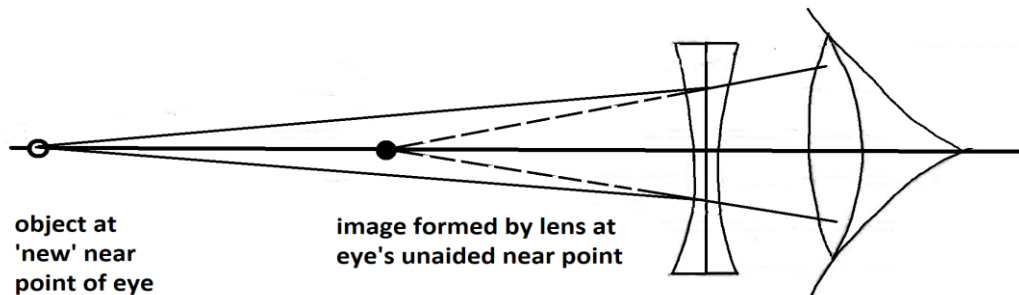


## MEDICAL PHYSICS

### 1-3 Defects of vision

1. (a) Myopia or short-sight is when an eye cannot focus on distant objects

(b) (i) Myopia is corrected by a diverging lens of focal length equal to the distance between the eye and the uncorrected far point.



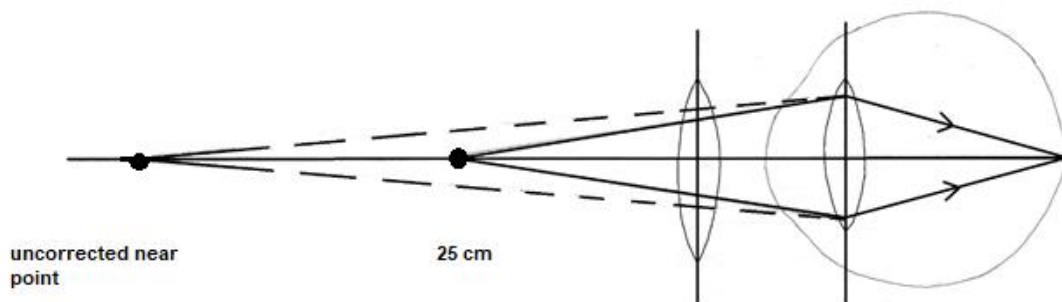
(ii) uncorrected far point = 8.0 m = - focal length of diverging lens

Required focal length for the diverging lens is therefore -8.0 m

$$\text{Power} = \frac{1}{f} = \frac{1}{-8.0} = -0.125 \text{ D}$$

2. (a) Hypermetropia or long-sight is when an eye cannot focus on nearby objects.

(b) (i) Hypermetropia is corrected by a converging lens of focal length such that it makes an object 25 cm from the eye appear to be at the uncorrected near point.



(ii) near point at 0.50 m so image distance  $v = -0.50 \text{ m}$   
object to be at 25 cm so object distance  $u = 0.25 \text{ m}$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \quad \text{so} \quad \frac{1}{f} = \frac{1}{0.25} + \frac{1}{-0.50}$$

$$\text{As power} = \frac{1}{f} \quad \text{power} = \frac{-0.50 + 0.25}{0.25 \times -0.50} = \frac{-0.25}{-0.125} = 2.0 \text{ D}$$

3. (a) uncorrected far point = 5.0 m  
near point = 25 cm = 0.25 m

(i) lens focal length required = - 5.0 m = f

$$\text{So Power} = \frac{1}{f} = \frac{1}{-5.0} = -0.20 \text{ D}$$

(ii) image formed at eye's unaided near point so  $v = -0.25 \text{ m}$   
object at corrected near point i.e. at  $u$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \quad \text{so} \quad \frac{1}{u} = \frac{1}{f} - \frac{1}{v} = \frac{1}{-5.0} - \frac{1}{-0.25}$$
$$= \frac{-0.25 - (-5.0)}{-5.0 \times -0.25}$$

$$\frac{1}{u} = \frac{+4.75}{+1.25}$$

$$u = \frac{+1.25}{+4.75}$$

$$u = 0.26 \text{ m to 2 sf}$$

(b) near point = 0.80 m

(i) image distance  $v = -0.80 \text{ m}$   
object at 0.25 m so  $u = 0.25 \text{ m}$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} = \frac{1}{0.25} + \frac{1}{-0.80}$$
$$= \frac{-0.80 + 0.25}{0.25 \times -0.80}$$

$$\frac{1}{f} = \frac{-0.55}{-0.20}$$

$$= +2.75$$

$$\text{Power} = \frac{1}{f} = +2.75 \text{ D}$$

(ii) distance of lens to the 'new' far point =  $f = \frac{1}{2.75} = 0.36 \text{ m to 2 sf}$

4. (a) Astigmatism is a sight defect in which objects are seen to be sharper in focus in one direction than in other directions. It is the result of uneven curvature of the cornea, which means straight lines in different orientations cannot be focused on the retina at the same time.

(b) Astigmatism is corrected using a cylindrical-shaped surface to the lens orientated so as to compensate for the uneven curvature of the cornea.

The curvature of the cylindrical-shaped surface must be specified as must the orientation of the axis of the cylindrical surface.