Speed of Light

Exercise Solutions

Solution 1:
In the Fizeau's apparatus,
Distance between the mirrors, D = 12.0 km = 12×10^3 m
Number of teeth in the wheel, n = 180
Speed of light = 3×10^8 ms^{-1}

we know,

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

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

$\Rightarrow \omega = [3x10^8]/[24x10^3] = 1.25 \times 10^4$ degree/sec

Solution 2:
Distance between fixed and rotating mirror = R = 16m
Distance between lens and rotating mirror = b = 6m
Distance between source and lens = a = 2m
Angular speed = $\omega = 356$ rev/s = $356 \times 2\pi$ rad/sec
Shift in image = s = 0.7 cm = 0.7×10^{-3} m/s
Now,
Speed of light = $c = (4R^2\omega a)/s(R+b)$
$= [4x16^2x\ 356x2\pi \times 2]/[0.7x10^{-3}(16+6)]$

$= 2.975 \times 10^8$ m/s

Solution 3:
Distance travelled by the light wave between two reflections from the rotating mirror = D = 4.8 km = 4.8×10^3
Number of faces of the mirror = N = 8
In the Michelson experiment, the speed of light = $c = (D\omega N)/2\pi$
Where, ω is angular speed of the mirror.

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

$= [3x10^8]/[4.8x10^3x8]$

$= 7.8 \times 10^3$ rev/sec