a lens.

[2 marks]

Solution:

Dioptre is the unit of measurement of the optical power of an optical instrument, like a lens or a mirror.
[0.5 Marks]
Power is equal to the reciprocal of the focal length. So, 1 doptre can be written as:

$1\ D = \frac{1}{1\ m}$ [0.5 Marks]

In other words, 1 dioptre is defined as the power of a lens of focal length 1 metre. [1 Mark]