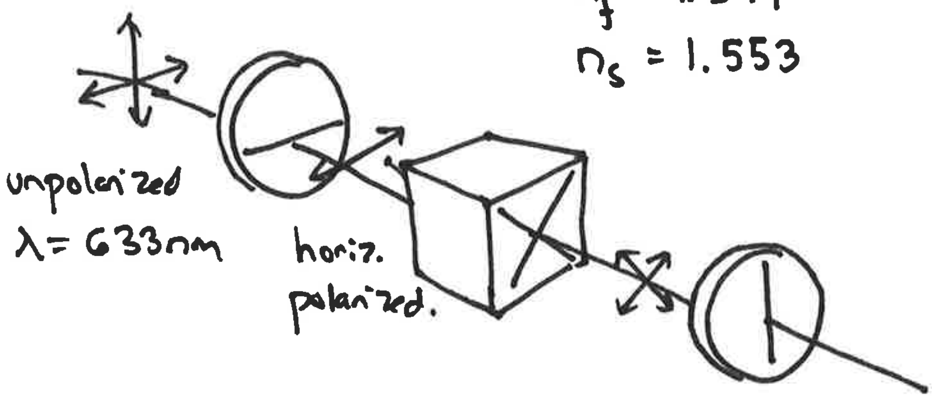
ASG vol 3 EX 23.1 (Birefringence, 1/4 wave-plates ...)

$n_f = 1.544$

$n_s = 1.553$




a) The extraordinary beam has a lower ($n_f = 1.544$) and the ordinary beam has a larger ($n_s = 1.553$) refractive index. So the ordinary beam is slower than the extraordinary beam.

b) We need $\Delta N = N_s - N_f = \frac{1}{2}$ ($\frac{1}{2}$ more oscillation of slow beam)

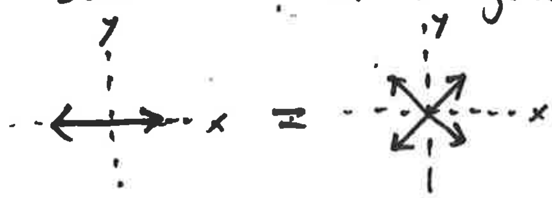
$$= \frac{d}{\lambda_s} - \frac{d}{\lambda_f} = \frac{1}{2}$$

$$d = \frac{1/2}{\frac{1}{\lambda_s} - \frac{1}{\lambda_f}} = \frac{1/2}{\frac{n_s}{\lambda} - \frac{n_f}{\lambda}} = \frac{(1/2)\lambda}{n_s - n_f}$$

$$= \frac{(1/2)(633\,nm)}{1.553 - 1.544} =$$

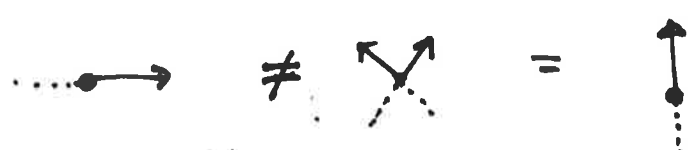
$$\boxed{d_{1/2} = 35.2\,\mu m}$$

c) Before entering the crystal, the beam was horizontally polarized. This horizontal polarization can be thought of as a sum of 2 diagonally polarized waves




After exiting the crystal, one of the diagonally polarized beams has been delayed by $\frac{1}{2}$ wavelength compared to the other. So whereas before hitting the crystal we had


now we have




The resultant wave is vertically polarized.

d) It will pass thru the analyzer. But if the analyzer is horizontal, it will be blocked.

e) $d = (1/4)\lambda/(n_s - n_f) = \boxed{17.6 \mu m}$