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

$u = -45\,cm \qquad v = 90\,cm$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{90} + \frac{1}{45} = \frac{1}{30}$$

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

When needle moved 5cm away from the lens

$u = -50\,cm$

$$\frac{1}{v'} = \frac{1}{f} + \frac{1}{u} = \frac{1}{30} + \frac{1}{-50} = \frac{2}{150} = \frac{1}{75}$$

$$\boxed{v' = 75\ cm}$$

Displacement of image $= v - v' = 90 - 75 = 15\,cm$

$$P = \frac{1}{f} = \frac{100}{30} = 3.3\ D$$

Q A lens of power 3D & another of -1.5 D are placed in contact. Will the combination be convergent or divergent?

A $P = P_1 + P_2$
$= 3D - 1.5D$
$= 1.5D$

$f = \frac{1}{P} = \frac{1}{1.5}$
$= 0.6\ m$

Hence, the combination will be convergent.

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

$m = -5 \qquad u = -20\ cm$

$m = \frac{f}{f+u} \Rightarrow -5 = \frac{f}{f-20} = \frac{50}{3}\ cm$

Now $\frac{1}{f_2} = \frac{1}{f} - \frac{1}{f_1} = \frac{3}{50} - \frac{1}{-25} = \frac{3+2}{50} = \frac{1}{10}$

$f_2 = 10\ cm \qquad P = \frac{100}{10} = 10D$

Hence, the lens is Conver & focal length is 10 cm

Q You are provided with lenses of powers 10D, 5D, −5D, −20D & −10D. Taking a pair of lenses at a time, which two lenses will you select to have a combination of total focal length when the two lenses are kept in contact in each case
(i) 20 cm (ii) 10 cm (iii) −20 cm (iv) 20/3 cm

(i) $P = P_1 + P_2 = 10D - 5D = 5D$

$$f = \frac{1}{P} = \frac{100}{5} = 20 \text{ cm}$$

(ii) $P = P_1 + P_2 = 10D$

$$f = \frac{1}{P} = \frac{100}{10} = 10 \text{ cm}$$

(iii) $P = P_1 + P_2 = -10D + 5D = -5D$

$$f = \frac{1}{P} = \frac{100}{-5} = -20 \text{ cm}$$

(iv) $P = P_1 + P_2 = 10D + 5D = 15D$

$$f = \frac{1}{P} = \frac{100}{15} = \frac{20}{3} \text{ cm}$$