

**Speed of Light****Exercise Solutions****Question 1:****Solution:**

In the Fizeau's apparatus,

Distance between the mirrors,  $D = 12.0 \text{ km} = 12 \times 10^3 \text{ m}$

Number of teeth in the wheel,  $n = 180$

Speed of light =  $3 \times 10^8 \text{ ms}^{-1}$

we know,

$$\text{Speed of light, } c = (2Dn\omega)/\pi$$

$$\Rightarrow \omega = c\pi/(2Dn) \text{ rad/sec} = c\pi/(2Dn) \times 180/\pi \text{ degree/sec}$$

$$\Rightarrow \omega = [3 \times 10^8]/[24 \times 10^3] = 1.25 \times 10^4 \text{ degree/sec}$$

**Question 2:****Solution:**

Distance between fixed and rotating mirror =  $R = 16 \text{ m}$

Distance between lens and rotating mirror =  $b = 6 \text{ m}$

Distance between source and lens =  $a = 2 \text{ m}$

Angular speed =  $\omega = 356 \text{ rev/s} = 356 \times 2\pi \text{ rad/sec}$

Shift in image =  $s = 0.7 \text{ cm} = 0.7 \times 10^{-3} \text{ m/s}$

Now,

$$\text{Speed of light} = c = (4R^2\omega a)/s(R+b)$$

$$= [4 \times 16^2 \times 356 \times 2\pi \times 2] / [0.7 \times 10^{-3} (16+6)]$$

$$= 2.975 \times 10^8 \text{ m/s}$$

**Question 3:****Solution:**

Distance travelled by the light wave between two reflections from the rotating mirror =

$$D = 4.8 \text{ km} = 4.8 \times 10^3$$

Number of faces of the mirror =  $N = 8$

In the Michelson experiment, the speed of light =  $c = (D\omega N)/2\pi$

Where,  $\omega$  is angular speed of the mirror.

$$\text{Or } \omega = (2\pi c)/DN \text{ rad/s} = c/(DN) \text{ rev/sec}$$

$$= [3 \times 10^8] / [4.8 \times 10^3 \times 8]$$

$$= 7.8 \times 10^3 \text{ rev/sec}$$