Physics C Chapter 33 HW

33.9) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin(62.4°) = \frac{c}{v}\sin(49.7°)$

$\boxed{v = 2.58\times10^8 \frac{m}{s}}$

33.11) a) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\theta_1 = 70° - 65° = 25°$

$n_x \sin 25° = \frac{4}{3}\sin 48°$

$\boxed{n_x = 2.34}$

b) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\frac{4}{3}\sin 48° = \sin\theta_2$

$\boxed{\theta_2 = 82.25°}$

33.15) $n_1 = 1.62$

a) $\sin\theta_c = \frac{n_2}{n_1}$

$\sin\theta_c = \frac{1}{1.62}$

$\theta_c = 38.11°$

$\theta = 90° - \theta_c$

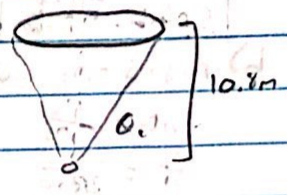
$\boxed{\theta = 51.89°}$

b) $\sin\theta_c = \frac{1.33}{1.62}$

$\theta_c = 55.18°$

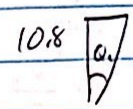
$\boxed{\theta = 34.81°}$

33.20)



$\sin\theta_c = \frac{1}{1.33}$

$\theta_c = 48.75°$

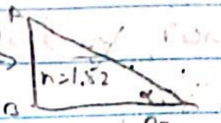


$\tan\theta_c = \frac{r}{10.8m}$

$r = 12.32\,m$

$\boxed{A = 476.57\,m^2}$

33.21) a)



$\sin\theta_c = \frac{n_2}{n_1}$

$\sin\theta_c = \frac{1}{1.52}$

$\theta_c = 41.14°$

$\alpha_{max} = 90° - 41.14°$

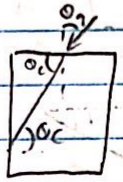
$\boxed{\alpha_{max} = 48.86°}$

b) $\sin\theta_c = \frac{1.33}{1.52}$

$\theta_c = 61.04°$

$\boxed{\alpha_{max} = 28.96°}$

33.39)



$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin\theta_a = 1.40\sin(90° - \theta_c)$

$\sin\theta_c = \frac{n_2}{n_1}$

$\sin\theta_c = \frac{1}{1.40}$

$\theta_c = 45.58°$

$\sin\theta_a = 1.40\sin(44.41)$

$\boxed{\theta_a = 78.46°}$

33.43) $\lambda = 580nm$, $d = 1.45cm$

$t = 2.55mm$, $n = 1.70$

$\lambda f = c$

$f = 5.17\times10^{14}Hz$

$n = \frac{c}{v}$

$v = 1.76\times10^8 \frac{m}{s}$

$\lambda_1 f = v$

$\lambda_1 = 341.34nm$

number of λ outside $= \frac{d-t}{580nm}$

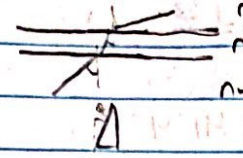
$\#\lambda_1 = 20603.45$

$\#\lambda_0 = 7470.56$

$\boxed{\#\lambda = 2.81\times10^4}$

33.47) $n_1 = 1.309$, $n_w = 1.333$

a) $\sin\theta_c = \frac{n_2}{n_1}$



$n_w \sin\theta = n_1 \sin\theta_c$

$\sin\theta_c = \frac{n_{air}}{n_1}$

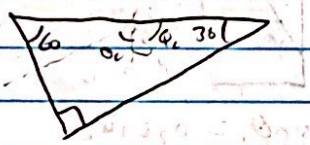
$1.333 \sin\theta = 1$

$\boxed{\theta = 48.61°}$

b) $\sin\theta_c = \frac{n_{air}}{n_w}$

$\boxed{\theta_c = 48.61°}$

33.50)



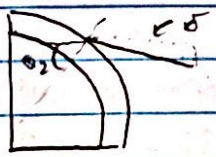
$\theta_c = 60°$

$\sin\theta_c = \frac{n_2}{n_1}$

$\sin 60 = \frac{n}{1.54}$

$\boxed{n = 1.333}$

33.51)



a) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin\theta_1 = n \sin\theta_2$

$\sin(90-\delta) = n \sin\theta_2$

$\sin(90-\delta) = n\left(\frac{R}{R+h}\right)$

$\theta + \delta = \arcsin\left(\frac{Rn}{R+h}\right)$

$\boxed{\delta = \arcsin\left(\frac{Rn}{R+h}\right) - \arcsin\left(\frac{R}{R+h}\right)}$

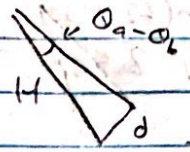
b) $\delta = 85.69° - 85.47°$

$\boxed{\delta = 0.22°}$

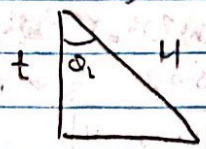
c) $\boxed{0.22° \approx 0.25°}$

33.52) $\theta_a = \theta_a'$

a)



$\sin(\theta_a - \theta_b) = \frac{d}{H}$



$\cos\theta_b = \frac{t}{H}$

$H = \frac{t}{\cos\theta_b}$

$\boxed{d = \frac{t\sin(\theta_a - \theta_b)}{\cos\theta_b}}$

b) $\theta_a = 66°$, $t = 2.4cm$

$n = 1.80$

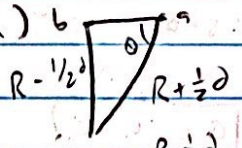
$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin 66° = 1.8 \sin\theta_b$

$\theta_b = 30.5°$

$\boxed{d = 1.62cm}$

33.59) a)



$\sin\theta = \frac{R - \frac{1}{2}d}{R + \frac{1}{2}d}$

$\boxed{\sin\theta = \frac{2R-d}{2R+d}}$

b) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin\theta = \frac{n_2}{n_1}$

$\frac{n_2}{n_1} = \frac{2R-d}{2R+d}$

$2R - d = \frac{n_2}{n_1}(2R+d)$

$2R - d = 2R\frac{n_2}{n_1} + \frac{dn_2}{n_1}$

$2R - 2R\frac{n_2}{n_1} = d + \frac{dn_2}{n_1}$

$2R\left(1 - \frac{n_2}{n_1}\right) = d + \frac{dn_2}{n_1}$

$\boxed{R = \frac{d + \frac{dn_2}{n_1}}{2 - 2\frac{n_2}{n_1}}}$

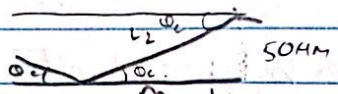
c) $R = \frac{d + \frac{d n_2}{n_1}}{2 - 2\frac{n_2}{n_1}}$

$\frac{n_2}{n_1} = \frac{1.4411}{1.4475}$

$\frac{n_2}{n_1} = 0.998$

$\boxed{R = 2.07 \times 10^{-2}\,m}$

d)



$\sin\theta_c = \frac{n_2}{n_1}$

$\theta_c = 86.01°$

$L_1 \tan 86.01 = 50MM$

$L_1 = 3.49 \times 10^{-6}\,m$

$L_2 \sin 86.01 = 50MM$

$L_2 = 5.01 \times 10^{-5}\,m$

$\frac{L_2}{L_1} = \frac{\Delta L}{1000m}$

$\Delta L = 14355.3m$ X

?

33.60) a) $2\theta_a^A - 2(\theta_a^A - \theta_b^A)$

$2\theta_b^A - 2\theta_a^A + 2\theta_b^A$

$\Delta = -2\theta_a^A + 4\theta_b^A$

$\boxed{\Delta = 2\theta_a^A - 4\theta_b^A + \pi}$

b) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\theta = \theta_a^A$

$\sin\theta = n \sin\theta_b^A$

$\theta_b^A = \arcsin\left(\frac{\sin\theta}{n}\right)$

$\boxed{\Delta = 2\theta - 4\arcsin\left(\frac{\sin\theta}{n}\right) + \pi}$

c) $\frac{\partial \Delta}{\partial \theta} = 0$

$2 - \frac{\partial}{\partial \theta}\left(4\arcsin\left(\frac{\sin\theta}{n}\right)\right) = 0$

$2 - 4\frac{\partial}{\partial \theta}\arcsin\left(\frac{\sin\theta}{n}\right) = 0$

$u = \frac{\sin\theta}{n}, \quad du = \frac{1}{n}\cos\theta\, d\theta$

$2 - 4\left(\frac{1}{\sqrt{1 - \frac{1}{n^2}\sin^2\theta}}\right)\left(\frac{1}{n}\cos\theta\right) = 0$

$\frac{\cos\theta}{n\sqrt{1 - \frac{1}{n^2}\sin^2\theta}} = \frac{1}{2}$

$\cos\theta = \frac{1}{2}\left(n - \frac{1}{n}\sin^2\theta\right)$

$\boxed{\cos^2\theta = \frac{1}{3}(n^2 - 1)}$

d) $\boxed{\theta_{1v} = 58.89°}$

$\boxed{\theta_{1r} = 59.58°}$

e) $\boxed{\Delta v = 139.2°}$

$\boxed{\Delta r = 137.5°}$

f) $\boxed{Rcd}$