(16 marks)

Q1 (a) $E = \frac{1}{2} kA^2$

$= \frac{1}{2}(35.0\ N/m)(4.00 \times 10^{-2}\ m)^2$

$= 28.0\ mJ$ marks

~~(b) $|v| = \omega(A^2 - x^2)^{1/2} = \sqrt{\frac{k}{m}}(A^2 - x^2)$~~

~~$= 1.02\ m/s$~~

(b) $\frac{1}{2}mv^2 = \frac{1}{2}kA^2 - \frac{1}{2}kx^2$

$= 12.2\ mJ$ marks

(c) $\frac{1}{2}kx^2 = E - \frac{1}{2}mv^2$

$= 15.8\ mJ$ marks

(16 marks)

Q2 For first pipe,

$$\lambda = v/f = \frac{343\ m/s}{256\ s^{-1}} = 1.34\ m$$

$\therefore$ Length, $d_1 = \lambda/2 = 0.67\ m$ marks

For second pipe,

$$\lambda = v/f = \frac{343\ m/s}{440\ s^{-1}} = 0.78\ m$$

$\therefore$ Length $d_2 = \lambda/2 = 0.39\ m$ marks

(b) $\therefore$ Original length $= d_1 + d_2 = 1.06\ m$

$\therefore \lambda = 2(d_1 + d_2) = 2.12\ m$ marks

(a) $\therefore f = v/\lambda = \frac{343}{2.12} = 162\ Hz$ marks

~~(c) For closed end, $\lambda = 4d$~~

~~$\therefore$ tube 1, $\lambda = 2.68\ m$~~

~~$f = v/\lambda = 128\ Hz$~~

~~$\therefore$ tube 2 $\lambda = 1.56\ m$~~

~~$f = v/\lambda = 220\ Hz$~~

(16 marks)

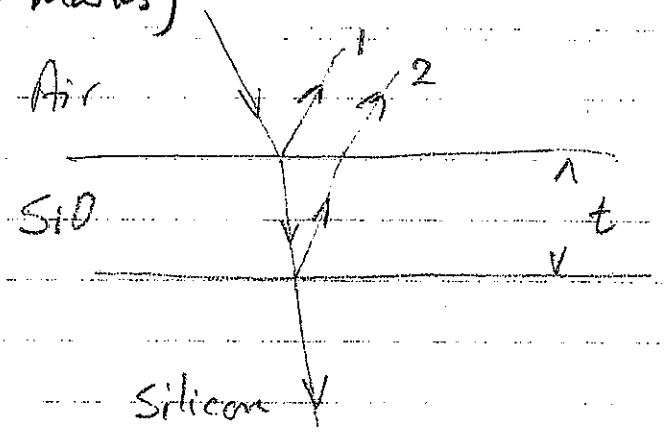
Q3 The mica introduces an optical path length $\Delta L = nt - t$ of 7 wavelengths ... marks

$\therefore t(n-1) = 7\lambda$ ... marks

$\therefore t = \frac{(7)(550 \times 10^{-9})}{(1.58 - 1)} = 6.64 \times 10^{-6}$ m ... marks

(16 marks)

Q4



a) Ray 1 undergoes π phase change on reflection 1 marks
Ray 2 " π " " " " marks

∴ Require an addition path length of $\lambda_n/2$ to create destructive interference

$$\therefore \quad t = \lambda_n/4 = \frac{\lambda}{4n} = \frac{550}{4\,(1.45)} = 94.8\ nm \quad : \text{ marks}$$

~~b) Maximum reflection when $\lambda_n/2 = t$~~

~~$\therefore \lambda = 2nt = 275\ nm$~~