EXERCISE – IV TOUGH SUBJECTIVE PROBLEMS

1. $y = A\cos(ax + bt)$

(a) $\frac{2\pi}{\lambda} = a \Rightarrow \lambda = \frac{2\pi}{a}$

$2\pi f = b \Rightarrow f = \frac{b}{2\pi}$

(b) $y_r = 0.8\ A\cos(ax - bt + \pi)$

$y_r = -0.8\ A\cos(ax - bt)$

since $A' = \left(\sqrt{\frac{I'}{I}}\right) \times A$

$A' = 0.8\ A$

(c) Reflected & incidence from a wave of

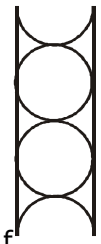
$A_{max} = A + 0.8\ A$

$= 1.8\ A$

and $A_{min} = A - 0.8\ A = 0.2\ A$

so $V_{max} = 1.8$ Aw & V_{min} = v

2. (a)



$l = \frac{3}{2}\lambda \Rightarrow \lambda = \frac{2}{3}L$

disp. node to pressure node

is $\frac{\lambda}{4} = \frac{2l}{3\times 4} = \frac{l}{6}$

(b) $750 = (2n + 1) f_0$

$1050 = [2(n + 1) + 1] f = 750 + 2f_0$

$2f_0 = 300 \Rightarrow f_0 = 150$ Hz

(c) $\frac{\lambda}{2} = 20$cm

$\Rightarrow \lambda = 0.4$ m

$v = f\lambda = 1100 \times 0.4 = 440$ m/s

$440 = \sqrt{\frac{rRT}{M}} \Rightarrow r = \frac{440\times 440}{8.31\times 293}\times\left(\frac{16}{1000}\right) = 1.28$

3. (a) $\lambda = \frac{v}{f} = \frac{330}{200} = 1.65$ m

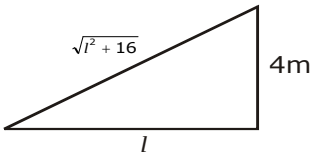
d = 4m

max. path difference = 4m = 2.42 λ

So minima at

path difference $\Delta x = 0.5\ \lambda, 1.5\ \lambda$

(b)

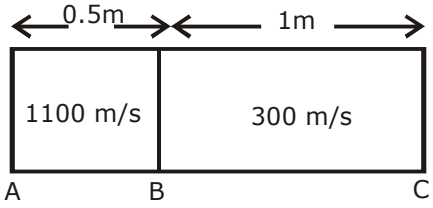


$\Delta x = \sqrt{l^2+16} - \lambda = 0.5\ \lambda$ & $1.5\ \lambda$

where $\lambda = 1.65$ m

solving $l = 9.28$ m & 1.99 m

4.



In AB $f_1 = \text{odd} \times \frac{v}{4l} = \text{odd} \times \frac{1100}{4\times 0.5}$

$= 550$; 1650, 2750....

In BC $f_2 = \frac{nv}{2l} = n \times 150 = 150$; 300 ; 450...

common & last frequency = 1650 Hz

(a) 1650 n

(b) $f' = \frac{v}{v - v_s} f$

$1650 = \frac{330}{330 - 30} \times f$

$f = \frac{1650\times 30}{33} = 1500$ Hz

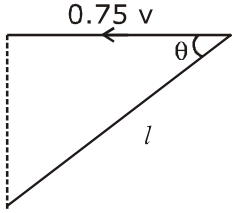
5. (a) $l' = \frac{v - v_s}{f} = \frac{332 - 32}{1000} = 0.3$ m

(b) $f' = \frac{v + v_0}{v - v_s} \times f = \frac{332 + 64}{332 - 32} \times 1000 = 1320$ Hz

(c) $\lambda' = \frac{v - v_s}{f} = \frac{332 - 64}{1320} = 0.2$ m

6. $f' = \frac{v}{v - v_s} f$

$2f_0 = \frac{v}{v - v_s} f_0 \quad \Rightarrow 2v - 2v_s = v$



$\Rightarrow v_s = \frac{v}{2} = 170$ m/s

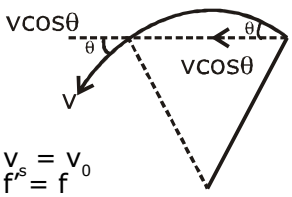
So, $0.75v \cos\theta = \frac{v}{2}$

$\cos\theta = \frac{1}{1.5} = \frac{2}{3}$

Now, $l = \frac{1500}{\sin\theta} = \frac{1500}{\sqrt{5}/3} = \frac{4500}{\sqrt{5}} = 900\sqrt{5}$

$t = \frac{900\sqrt{5}}{v} = \frac{2012}{340} = 5.95$

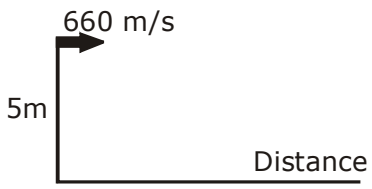
7.



$v_s = v_0$

$f' = f$

8.



$= \frac{165}{17} = 9.7$ m