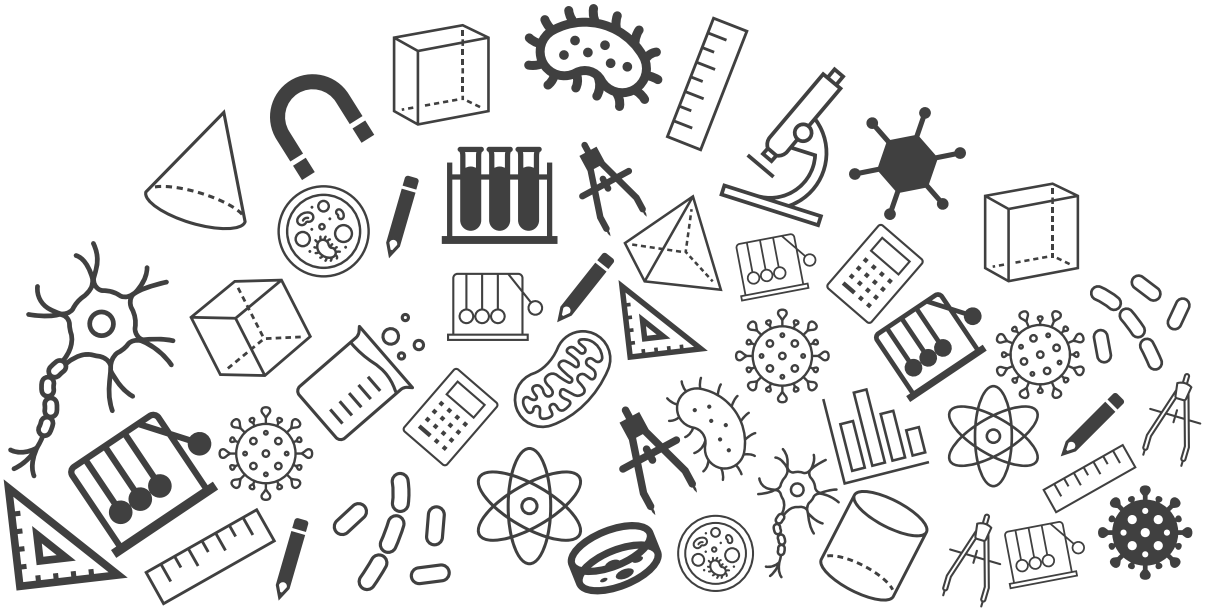
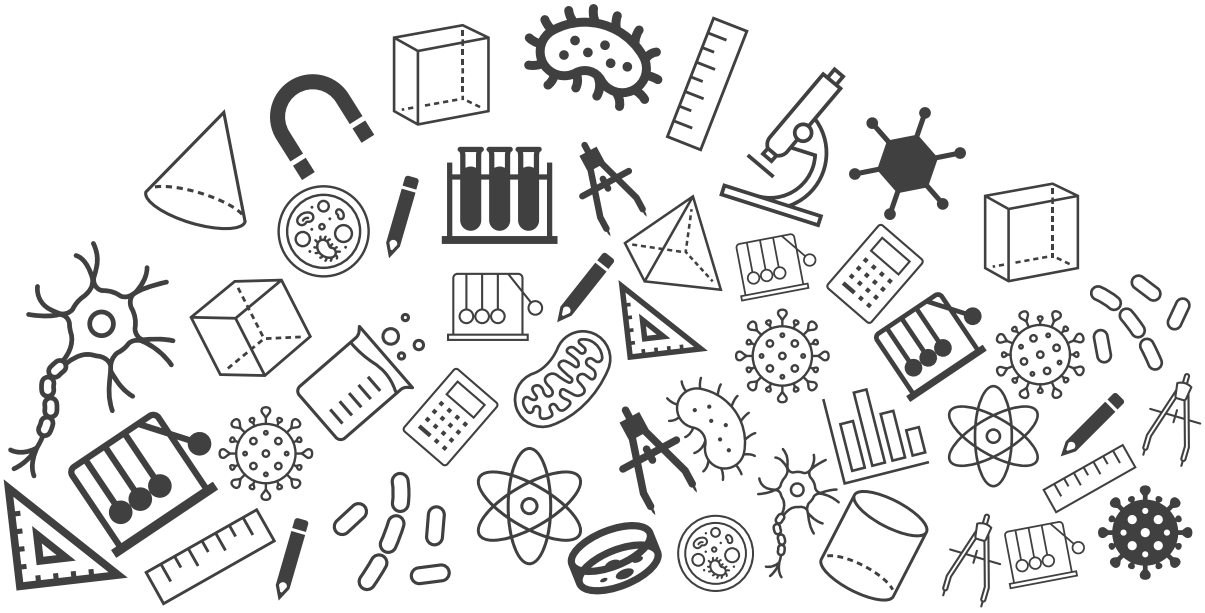
Grade 10: Science
Exam Important Questions



Human Eye and the Colourful World



1. The change in focal length of an eye lens is caused by the action of the

(a) pupil
(b) retina
(c) ciliary muscles
(d) iris

[1 mark]
[NCERT Exercise]
[Parts of Eye]

Solution:

Correct Option: (c)
The change in focal length of an eye lens is caused by the action of ciliary muscles. Ciliary muscles contract and relax to adjust the focal length of the eyelens to see objects at different distances clearly.
[1 mark]

2. The far point of a myopic person is $80\ cm$ in front of the eye. What is the nature and power of the lens required to correct the problem?
[3 marks]
[NCERT Exercise]
[Defects of vision]

Solution:

Given: $\text{Farpoint} = 80\ cm$, and the person is myopic.

To find: Nature and power of the correcting lens

Rationale: The corrective lens should form the image of far away (at infinity) objects at the Farpoint.

Object distance, $u = -\infty$
Image distance, $v = -80\ cm$ (image is formed at the far point ahead of the lens.)

According to the lens formula:

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

$$\Rightarrow \frac{1}{f} = \frac{1}{(-80)} - \frac{1}{(-\infty)}$$

$$\Rightarrow f = -80\ cm = -0.8\ m$$

Since, Power of the lens, $P = 1/\text{Focal length}(\text{ in} metres)$

$$\Rightarrow \text{power}, P = \frac{1}{f}$$

$$\Rightarrow P = \frac{1}{(-.8\ m)}$$

$$\Rightarrow P = -1.25\ D$$

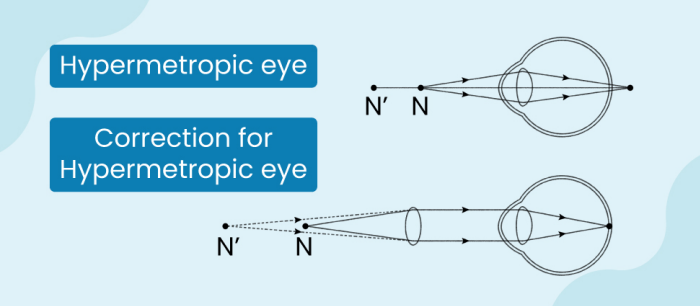
(2 marks)

Therefore, the person in question needs a concave lens of focal length $-0.8m$ and power $-1.25\ D$ to correct myopia.

(1 mark)

3. Make a diagram to show how hypermetropia is corrected. The near point of a hypermetropic eye is $1\ m$. What is the power of the lens required to correct this defect? Assume that the near point of the normal eye is $25\ cm$.
   [5 marks]
   [NCERT Exercise]
   [Defects of vision: Correction]

Solution:
An individual suffering from hypermetropia can see distant objects clearly but he/she will face difficulty in seeing nearby objects clearly. This happens because the eye lens focuses the incoming divergent rays beyond the retina. This can be corrected by using a convex lens. A convex lens of a suitable power converges the incoming light in such a way that the image is formed on the retina.



[2 marks]

Given: Object distance, $u = -25\ cm$ (Near point of normal eye)
Image distance, $v = -1\ m = -100\ cm$ (Image is formed at the near point of the hypermetropic eye)

To find: Focal length of the correcting lens, $f = ?$

According to the lens formula:

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

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

$$\Rightarrow \frac{1}{f} = \frac{1}{(-100)} - \frac{1}{(-25)}$$

$$\Rightarrow \frac{1}{f} = \frac{-1+4}{(100)} \Rightarrow \frac{1}{f} = \frac{3}{100}$$

$$\Rightarrow f = \frac{100}{3} \Rightarrow f = 33.3\ cm = 0.33\ m$$

Since, Power of lens, $P = 1/\text{Focal length}(\text{in } metres)$

$$\Rightarrow Power,\ P = \frac{1}{f}$$

$$\Rightarrow P = \frac{1}{(+0.33\ m)} \Rightarrow P = +3D$$

A convex lens of focal length $+0.33\ m$ and power $+3\ D$ is required to correct the defect.

[3 marks]

4. Why does the sky appear dark instead of blue to an astronaut?

[2 Marks]

[NCERT Exercise]

[Scattering of light]

Solution:

Since the earth has atmosphere, it leads to scattering of light thus the sky appears blue. (1 Mark)
In space, there is no atmosphere. So, no scattering of light occurs. Thus, for an astronaut, the sky appears dark.
(1 Mark)

5. A person with a myopic eye cannot see objects beyond 1.2 m distinctly. What should be the type of the corrective lens used to restore proper vision?

[1 Mark]

[NCERT Intext Question]

[Defects of vision]

Solution:
The person should use a concave lens of focal length 1.2 m to restore proper vision. The concave lens will bring the image back to the retina.

(1 Mark)

6. Explain myopia, hypermetropia and their corrections.

[4 Marks]

Solution:
Myopia:

Nearsightedness, also called myopia is a common name for impaired vision in which a person sees near objects clearly while distant objects appear blurred. In such a defective eye, the image of a distant object is formed in front of the retina and not at the retina itself. Consequently, a nearsighted person cannot focus clearly on an object farther away than the far point for the defective eye. [1 Mark]

Correction:-

This defect can be corrected by using a concave (diverging) lens. A concave lens of appropriate power or focal length is able to bring the image of the object back on the retina itself. [1 Mark]

Hypermetropia:

Farsightedness, also called hypermetropia, common name for a defect in vision in which a person sees near objects with blurred vision, while distant objects appear in sharp focus. In this case, the image is formed behind the retina. [1 Mark]

Correction:-

This defect can be corrected by using a convex (converging) lens of appropriate focal length. When the object is at N', the eye exerts its maximum power of accommodation. Eyeglasses with converging lenses supply the additional focusing power required for forming the image on the retina.

[1 Mark]

7. A person suffering from myopia uses a concave lens of focal length 50cm. What is the power of the lens?
[1 Mark]

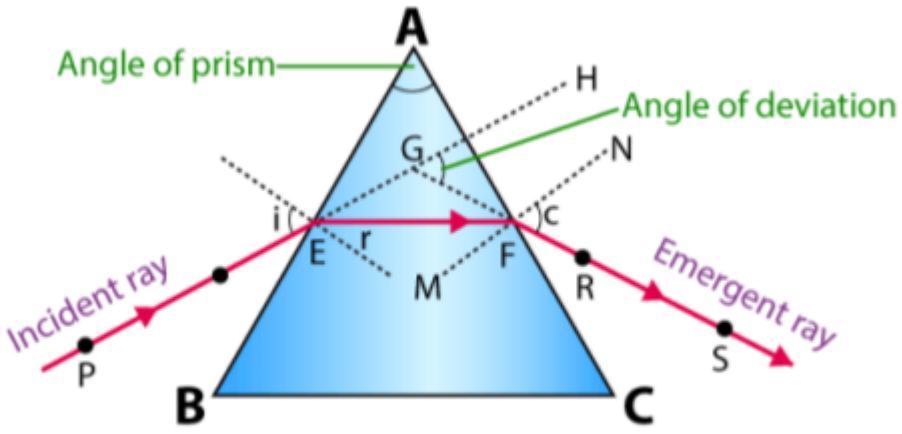
Solution:

So focal length = - 50 cm = - 0.50 meter [0.5 Marks]

power = - 1/0.50 = -2 Dioptre or - 2 D [0.5 Marks]

8. Explain the refraction of light through a triangular glass prism using a labelled ray diagram. Hence, define the angle of deviation.
[3 Marks]
[Dispersion of Light]

Solution:
The refraction of light through a triangular glass prism is shown below. A ray of light PE is entering from air to glass at the first surface AB. The light ray EF on refraction has bent towards the normal.
At the second surface AC, the light ray FS has entered from glass to air and bent away from normal.
[1 Mark]
The angle made by extending incident ray(EH) with the emergent ray(FS) is called angle of deviation.
[1 Mark]



[1 Mark]

9. What is atmospheric refraction? Use this phenomenon to explain advance sunrise and delayed sunset with the help of diagram.

[3 Marks]

[Prev Year Question: 2019]

[Atmospheric refraction]

Solution:

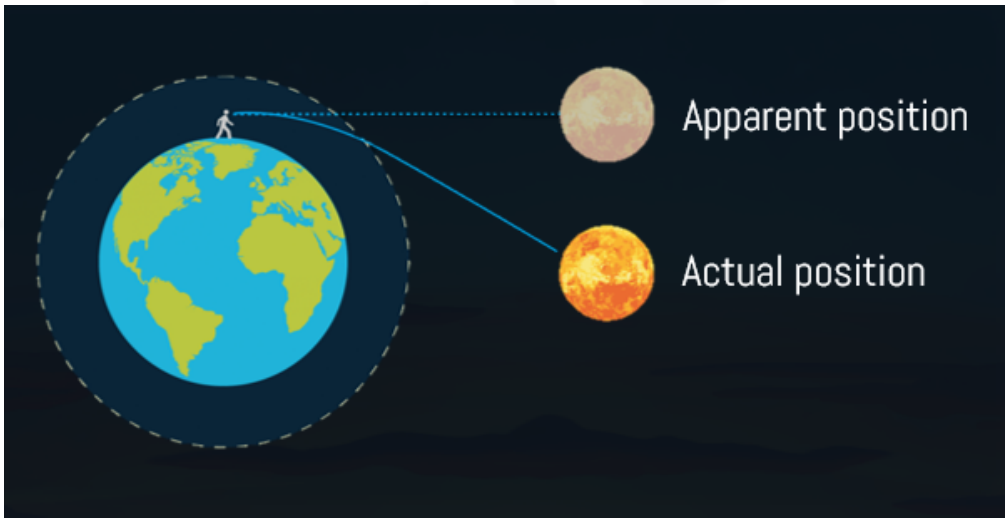
Atmospheric refraction is the refraction of light caused by the earth's atmosphere due to change in the refractive indices of different layers.

(1 Mark)

Advanced sunrise:

- When the sun is slightly below the horizon, light rays coming from the sun travel from the rarer to denser layer of air.
- Because of atmospheric refraction of light, light appears to come from a higher position above the horizon.
- Thus, the sun appears earlier than the actual sunrise.

(1 Mark)



Delayed sunset: Same reason, because similar refraction occurs at the sunset.

(1 Mark)

10. Why are the 'danger signal' lights red in colour ?

[1 Mark]

[S Chand Lakhmir Singh]

[Scattering of light]

Solution:
Red colour scatters the least as it has the greatest wavelength. So red light is able to travel the longest distance through the fog, rain, and air particles. That is why the red colour is used in danger signals.

(1 Mark)

11. Why do different coloured rays deviate differently on passing through a glass prism?

[2 Marks]

[S Chand Lakhmir Singh]

[Dispersion of light]

Solution:
The speed of light of different colours in a medium like glass is different. Varying speeds for different colours lead to different refractive indices for different colours.

(1 Mark)

It has been observed that the refractive index of glass for violet colour is more than that for red colour. All the colours present in white light refract through different angles and hence, emerge out from the prism with different directions and become distinct.

(1 Mark)