

WS-11 $\rightarrow$ Topic $\rightarrow$ qth foundation

① According to given data $V_1 = 15 \text{ cm}$; $V_2 = 100 \text{ cm}$

$$P = 0.80 \Rightarrow f = \frac{1}{P} = \frac{1}{0.8} = 125 \text{ cm.}$$

From lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

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

$$\Rightarrow \frac{1}{u} = -\frac{1}{15} + \frac{1}{125}$$

$$\Rightarrow \frac{1}{u} = \frac{-25 + 3}{15 \times 125} \Rightarrow \frac{1}{u} = \frac{-22}{15 \times 125} \Rightarrow u = -\frac{15 \times 125}{22}$$

For $V_2 = 100 \text{ cm}$

$$\Rightarrow u = -17 \text{ cm}$$

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

$$\Rightarrow \frac{1}{u} = -\frac{1}{100} - \frac{1}{125} = \frac{4-5}{500} \Rightarrow u = -500 \text{ cm.}$$

②

According to given data $v = -1.5 \text{ m}$; $u = \infty$

$\therefore$ From lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

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

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

$$\Rightarrow P = \frac{1}{v} = -\frac{1}{1.5} = -\frac{2}{3} = -0.67 \text{ D}$$

③

$$V = F \cdot P = 83 \text{ cm}$$

$$u = \infty$$

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

$$\Rightarrow \frac{1}{f} = -\frac{1}{83} - \frac{1}{\infty} = -\frac{1}{83}$$

$$\Rightarrow P = -\frac{1}{\frac{1}{83}} = -\frac{100}{83} = -1.25 \text{ D}$$

⑤

$$\text{Given } N \cdot P = 50 \text{ cm} = x$$

$$D = 25 \text{ cm}$$

For seeing distant objects the focal length of lens

$$\text{required is } f = \frac{x \cdot D}{x - D} = \frac{50 \times 25}{50 - 25}$$

$$f = 50 \text{ cm} \quad ; \quad P = \frac{100}{f} = \frac{100}{50} = 2 \text{ D}$$

$$\text{If } F \cdot P = 1.5 \text{ m}$$

$$\text{Focal length } f = F \cdot P = -1.5 \text{ m}$$

$$P = + \frac{100}{f} = -\frac{1}{1.5} = -\frac{2}{3} \text{ D}$$

⑥

$F \cdot P = 250 \text{ cm}$. He cannot see distant object
ie $u = \infty$

$$\text{From lens formula } \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\Rightarrow \frac{1}{f} = -\frac{1}{250} - \frac{1}{\infty} = -\frac{1}{250}$$

$\Rightarrow f = -250 \text{ cm} \rightarrow$ diverging or
concave lens

⑦

clearly the person can not see an object placed beyond 50 cm. He is suffering from myopia.

$$F.P = 50 \text{ cm} \quad ; \quad u = \infty$$

$$\therefore \frac{1}{f} = \frac{1}{v} - \frac{1}{u} \quad \Rightarrow \quad \frac{1}{f} = -\frac{1}{50}$$

$$\Rightarrow \frac{1}{f} = -\frac{1}{50} - \frac{1}{\infty} \quad \Rightarrow \quad P = \frac{100}{f} = -\frac{100}{50} = -2 \text{ D}$$

⑧

when $u < 100 \text{ cm}$ he can not see object clearly.

that is he is suffering from hypermetropia.

To see object at 25 cm (i.e) N.P

$$x = 100 \text{ cm} ; \quad v = D = 25 \text{ cm}$$

The focal length of lens required $f = \frac{x \cdot D}{x - D} = \frac{100 \times 25}{100 - 25}$

$$f = \frac{100 \times 25}{75} = \frac{100}{3} \text{ cm}$$

$$\Rightarrow P = \frac{100}{f} = 100 \times \frac{1}{f} = 100 \times \frac{3}{100} = 3 \text{ D}$$

⑨

$u = 2 \text{ m}$ very far away from eye, image is formed at $v = \infty$

$\therefore$ From $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \quad \Rightarrow \quad \frac{1}{f} = \frac{1}{\infty} - \frac{1}{2} \quad \Rightarrow \quad f = -2$

$$P = \frac{1}{f} = -\frac{1}{2} \text{ m} = -0.5 \text{ D}$$

(10)

F.P = Far point : 5 m

$$u = -5 \text{ m}$$

$$\therefore \text{From } \frac{1}{f} = \frac{1}{v} - \frac{1}{u} = -\frac{1}{5} - \frac{1}{\infty} = -\frac{1}{5}$$

$$P = \frac{1}{f} \text{ D} = -\frac{1}{5} \text{ D} \\ = -0.2 \text{ D}$$

(15)

Near sighted $\rightarrow$ Myopia $\rightarrow P = -5.5 \text{ D}$

To overcome long sight he is using lens of focal
length $f = 1.5 \text{ D}$

So the person is suffering from Pres biopia

$$f = \frac{1}{P} = \frac{100 \text{ cm}}{P} = \frac{100}{-5.5} = -18.2 \text{ cm}$$

lens is concave

For Near vision

$$f = \frac{100}{P} = \frac{100}{1.5} = \frac{200}{3} = 66.7 \text{ cm}$$

(17)

clearly $v = -1 \text{ m}$

$$u = -3 \text{ m}$$

$$\text{From } \frac{1}{f} = \frac{1}{v} - \frac{1}{u} \\ = -\frac{1}{1} - \frac{1}{(-3)}$$

$$\frac{1}{f} = -1 + \frac{1}{3} = -\frac{2}{3}$$

$$P = \frac{1}{f} = -\frac{2}{3} = -0.67 \text{ D}$$

lens is concave.

(18)

$$v = -10 \text{ cm} \quad ; \quad u = -25 \text{ cm}$$

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

$$\frac{1}{f} = -\frac{1}{10} + \frac{1}{25} = -\frac{5+2}{50}$$

$$\Rightarrow \frac{1}{f} = -\frac{3}{50} \Rightarrow f = -\frac{50}{3} = -16.67 \text{ cm}$$

lens is concave lens

(4)

option A correct.

$$\text{For } v = 2 \text{ m} \quad ; \quad u = \infty$$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{2} - \frac{1}{\infty}$$

$$\Rightarrow P = \frac{1}{2} = 0.5 \text{ D}$$

$$\text{For } v = 1 \text{ m} \quad ; \quad u = 25 \text{ cm}$$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{100} - \frac{1}{25} = \frac{24}{2500} - \frac{100}{2500} = -\frac{3}{100}$$

$$\Rightarrow P = -3 \text{ D}$$

$$v = 1 \quad ; \quad u = \infty$$

$$\frac{1}{f} = \frac{1}{1} - \frac{1}{\infty} = 1$$

$$\Rightarrow P = 1 \text{ D}$$

$$v = 2 \text{ m}$$

$$u = 25 \text{ cm}$$

$$= \frac{25}{100} \text{ m}$$

$$\frac{1}{f} = \frac{1}{2} - \frac{1}{\frac{25}{100}} = \frac{1}{2} - \frac{100}{25}$$

$$P = 3.5 \text{ D}$$

So extra -0.5 D and addition 3.5 D of bifocal required



1. Task

SAQ's

①

$$u = \infty ; v = F \cdot P \\ = -25 \text{ m}$$

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

$$\Rightarrow \frac{1}{f} = \frac{1}{-25} - \frac{1}{\infty} \\ = -\frac{1}{25} \text{ m}$$

$$P = \frac{1}{f} = -\frac{1}{25} \text{ D}$$

$$P = -0.04 \text{ D}$$

②

$$u = -23 \text{ cm} ; v = -69 \text{ cm}$$

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

$$\Rightarrow \frac{1}{f} = \frac{1}{-69} - \left(\frac{1}{-23} \right)$$

$$= -\frac{1}{69} + \frac{1}{23}$$

$$= \frac{-1+3}{69}$$

$$\Rightarrow \frac{1}{f} = \frac{2}{69}$$

$$\Rightarrow f = \frac{69}{2} = 34.5 \text{ cm}$$

③

The concave lens should form the image of the object at ∞ at a distance of 50 cm

$$v = \infty ; u = -50 \text{ cm}$$

$$\text{From } \frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{\infty} + \frac{1}{50} \Rightarrow \frac{1}{f} = \frac{1}{50}$$

$$\Rightarrow P = \frac{1}{f} = \frac{1}{50} = 0.02 \text{ D}$$

$$= 2 \text{ D}$$



(4)

(u)

The person cannot see objects clearly beyond 200 cm
 so far point = 200 cm; for the distant object
 $u = \infty$

Hence, he should use a lens which forms a virtual image of the distant object.

Using lens formula

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

$$\Rightarrow \frac{1}{f} = P = \frac{1}{-200} - \frac{1}{\infty} = -\frac{1}{200}$$

$$P = -0.5 \text{ D}$$

(5)

Given $u = -50 \text{ cm}$; $v = -25 \text{ cm}$

By lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\Rightarrow \frac{1}{f} = \frac{1}{-25} - \frac{1}{-50} = -\frac{1}{50} + \frac{1}{25} =$$

$$\Rightarrow f = 50 \text{ cm}$$

$$\text{Power } P = \frac{1}{f} = \frac{100}{50} = 2 \text{ D}$$

(6)

Given $v = -2.5 \text{ m}$; $u = \infty$

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

$$\Rightarrow \frac{1}{f} = -\frac{1}{2.5} - \frac{1}{\infty}$$

$$\Rightarrow \frac{1}{f} = -\frac{10}{25}$$

$$\Rightarrow P = \frac{1}{f} = -0.4 \text{ D}$$

⑧

$$u = -25 \text{ cm} ; P = 3D \Rightarrow f = \frac{3}{160} \text{ cm} \quad \frac{100}{3} \text{ cm}$$

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

$$\Rightarrow \frac{3}{100} = \frac{1}{v} - \left[\frac{-1}{25} \right]$$

$$\Rightarrow \frac{3}{100} = \frac{1}{v} + \frac{1}{25}$$

$$\Rightarrow \frac{1}{v} = \frac{3}{100} - \frac{1}{25}$$

$$\Rightarrow \frac{1}{v} = \frac{3-4}{100} = \frac{-1}{100}$$

$$\Rightarrow v = -100 \text{ cm} = -1 \text{ m}$$

⑨

$$v = N \cdot p = -100 \text{ cm}$$

$$u = D = -25 \text{ cm}$$

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

$$\therefore \frac{1}{f} = -\frac{1}{100} - \left[\frac{-1}{25} \right]$$

$$\frac{1}{f} = -\frac{1}{100} + \frac{1}{25}$$

$$\frac{1}{f} = \frac{-1+4}{100} = \frac{3}{100} \text{ cm}$$

$$\Rightarrow f = \frac{100}{3} \text{ cm}$$

$$\text{Power} = \frac{1}{f} \text{ m} = \frac{100}{\frac{100}{3}}$$

$$P = 3D$$

⑩

$$F \cdot p = -80 \text{ cm}$$

$$\frac{1}{f} = \frac{1}{F \cdot p} \Rightarrow -\frac{1}{80 \text{ cm}}$$

$$P = \frac{100}{f} = \frac{100}{-80} = -\frac{5}{4}$$

$$P = -1.25D$$

concave lens

⑦

$$\text{we know } P = \frac{1}{f} : P = -0.8D$$

$$\Rightarrow \frac{1}{f} = -0.8 \Rightarrow f = \frac{-1 \times \text{m}}{0.8} = \frac{-100}{0.8}$$

$$\Rightarrow f = -125 \text{ cm}$$

$$\text{For near point } u_1 = -15 \text{ cm} ; u_2 = ?$$

$$\therefore \frac{1}{f} = \frac{1}{u_1} - \frac{1}{u_2} \Rightarrow \frac{-1}{125} = -\frac{1}{15} - \frac{1}{u_2}$$

$$\Rightarrow u_2 = -17 \text{ cm}$$

$$\text{For distant point } v_2 = 100 \text{ cm} ; u_2 = ?$$

$$\therefore \frac{1}{f} = \frac{1}{v_2} - \frac{1}{u_2} \Rightarrow \frac{-1}{125} = \frac{1}{100} - \frac{1}{u_2}$$

$$\Rightarrow u_2 = -500 \text{ cm}$$

$$\text{Range is } 17 \rightarrow 500 \text{ cm}$$



(5)

(16)

$f = -70 \text{ cm} \rightarrow$ concave lens $\rightarrow$ the person is suffering from myopia

$$u = \infty$$

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

$$v = f = -70 \text{ cm}$$

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

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

(17)

Given $f = 60 \text{ cm}$; $O = 25 \text{ cm}$; N.P. = $x = ?$

$$f = \frac{x \cdot O}{x - O}$$

$$\Rightarrow 12x - 12 \times 25 = 5x$$

$$\Rightarrow 60 = \frac{x + 255}{x - 25}$$

$$\Rightarrow 12x - 5x = 12 \times 25$$

$$\Rightarrow 7x = 12 \times 25$$

$$\Rightarrow 12 = \frac{5x}{x - 25}$$

$$\Rightarrow x = \frac{12 \times 25}{7} = 43 \text{ cm}$$

$$\Rightarrow 12(x - 25) = 5x$$