① Using Brewster's law

$\mu = \tan(i_p) \Rightarrow i_p = \tan^{-1}\mu = \tan^{-1}(1.54) = 57^\circ$

$i_p + r = 90 \Rightarrow r = 90 - 57 = 33^\circ$

② Malus law, $I = I_0 \cos^2\theta$

$I \to \frac{I_0}{2} \Rightarrow \frac{I_0}{2} = I_0 \cos^2\theta \Rightarrow \cos\theta = \pm\frac{1}{\sqrt{2}}$

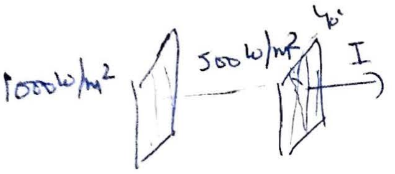
$\Rightarrow \theta = \pm 45^\circ, \pm 135^\circ$

③ First crossed ($\theta = 90^\circ$), then rotated by 60°, so effective angle is 30°.

If I_0 is Incident intensity, then transmitted through first Nicol is $I_0/2$; Now $I_0/2$ is incident on Nicol with angle 30° w.r.t. direction of polarisation then

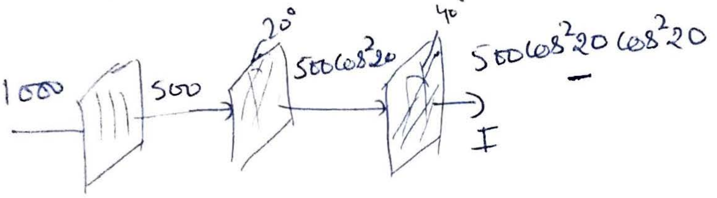
$$I = \frac{I_0}{2}\cos^2 30 = \frac{3}{8} I_0$$

④ (i)



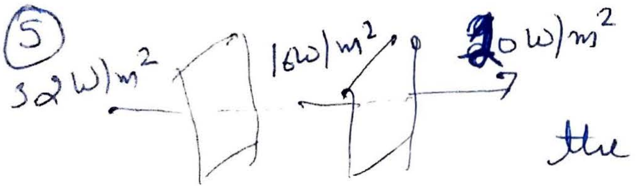
$I = 500 \cos^2 40 = 293.412 \text{ W/m}^2$

(ii)



$I = 500 \cos^2 20 \cos^2 20 = 389.86 \text{ W/m}^2$

⑤



Irrespective of angle between the polaroids, this is not possible

⑥ $t = \frac{\lambda}{2|\mu_o - \mu_e|} = \frac{6000}{2(1.55 - 1.54)} = 3 \times 10^{3}$ cm

⑦ (a) Phase diff b/w E_x & $E_y = \pi$, path diff. $= \lambda/2$

This corresponds to half wave plate & light will be linearly polarised.

(b) Phase diff $= \frac{\pi}{2} \Rightarrow$ path diff $= \lambda/4$

Circularly polarised light.