

HC VERMA Solutions for Class 11 Physics Chapter 21 Speed of Light

Question 1

In an experiment to measure the speed of light by Fizeau's apparatus, following data are used: Distance between the mirrors = 12.0 km, Number of teeth in the wheel = 180. Find the minimum angular speed of the wheel for which the image is not seen.

Solution 1

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

$$n = 180$$

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

Using,

$$C = (2Dn\omega) \div n$$

$$W = [n \times (3 \times 10^8)] \div [2 (12 \times 10^3) (180)] \text{ rad/sec}$$

$$W = [(n \times 10^5) \div (8 \times 180)] \times [180 \div n] \text{ deg/sec}$$

$$W = 1.25 \times 10^4 \text{ deg/sec}$$

Question 2

The image is not seen. 2. In an experiment with Foucault's apparatus, the various distances used are as follows: Distance between the rotating and the fixed mirror = 16 m Distance between the lens and the rotating mirror = 6 m, Distance between the source and the lens = 2 m. When the mirror is rotated at a speed of 356 revolutions per second, the image shifts by 0.7 mm. Calculate the speed of light from these data.

Solution 2

$$R = 16 \text{ m} ; b = 6 \text{ m} ; a = 2 \text{ m} ; s = 0.7 \text{ cm} = 0.7 \times 10^{-3} \text{ m}$$

$$W = 256 \text{ rev/sec}$$

$$W = 256 \times 2\pi \text{ rad/sec}$$

Speed of Light

$$C = (4R^2\omega a) \div S(R+b)$$

$$= [4 \times (16)^2 \times 256 \times 2\pi \times 2] \div [0.7 \times 10^{-3} (16+6)]$$

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

Question 3

In a Michelson experiment for measuring speed of light, the distance travelled by light between two reflections from the rotating mirror is 4.8 km. The rotating mirror has a shape of a regular octagon. At what minimum angular speed of the mirror (other than zero) the image is formed at the position where a non-rotating mirror forms it?

Solution 3

$$D = 4.8 \text{ km}$$

$$D = 4.8 \times 10^3 \text{ m} ; N = 8$$

Using

$$C = (DWN) \div (2\pi)$$

$$W = (2\pi C) \div (DN) \text{ rad/sec}$$

$$W = C \div (DN) \text{ rev/sec}$$

$$= [3 \times 10^8] \div [(4.8 \times 10^3) \times (8)]$$

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