

SOLUTIONS TO CONCEPTS CHAPTER 21

1. In the given Fizeau's apparatus,

$$D = 12 \text{ km} = 12 \times 10^3 \text{ m}$$

$$n = 180$$

$$c = 3 \times 10^8 \text{ m/sec}$$

$$\text{We know, } c = \frac{2Dn\omega}{\pi}$$

$$\Rightarrow \omega = \frac{\pi c}{2Dn} \text{ rad/sec} = \frac{\pi c}{2Dn} \times \frac{180}{\pi} \text{ deg/sec}$$

$$\Rightarrow \omega = \frac{180 \times 3 \times 10^8}{24 \times 10^3 \times 180} = 1.25 \times 10^4 \text{ deg/sec}$$

2. In the given Foucault experiment,

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

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

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

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

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

So, speed of light is given by,

$$c = \frac{4R^2\omega a}{s(R+b)} = \frac{4 \times 16^2 \times 356 \times 2\pi \times 2}{0.7 \times 10^{-3} (16+6)} = 2.975 \times 10^8 \text{ m/s}$$

3. In the given Michelson experiment,

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

$$N = 8$$

$$\text{We know, } c = \frac{D\omega N}{2\pi}$$

$$\Rightarrow \omega = \frac{2\pi c}{DN} \text{ rad/sec} = \frac{c}{DN} \text{ rev/sec} = \frac{3 \times 10^8}{4.8 \times 10^3 \times 8} = 7.8 \times 10^3 \text{ rev/sec}$$

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