4. In a double-slit experiment the angular width of a fringe is found to be 0.2° on a screen placed 1 m away. The wavelength of light used is 600 nm. What will be the angular width of the fringe if the entire experimental apparatus is immersed in water? Take refractive index of water to be $\frac{4}{3}$

Sol. Given,

Angular width of a fringe = 0.2°

Wavelength of light used, λ = 600 nm = 600$\times$ 10^{-9} m

Refractive index of water, $\mu = \frac{4}{3}$

Angular fringe separation, $\theta = \frac{\lambda}{d}$ or $d = \frac{\lambda}{\theta}$

In water, $d = \frac{\lambda'}{\theta'}$

$\therefore \quad \frac{\lambda}{\theta} = \frac{\lambda'}{\theta'}$

$\Rightarrow \quad \frac{\theta'}{\theta} = \frac{\lambda'}{\lambda} = \frac{1}{\mu} = \frac{3}{4} \left[\because {}_{a}\mu_{\omega} = \frac{\lambda_a}{\lambda_\omega}\right]$

Angular fringe width when immersed in water,

$\theta' = \frac{3}{4}\theta$

$= \frac{3}{4} \times 0.2^{\circ}$

= 0.15°