

Q1) The image of a needle placed at 45cm from a lens is formed on a screen placed 90cm on the other side of the lens. Find the displacement of the image if the object is moved 5cm away from the lens. Also find the power of the lens.

$$u = -45 \text{ cm} \quad v = 90 \text{ cm}$$

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

$$= \frac{1}{90} + \frac{1}{45} = \frac{1}{30}$$

$$f = 30 \text{ cm}$$

When the needle is moved 5cm away from the lens

$$u = -(45 + 5) = -50 \text{ cm}$$

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

$$= \frac{1}{30} + \frac{1}{-50} = \frac{2}{150}$$

$$\Rightarrow v' = 75 \text{ cm}$$

Displacement of image =  $v - v' = 90 - 75 = 15 \text{ cm}$   
towards the lens



Q2) A lens of power  $+3D$  and another of power  $-1.5D$  are placed in contact. Will the combination be convergent or divergent? Also find the focal length & power of the combination.

$$P = P_1 + P_2$$

$$= 3D + (-1.5D)$$

$$= +1.5D$$

It will be convergent

$$P = \frac{1}{f}$$

$$1.5 = \frac{1}{f}$$

$$f = 0.66$$

Q3) Find the nature & focal length of a lens which must be placed in contact with a concave lens of focal length  $0.25m$  in order that the lens combination may produce a real image 5 times the size of the object  $0.2m$  from the combination.



concave lens

$$f = -25 \text{ cm}$$

$$P = -4 \text{ D}$$

In combination

$$u = -20 \text{ cm}$$

~~$$m = \frac{v}{u}$$~~

$$m = -\frac{5}{1} = \frac{v}{-20}$$

$$\Rightarrow -5 \times -20 = v$$

$$v = 100 \text{ cm}$$

By lens formula

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

$$\frac{1}{f} + \left(\frac{-1}{25}\right) = \frac{1}{100} - \left(\frac{-1}{20}\right)$$

$$\frac{1}{f} - \frac{1}{25} = \frac{1}{100} + \frac{1}{20}$$

$$\frac{1}{f} - \frac{1}{25} = \frac{20 + 100}{100 \times 20}$$

$$\frac{25 - f}{25f} = \frac{120}{2000}$$



$$\Rightarrow 25 \times 120j = 200(25 - j)$$

$$\Rightarrow 300j = 5000 - 200j$$

$$\Rightarrow 500j = 5000$$

$$\Rightarrow j = 10 \text{ cm}$$

$$\text{Power} = \frac{1}{f} = 10 \text{ D} \quad (\text{convex lens})$$

Q) You are provided with lenses of powers +10D, +5D, -5D, -20D & -10D. Taking a pair of lens at a time, which 2 lens will you select to have a combination of total focal length when the two lens are kept in contact in each case  
 i) 20cm. ii) -10cm iii) -20cm iv)  $\frac{20}{3}$ cm

i)  $P = P_1 + P_2$   
 $= 10\text{D} - 5\text{D} = 5\text{D}$   
 $f = 20\text{cm}$

ii)  $P = -5\text{D}$   
 $f = \frac{100}{-5} = -20\text{cm}$

iii)  $P = 10\text{D} - 20\text{D}$   
 $= -10\text{D}$   
 $f = \frac{100}{-10} = -10\text{cm}$

iv)  $P = 15\text{D}$   
 $f = \frac{100}{15} = \frac{20}{3}\text{cm}$