10TH CBSE SCIENCE PHYSICS CASE STUDY QUESTIONS

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Many optical instruments consist of a number of lenses. They are combined to increase the magnification and sharpness of the image. The net power (P) of the lenses placed in contact is given by the algebraic sum of the powers of the individual lenses P_1, P_2, P_3..... as

$P = P_1 + P_2 + P_3$ .....

This is also termed as the simple additive property of the power of lens, widely used to design lens systems of cameras, microscopes and telescopes. These lens systems can have a combination of convex lenses and also concave lenses.

(i) What is the nature (convergent/divergent) of the combination of a convex lens of power + 4D and a concave lens of power - 2D?

(ii) Calculate the focal length of a lens of power 2.5D.

(iii) Draw a ray diagram to show the nature and position of an image formed by a convex lens of power + 0.1D, when an object is placed at a distance, of 20 cm from its optical centre.

Or

How is a virtual image formed by a convex lens different from that formed by a concave lens?

Under what conditions do a convex and a concave lens form virtual images?

Answer : (i) The combination of a convex lens of power + 4D and a concave lens of power - 2D is convergent in nature.

(ii) We know that,

Focal length, $f = \frac{1}{\text{Power}} = \frac{1}{-2.5}$ [$\because$ Power = -2.5 D]

f = -0.4 m = - 40 cm

Here, negative sign indicates that the lens is a concave lens.

(iii) Given, distance of object, u = -20 cm

Power, P = 0.1 D

$\therefore \quad f = \frac{1}{P} = \frac{1}{0.1} = 10 \text{ m} = 1000 \text{ cm}$

So, the object lies between lens and F_1. Therefore, image will be virtual, erect and magnified.

On a sunny day, Krish looked at the sky through a water fountain and he was surprised to see a rainbow In the sky

(i) The location of the sun when Krish observed a rainbow was

(a) behind him

(b) in front of him

(c) overhead

(d) on his left side

(ii) The phenomena of light involved in the formation of a rainbow are

(a) reflection, refraction and dispersion

(b) refraction, dispersion and total internal reflection

(c) refraction, dispersion and scattering

(d) dispersion, scattering and total internal reflection

(iii) In the formation of a rainbow, the role of water droplets present in the water fountain is to act as a
(a) glass slab
(b) convex lens
(c) concave lens
(d) prism
(iv) While entering a water droplet, the sunlight gets
(a) refracted only
(b) reflected internally
(c) refracted and dispersed
(d) first refracted and then dispersed while coming out of the water droplet

Answer : (i) (a) The rainbow appears opposite side of the Sun in sky.
(ii) (b) Refraction, dispersion and total internal reflection are the phenomenon involved in the formation of rainbow.
(iii) (a) Tiny water droplets act as prism in formation of rainbow.
(iv) (a) The water droplets are denser than air, therefore sunlight gets refracted and then dispersed, while coming out of the water droplet.

The rate of flow of charge is called electric current. The SI unit of electric current is Ampere (A). The direction of flow of current is always opposite to the direction of flow of electrons in the current.
The electric potential is defined as the amount of work done in bringing a unit positive test charge from infinity to a point in the electric field. The amount of work done in bringing a unit positive test charge from one point to another point in an electric field is defined as potential difference.

$$V_{AB} = V_B - V_A = \frac{W_{BA}}{q}$$

The SI unit of potential and potential difference is volt.
(i) The 2 C of charge is flowing through a conductor in 100 ms, the current in the circuit is
(a) 20 A **(b) 2 A**
(c) 0.2 A **(d) 0.02 A**
(ii) Which of the following is true?
(a) Current flows from positive terminal of the cell to the negative terminal of the cell outside the cell.
(b) The negative charge moves from lower potential to higher potential.
(c) The direction of flow of current in same as the direction of flow of positive charge.
(d) All of these
(iii) The potential difference between the two terminals of a battery, if 100 joules of work is required to transfer 20 coulombs of charge from one terminal of the battery to other is
(a) 50 V **(b) -5 V**
(c) 0.5 V **(d) 500 V**
(iv) The number of electrons flowing per second in a conductor if 1A current is passing through it
(a) 6.25×10^{20} **(b) 6.25×10^{19}**
(c) 6.25×10^{18} **(d) 6.25×10^{-19}**
(v) The voltage can be written as
(a) Work done x charge x time **(b)** $\frac{\text{Work done}}{\text{Current} \times \text{time}}$
(c) $\frac{\text{Work done} \times \text{time}}{\text{Current}}$ **(d) Work done x charge**

Answer : **(i) (a):** q = 2 C, t= 100 ms = 0.1 s

$$I = \frac{q}{t} = \frac{2}{0.1} = 20 \text{ A}.$$

(ii) (d)

(iii) (b): W = 100 J, q = 20 C

$$V = \frac{W}{q} = \frac{100}{20} = 5 \text{ V}$$

(iv) (c): I = 1 A, t = 1 s

q = It = 1 x 1 = 1C

$$n = \frac{q}{e} = \frac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18}$$

(v) (c): $V = \frac{W}{q} = \frac{W}{It}$

A student took concave mirrors of different focal lengths and performed the experiment to see the Image formation by placing an object at different distances with these mirrors as shown in the following table.

Case No.	Object-distance	Focal length
I	45 cm	20 cm
II	30 cm	15 cm
III	20 cm	30 cm

Now, answer the following questions :

(i) List two properties of the image formed in Case I.

(ii) In which one of the cases given in the table, the mirror will form real image of same size and why?

(iii) Name the type of mirror used by dentists. Give reason why do they use such type of mirrors.

Or Look at the table and identify the situation (object distance and focal length) which resembles the situation in which concave mirrors are used as shaving mirrors? Draw a ray diagram to show the image formation in the case.

Answer : (i) (a) The image will be real.

(b) The image will be inverted and diminished.

(ii) In Case II, the mirror will form real image of same size because the position of object is at centre of curvature.

(iii) Dentists use concave mirrors to see magnified image of the teeth of patients.

Or In Case III, the mirror will form virtual, erect and magnified image, so concave mirrors are used as shaving mirrors.