SSP Exercise - I

Ex - I

SAMCQ

Q.1 (A) At $t=0$, $y = \exp\left(-(x+2)^2\right)$

1

Ex I

At $t = 1s$, $y = \exp\left[-(x-c+2)^2\right]$

(Replaced x by $x-ct$)

But at $t=2$, $y = \exp\left[-(x-2)^2\right]$

$\Rightarrow -2 = 2-c$ or $C = 4\ m/s$

Q.2 (D) At $x=0$, $t=0$, $y<0$

2

Ex I

Also $\frac{\partial y}{\partial t} = -c\frac{\partial y}{\partial x} < 0$ at $x=0$ & $t=0$

These conditions are met by $y = \sin\left(kx - \omega t - \frac{\pi}{6}\right)$ and not by others.

(1) Exercise I — 54 question

Q.3 (A) $\lambda = 0.4\,cm$, $f = 250\,Hz$

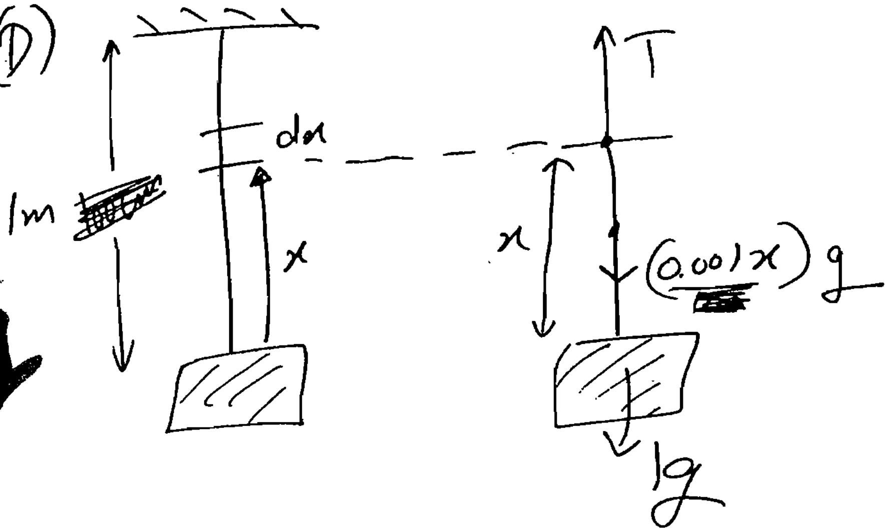
3/5

$c = f\lambda = 250 \times 0.4 = 100\,cm\,s^{-1}$

$= 1\,m/s$

Q.4 (D)

4/5



$T = (1 + 0.001x)g$

$v = \sqrt{\dfrac{T}{\mu}} = \sqrt{\dfrac{(1+0.001x)g}{0.001}}$, let $g = 10\,m/s^2$

$\dfrac{dx}{dt} = \sqrt{(1000 + x)10} = \sqrt{1000 + x}$

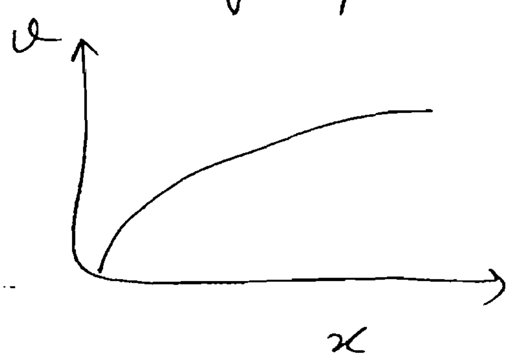
$$\int_0^1 \frac{dx}{\sqrt{10000+x}} = \int dt$$

$$\Rightarrow t = 0.01\,s$$

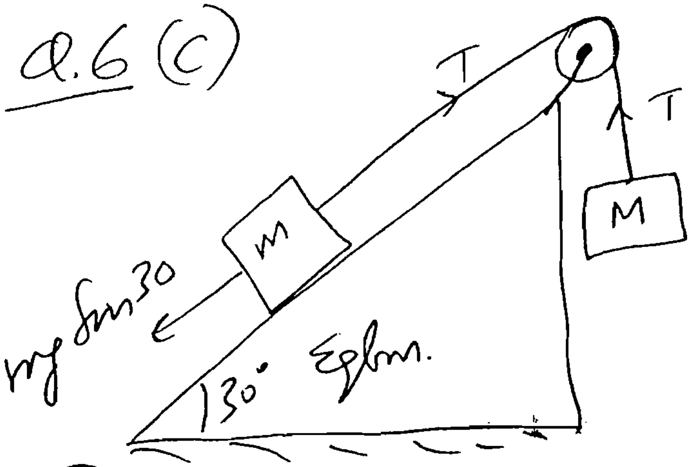
Q.5 (c) $\quad V = \sqrt{\dfrac{4xg}{4}}$ or $v^2 = g.x$

$\Rightarrow$ (parabola)

5



Q.6 (C)



6 / 21

$T = mg\sin 30^\circ$ & $T = Mg$

$mg\sin 30^\circ = Mg$ or $M = \frac{m}{2}$

$V = \sqrt{\frac{T}{\mu}}$ or $T = \mu . v^2$

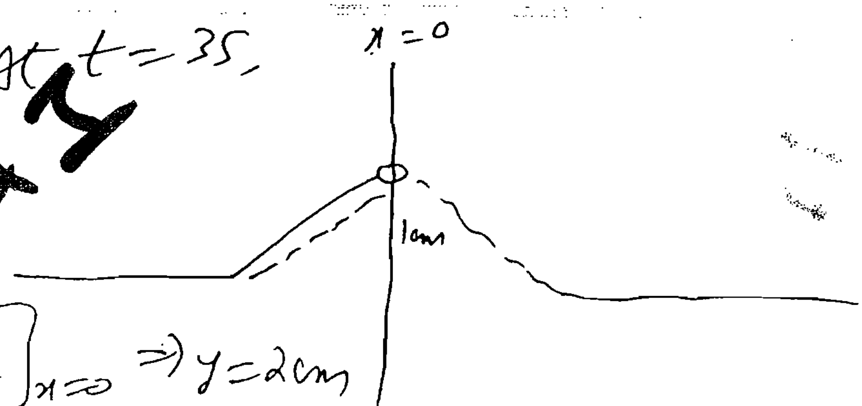
$= \frac{10^{-2}\,kg}{m} \times (100)^2$

$= 10^2\,N = 100N$

$\Rightarrow M = 10N$ and $m = 2M = 20N$

Q.7 (D) At $t = 3s$

7 | 8 3



$y = y_i + y_r \Big]_{x=0} \Rightarrow y = 2cm$

There is no phase change on reflection from free end.

MAMCQ

Q.1(c) $y = 2mm \sin(2\pi x - 100\pi t + \frac{\pi}{3})$

When $x = 4$,

$y = 2\sin(8\pi - 100\pi t + \frac{\pi}{3}) = 0$

1

3.2

$\Rightarrow \sin(8\pi - 100\pi t + \frac{\pi}{3}) = 0$

or $25\pi - 300\pi t = 3n\pi$

or $t = \frac{25 - 3n}{300}$ where n is an integ

If we put $n = 8$, $t = \frac{1}{300}$ s

Q.2 (B) $2\pi f A = 4 f \lambda$ (As max m. particle speed $= \omega A$ & wave speed $= \frac{\omega}{k}$)

2/2×I

or $\lambda = \frac{\pi A}{2}$

Q.3 (B, D) $y = \cos(500t - 70x)$

3/2×I

is a wave transverse or longitudinal?

$v = \frac{\omega}{K} = \frac{500}{70} = \frac{50}{7}$ m/s

$K = \frac{2\pi}{\lambda} = 70$ or $\lambda = \frac{2\pi}{70}$ m $= \frac{20\pi}{7}$ cm

$f = \frac{\omega}{2\pi} = \frac{500}{2\pi} = \frac{250}{\pi}$ Hz

Q.4 (C, D) $\frac{\partial y}{\partial t} = -c \cdot \frac{\partial y}{\partial x}$

Ex I

Q & R are symmetric about origin, hence $\left|\frac{\partial y}{\partial x}\right|_Q = \left|\frac{\partial y}{\partial x}\right|_R$

$\left|\frac{\partial y}{\partial x}\right|_P > \left|\frac{\partial y}{\partial x}\right|_Q$ is visible

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Q.5 to Q.8 5-8 / Ex II

$\frac{\partial y}{\partial t} = -c \frac{\partial y}{\partial x}$

Here c is -ve, so $\frac{\partial y}{\partial t}$ will have the same sign as $\frac{\partial y}{\partial x}$.

Hence,

Q.5 [redacted] (A, D)

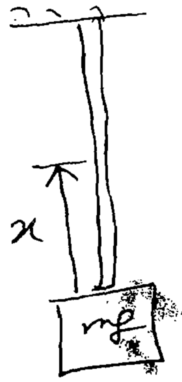
Q.6 (C)

Q.7 (B, C)

Q.8 (C, D)

Q. 9 (B, D) $T = \mu x g + mg$

9/EX



$$v = \frac{dx}{dt} = \sqrt{\frac{T}{\mu}} = \sqrt{xg + \frac{mg}{\mu}}$$

As $x \uparrow$, $\frac{dx}{dt} \uparrow$s.

$$\frac{dv}{dt} = \cancel{\frac{1}{2}\left[xg + \frac{mg}{\mu}\right]^{-\frac{1}{2}}} \cdot \frac{dv}{dx} \cdot \frac{dx}{dt}$$

$$= v \cdot \frac{dv}{dx} = v \cdot \frac{1}{2}\left[xg + \frac{mg}{\mu}\right]^{-\frac{1}{2}} \cdot g$$

$$= \frac{g}{2} \text{ (constant acceleration)}$$

SUBJECTIVE – I

Q.1 At $t=0$, point P is moving upward, so its $\frac{\partial y}{\partial t} > 0$,

Further $\left.\frac{\partial y}{\partial x}\right|_P > 0$

$$\Rightarrow \frac{\partial y}{\partial t} = -c\,\frac{\partial y}{\partial x}$$

(a) $\Rightarrow c < 0$.

Also,

$$K = \frac{2\pi}{\lambda} = \frac{2\pi}{4\times10^{-2}\,m} = 50\pi\, m$$

$$c = \frac{\frac{\partial y}{\partial t}}{\frac{\partial y}{\partial x}} = \frac{20\pi\ \frac{cm}{s}}{\tan 6^\circ} = \frac{20\pi\times10^{-2}\,m/s}{0.105}$$

$\Rightarrow c = 6\,m/s \Rightarrow \omega = Kc = 50\pi\times6 = 300\pi$

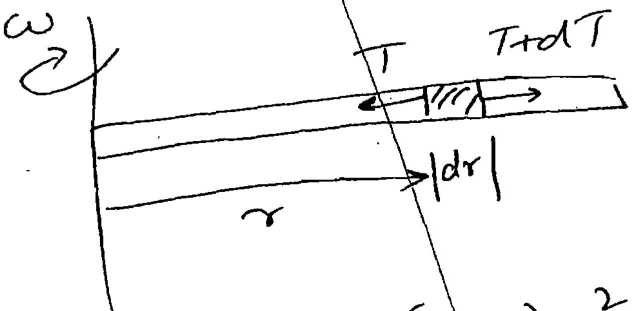
(b) Thus $y = 4\times10^{-3}\sin 100\pi\left(3t + 0.5x + \frac{1}{400}\right)$

where x, y are in metres.

(c) Total energy carried by wave per cycle of the string $= \frac{1}{2}\mu\omega^2 A^2 \lambda$

$= 144\pi^2 \times 10^{-5}\ J$

Q.2



$$-dT = (\mu\, dr)\,\omega^2 r$$

$$-\int_T^0 dT = \mu\omega^2 \int_r^R r\, dr$$

$$T = \frac{\mu\omega^2}{2}\left(R^2 - r^2\right)$$

$$\frac{dr}{dt} = \sqrt{\frac{I}{M}} = \sqrt{\frac{\omega^2}{2}\left(R^2 - r^2\right)}$$

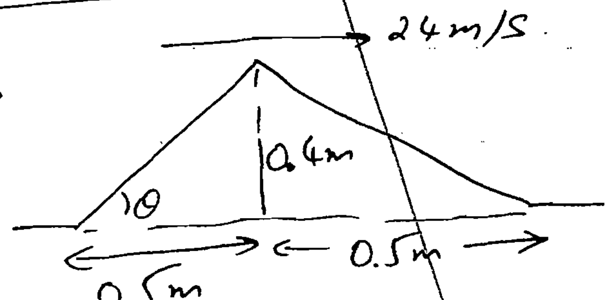
$$\int_0^R \frac{dr}{\sqrt{R^2 - r^2}} = \frac{\omega}{\sqrt{2}} \int_0^t dt$$

$$\left[\sin^{-1}\left(\frac{r}{R}\right)\right]_0^R = \frac{\omega}{\sqrt{2}} \cdot t$$

$$\frac{\pi}{2} = \frac{\omega}{\sqrt{2}} \cdot t$$

$$t = \frac{\pi}{\omega\sqrt{2}}$$

Q.3



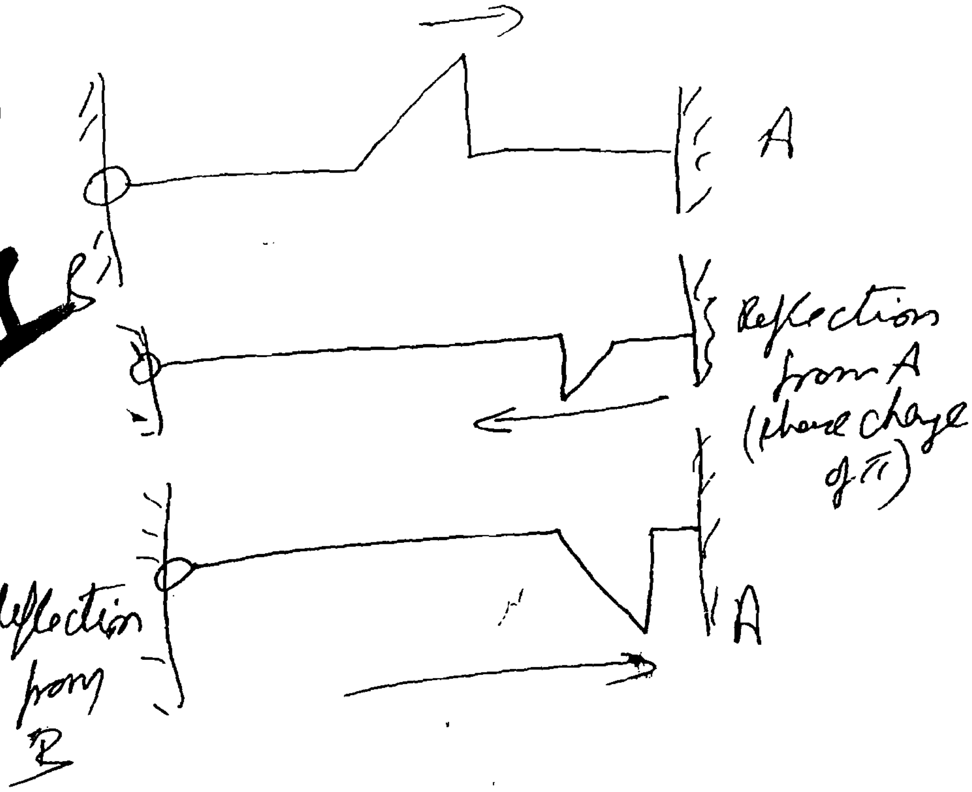
$$\tan\theta = \frac{4}{5}$$

$$\frac{\partial y}{\partial t} = -c \cdot \frac{\partial y}{\partial x} = -24\,\frac{m}{s} \times \left(\frac{\pm 4}{5}\right)$$

$$= \mp 19.2\ m/s$$

Exercise — II

Q.1 (A)



Q.2 (C) use:

$$A_r = \frac{\left(\sqrt{\frac{T}{M}} - \sqrt{\frac{T}{4M}}\right)}{\sqrt{\frac{T}{M}} + \sqrt{\frac{T}{4M}}} \cdot A_i$$

Q.3 (B) use:

$$P_t = \frac{1}{2}(4M)\,\omega^2 A_t^2 \cdot \left(\sqrt{\frac{T}{4M}}\right) \quad \text{and}$$

$$P_i = \frac{1}{2}(M)\,\omega^2 A_i^2 \left(\sqrt{\frac{T}{M}}\right)$$

Q.4

Q.5

Q.6 (

Q.4 (B) $\frac{3\lambda}{2} = 1m$

11/Ex I

$\Rightarrow c = f\lambda = 300 \times \frac{2}{3} = 200 \frac{m}{s}$

Q.5 (B) $A_{max} = 2A = 2(10) = 20$ units

12 Ex I

$\frac{\lambda}{2} = \frac{1}{2}\left(\frac{2\pi}{K}\right) = \frac{\pi}{2\pi(0.02)} = 25$ units

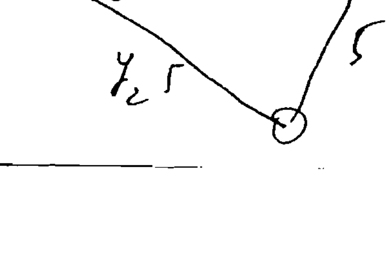
Q6 (A) $y_1 = 5\sin(\omega t - Kx)$

13/Ex y I

$y_2 = -5\cos(\omega t - Kx - 150^\circ)$

Now $\cos\theta = \sin(90 + \theta)$

$\Rightarrow y_2 = -5\sin(\omega t - Kx - 60^\circ)$



$\Rightarrow$ Amplitude of resultant $= 5$

2.7(B) The resultant wave must have $y=0$ at $x=0$.

14/ As $y_1 = A\cos(kx-\omega t)$

$y_2 = -A\cos(kx+\omega t)$

$y_1+y_2 = 2A\sin kx \cos\omega t$

(At $x=0$, $\sin kx = 0$)

2.9

2.8(A) $(n+1)\frac{\lambda}{2} = L$

2.

15/ and $\frac{\lambda}{4} = d$ (Gap between adjacent node & Antinode)

$\Rightarrow L = 2d(n+1)$

Q.9 Verify dimensionally.

$$[Y] = \left[\frac{\text{Stress}}{\text{Strain}}\right] = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$$

$$[\rho] = ML^{-3}$$

$$[\alpha] = \text{dimensi}$$

Q.9 (B) Stress = Y. Strain

$$= Y.\frac{\Delta l}{l}$$

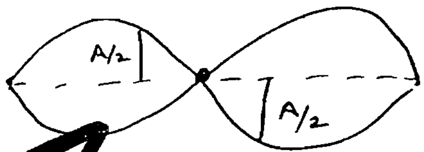
16/24

$$\frac{T}{A} = Y\alpha\Delta T$$

$$\text{frequency} \propto \sqrt{\frac{T}{\mu}} = \sqrt{\frac{T}{\rho A}}$$

$$\text{frequency} \propto \sqrt{\frac{Y\alpha}{\rho}}$$

Q. 10 (C)



17/8

$$\sin\left(\frac{20\pi x}{3}\right) = \pm\frac{1}{2}$$

$$\frac{20\pi}{3}(x_2 - x_1) = \left(\pi + \frac{\pi}{6}\right) - \left(\pi - \frac{\pi}{6}\right)$$

$$\frac{20\pi}{3}(x_2 - x_1) = \frac{\pi}{3}$$

$$(x_2 - x_1) = \frac{1}{20} = 0.05\,m = 5\,cm$$

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11 (D) $f = \frac{n}{2l}\sqrt{\frac{T}{\mu}}$ (when both ends are fixed)

18/8

$$f_1 = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$$

$$f_2 = \frac{2}{2l}\sqrt{\frac{T}{\mu}}$$

$$f_3 = \frac{3}{2l}\sqrt{\frac{T}{\mu}}$$

$$f' = \frac{(2n-1)}{4l}\sqrt{\frac{T}{\mu}}$$ (when only one end is fixed)

$$n_1 = \frac{1}{4l}\sqrt{\frac{T}{\mu}}$$

$$n_2 = \frac{3}{4l}\sqrt{\frac{T}{\mu}}$$

$$n_3 = \frac{5}{4l}\sqrt{\frac{T}{\mu}}$$

$n_2 = \frac{f_1 + f_2}{2}$ is evident.

me

Q.12 (D) $f \propto \sqrt{T}$

19/Ex I

$f = K\sqrt{V\rho g}$

$\frac{f}{2} = K\sqrt{V(\rho-1)g}$

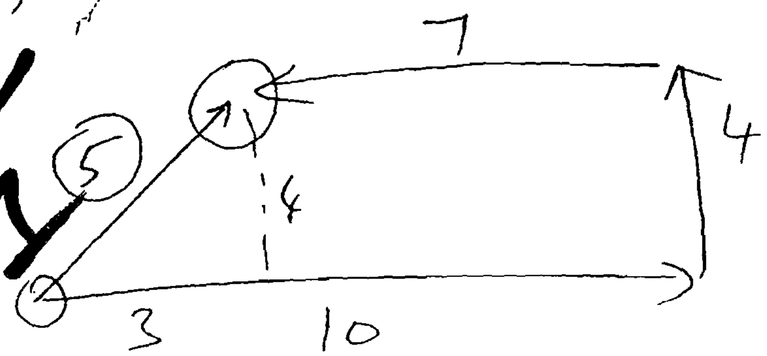
$\Rightarrow \rho = \frac{4}{3}$

$\frac{f}{3} = \sqrt{V(\rho-x)g}$

or $x = \frac{32}{27}$

Q.13 (A)

20/Ex I



Q.14 (A) $\cancel{10-6}$

21

Ex I

Path difference $= 10-6 = 4m$

$4 = n\lambda$ or $\lambda = \frac{4}{n}$

Here 4m qualifies

Q 15 (B) $I_{max} = \cancel{ER} K(\sqrt{4}+\sqrt{1})^2$

$= 9K$

22

Ex I

$I_{min} = K(\sqrt{4}-\sqrt{1})^2$

$= K$

$dB_{max} = 10 \log_{10} \frac{I_{max}}{I_0}$

$dB_{min} = 10 \log_{10} \frac{I_{min}}{I_0}$

$dB_{max} - dB_{min} = 10 \log_{10} \frac{I_{max}}{I_0} = 10 \log_{10} 9$

$= 20 \cdot \log_{10} 3$

Q.16 (B) $x = 5\,cm$

23 Ex.

$2x = 10\lambda$

$\lambda = \frac{2x}{10} = 1\,cm$

Q.17 (A), $\frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{I_1} + \sqrt{I_2}}{\sqrt{I_1} - \sqrt{I_2}}\right)^2 = \frac{49}{9}$

24 Ex.

$\Rightarrow \frac{I_1}{I_2} = \frac{25}{4}$

Q.18 (B) $I = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\delta$

25 Ex.

A, $I_A = I + 4I + 2\sqrt{I}\sqrt{4I}\cos\frac{\pi}{2}$

$= 5I$

At B,

$$I_B = I + 4I + 2\sqrt{I}\sqrt{4I}\cos\pi$$
$$= 5I - 4I = I$$

$$I_A - I_B = 5I - I = 4I$$

49/9

Q.19 (A) $\lambda = \frac{c}{f} = \frac{330 m/s}{660 Hz} = 0.5 m$

26/27

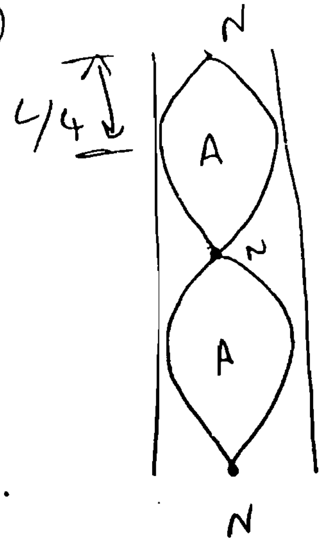
Maxm. amplitude will be produced at an Anti-node, which is at $\frac{\lambda}{4}$ from the wall (node)

$$\frac{\lambda}{4} = \frac{0.5}{4} = 0.125 m$$

1/2

Q.20 (B)

17



Because wave in 2^{nd} harmonic in an open pipe.

Q.21 (C)

28

$$\frac{V\cancel{E}}{2l} - \frac{\cancel{E}V}{2(l+x)}$$

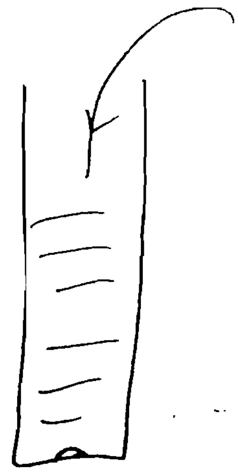
$$= \frac{V\cancel{E}}{2l}\left[1 - \frac{1}{\left(1+\frac{x}{l}\right)}\right]$$

$$= \frac{V\cancel{E}}{2l}\left[1 - \left(1-\frac{x}{l}\right)\right]$$

$$= \frac{Vx}{2l^2}$$

29.2 (B)

Ex 2



As water is poured, initially air-column reduces, so frequency increases.

Later steady-state is achieved so frequency becomes constant.

30.2 (C) $\lambda = 1m$, the resonance lengths of air column are

Ex 1

$\frac{\lambda}{4}, \frac{3\lambda}{4}, \frac{5\lambda}{4}$ ---

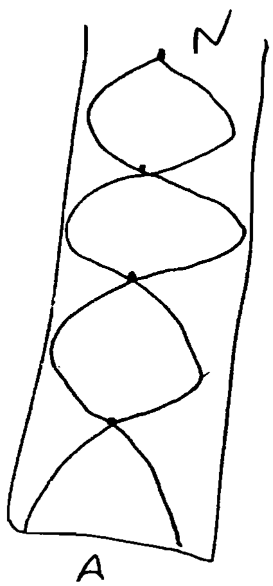
25cm, 75cm, 12~~5cm~~ ---

Water column $= 120 - 75 = 45cm$ when the resonance happens for the 1st time

Q.24 (B) $\frac{3v}{4l_1} = \frac{4v}{2l_2}$

or $\frac{l_1}{l_2} = \frac{3}{8}$

Q.25 (D)



$\frac{7\lambda}{4} = \cancel{B}\, l$

$\frac{\lambda}{4} = \frac{l}{7}$

$\lambda = \frac{105 \times 4}{7} = 60\text{cm}$

Q.26

Q.2

Q.28

Q.26 (D) $\lambda = \frac{v}{f} = \frac{350\,m/s}{1750\,Hz} = 20cm$

33

Ex 2 The required minimum distance $= \frac{\lambda}{2} = 10cm$

Q.27 (A) $f_{p^{th}\,overtone} = \frac{(2p+1)\cdot v}{4l}$

34

Ex 3 1st harmonic $= \frac{v}{4l}$

60cm Q.28 (C) $\frac{V}{4(L+0.6r_1)} = \frac{V}{(L+1.2r_2)}$

35

Ex 3 $\Rightarrow r_2 - 2r_1 = 2.5L$

Q.29 (C)

$$\frac{3v}{4L_c} = \frac{2v}{2L_o}$$

36/42 Also,

$$\frac{nC}{4L_c} = \frac{mL}{2L_o}$$

$$\Rightarrow \frac{n}{3} = \frac{m}{2}$$

$$n : m = 3:2 = 9:6$$

Q.30 (C) $l_1 + e = \frac{\lambda}{4}$

37/42

$$l_2 + e = \frac{3\lambda}{4}$$

$$\frac{l_2+e}{l_1+e} = 3 \text{ or } l_2 + e = 3(l_1+e)$$

$$\Rightarrow e = \frac{1}{2}(l_2 - 3l_1)$$

Q.

Q.31 (B) $A = A_{max} \sin Kx$

38

$K = \frac{2\pi}{\lambda}$ where $(2n+1)\frac{\lambda}{2} = L$

EI

$n=3$ for IIIrd overtone

$\Rightarrow \frac{7\lambda}{2} = L$

for $x = \frac{L}{7}$

$A = A_{max} \sin \frac{2\pi}{\left(\frac{2L}{7}\right)}\left(\frac{L}{7}\right)$

$= A_{max}$

$|A| = a$

$= \epsilon)$

$3Q_1)$

Q.32 (D)

$$\frac{\lambda}{4} + e = 40$$

$$\frac{3\lambda}{4} + e = 122$$

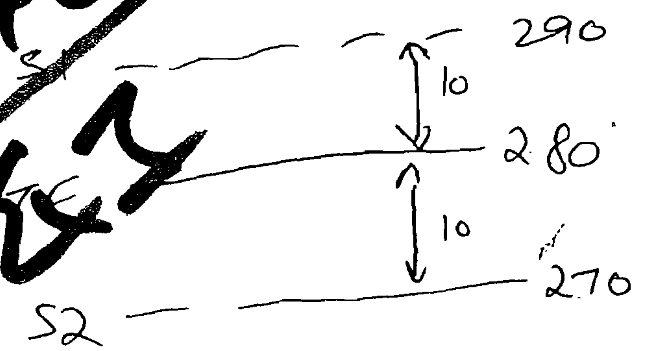
39

for III rd resonance

$$\Rightarrow \frac{5\lambda}{4} + e = 204\text{ cm}$$

Q.33 (D) Sonometer (S1 or S2) = 280 + 10 = 290 or 280 − 10 = 270

40



When tension increases in the sonometer, the frequency increases. 11 beats/s ⇒ gap increases, so it is S1.

Q.34 (C)

41/EcI

$$256 - x = f$$
$$262 - x = 2f$$
$$\Rightarrow x = 250 \text{ Hz}$$

Q.35 (A)

42/EcI

Initially,

$$\frac{V}{2l} - \frac{V}{4l} = \pm 4$$

$$\frac{V}{4l} = +4$$

If their lengths were twice, then

$$\frac{V}{2(2l)} - \frac{V}{4(2l)} = \frac{c}{8l} = \frac{1}{2}\left(\frac{c}{4l}\right)$$

$$= \frac{4}{2} = 2$$

-290

270

re

eaves

acy,

1.

MAMCQ

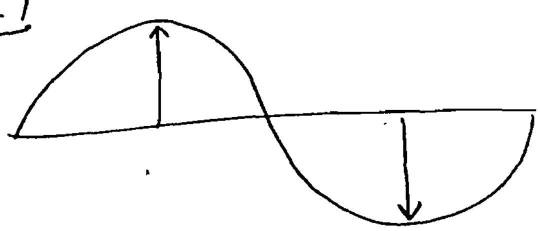
Q.1 (A,B)

$$\text{Amp} = 2\sin \pi x$$
$$= 2\sin \pi \cdot \left(\tfrac{1}{6}\right)$$
$$= 2 \times \tfrac{1}{2} = 1\,\text{mm}$$

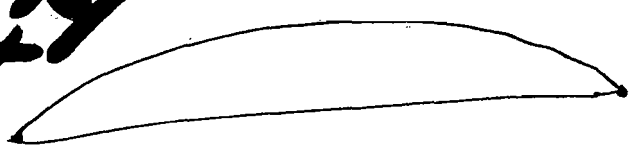
$$\frac{\partial y}{\partial t} = 200\pi \sin(\pi x) \cdot \cos(100\pi t)$$

Q.2 (B,C)

Look!



(B) is wrong.

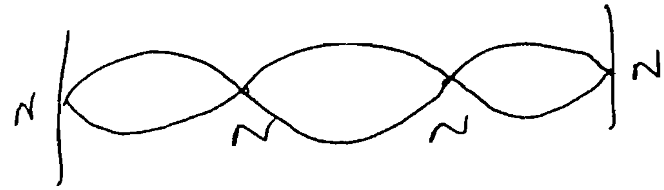


(D) is wrong.

Q.3

Q.4

Q.3 (D)



12 / Ex I

$\frac{3\lambda}{2} = L$ or $\lambda = \frac{2L}{3}$

$K = \frac{2\pi}{\lambda} = \frac{2\pi}{(2L/3)} = \left(\frac{3\pi}{L}\right)$

further $x = 0$ is a node.

$y(x,t) = A \sin Kx . \cos \omega t$

$= A \sin\left(\frac{3\pi}{L} \cdot x\right) \cos\left(\frac{3\pi v}{L} \cdot t\right)$

Q.4 (C, D) use: $f = \frac{1}{2L}\sqrt{\frac{T}{\mu}} = \frac{1}{2L}\sqrt{\frac{T}{\rho \pi r^2}}$

13 / Ex II

Now, $d = 2r$

$f = \frac{1}{L.d}\sqrt{\frac{T}{\rho\pi}}$

Q.5 (B)

$$\frac{\lambda}{2} = 2\text{cm}$$

$$L = n(2\text{cm})$$

$$L = (n+1)(1.6\text{ cm})$$

14
Ex I

$$\Rightarrow L = \left(\frac{L}{2}+1\right)(1.6\text{cm})$$

$$\Rightarrow L = 8\text{cm}$$

Q.6
(A, C)

$$E_{Total} = \frac{1}{4}\mu\omega^2 A^2 L$$

$$\omega = 2\pi f$$

$$E_{Total} \propto f^2 \propto n^2(f_0^2)$$

15
Ex II

- In stationary wave each particle does an SHM with a different amplitude so time average KE is half that of the total energy

Q.7(c) In a stationary wave,

16

E.II

points in the same loop are in phase and out of phase with points in the neighbouring loop.

Q.8(c) Put $x=0$

$y_1 = A\cos Kvt$ and ~~$y_2 = A\cos(Kvt+\phi)$~~

17

E.II

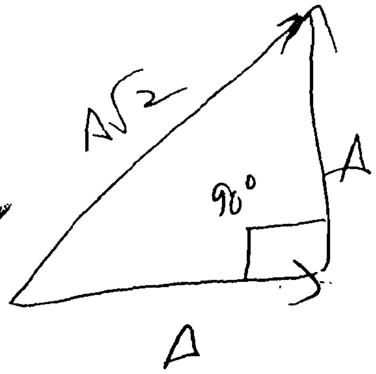
$y_2 = A\cos(Kvt+\phi)$

$y = y_1 + y_2 = \cancel{2\sin\cos}$ $2A\cos\left(Kvt+\frac{\phi}{2}\right)\cdot\cos\left(\frac{\phi}{2}\right)$

for $\phi=\pi$, $y=0$

Q.9 (C)

18
Ex II



Q.10 $\quad \dfrac{3\pi R}{2} - \dfrac{\pi R}{2} = n\lambda$ (for Maxima)

(B, C)

19
Ex II

Hence $\lambda = \dfrac{\pi R}{n}$

$\lambda = \pi R, \dfrac{\pi R}{2}, \dfrac{\pi R}{3}$

Q.11 $\quad \dfrac{3\pi R}{2} - \dfrac{\pi R}{2} = \dfrac{(2n+1)\lambda}{2}$ (for Minima)

(B, C, D)

20
Ex II

$\lambda = \dfrac{2\pi R}{2n+1}$

$\Rightarrow \lambda = 2\pi R, \dfrac{2\pi R}{3}, \dfrac{2\pi R}{5}$

Q.16
(D)

Q.1

Q.1
(B

Q.15
(C, D

Q.12
(D) $I_{max} = 4I_0$

21
EII

Here I_0 is $\frac{I_0}{2}$ so, $I_{max} = 2I_0$

Q.13(A) $\lambda = \frac{\pi R}{n}$ (for maxima)

22
EII

$\lambda_{max} = \pi R$

Q.14 $\lambda = \frac{2\pi R}{2n+1}$ (for minima)
(B) 23
EII

$\lambda_{max} = 2\pi R$

Minima

Q.15 IInd overtone of open pipe = IInd overtone of closed pipe
(C, D)
$$\frac{3v}{2l_0} = \frac{5v}{4l_c}$$

24
EII

$$\Rightarrow \frac{l_c}{l_0} = \frac{10}{12} = \frac{5}{6}$$

Ist overtone of open pipe (A) $= \frac{2v}{2l_0}$

Ist overtone of closed pipe (B) $= \frac{3}{4l}$

$\Rightarrow f_A / f_B = \frac{4l_c}{3l_0} = \frac{4\times}{3\times}$
$= 10/9$

Q.16

$$c = \sqrt{\frac{\gamma RT}{M}} \qquad \frac{c}{l}$$

$$\frac{f_C}{f_D} = \sqrt{\frac{M_D}{M_C}} = \sqrt{}$$

$$\frac{f_C}{f_D} = \frac{l_D}{l_C}\sqrt{\frac{M_D}{M_C}} = \frac{l/3}{2l/3}\sqrt{\frac{44}{28}}$$

$$= \frac{1}{2}\sqrt{\frac{44}{28}} = \sqrt{\frac{11}{28}}$$

Q.16 (C)

$$f = \frac{v}{2l} = \frac{1}{2l}\sqrt{\frac{\gamma RT}{M}}$$

Here,

$$\frac{f_1}{f_2} = \frac{l_2}{l_1}\sqrt{\frac{M_2}{M_1}}$$

25 / Ex II

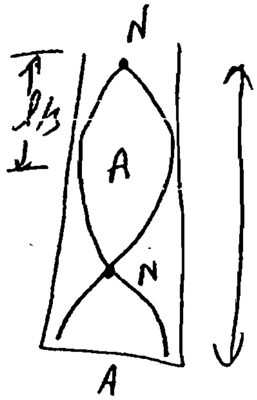
$$\frac{f_C}{f_D} = \frac{l/3}{2l/3}\sqrt{\frac{44}{28}} = \sqrt{\frac{11}{28}}$$

Q.17 (B, D) $f \propto \frac{1}{\sqrt{M}}$

$\frac{26}{Ex\ II}$

If $M \uparrow$, $f \downarrow$ and vice-versa

Q.18 (B) 1st overtone



$\frac{27}{Ex\ II}$

Pressure amplitude is at $\frac{l}{3}$ from open end $\Rightarrow \frac{1.2}{3} = 0.4\,m$

Q.19 (C) $\frac{\omega}{k} = \frac{50\pi}{10\pi} = \frac{5m}{s}$

$\frac{28}{Ex\ II}$

Q.20 (C)

$5 \,|\, 425, 595, 765$

$17 \,|\, 85, 119, 153$

$|\, 5, 7, 9$

Fundamental frequency $= 17 \times 5 = 85\,Hz$

$\lambda = \frac{c}{f} = \frac{340}{85} = 4\,m$

$l = \frac{\lambda}{4} = 1\,m$

$\frac{29}{Ex\ II}$

Exercise — III

Q.1 (B) 43/Ex

$$\left(\frac{V}{1} - \frac{V}{1.02}\right) = 6$$

$$\Rightarrow V = 300 \frac{m}{s}$$

Q.2 (D) 44/Ex

$$\frac{110}{100} = \frac{C}{C - V_s}$$

$$\frac{100 - x}{100} = \frac{C}{C + V_s}$$

$$\Rightarrow x = 8.5$$

Q.3 (C) 45/Ex

$$f' = \left(\frac{C - V_L}{C - V_s}\right) \cdot f_0$$

$$V_L = V_s = 30\,m/s$$

$$\Rightarrow f' = f_0$$

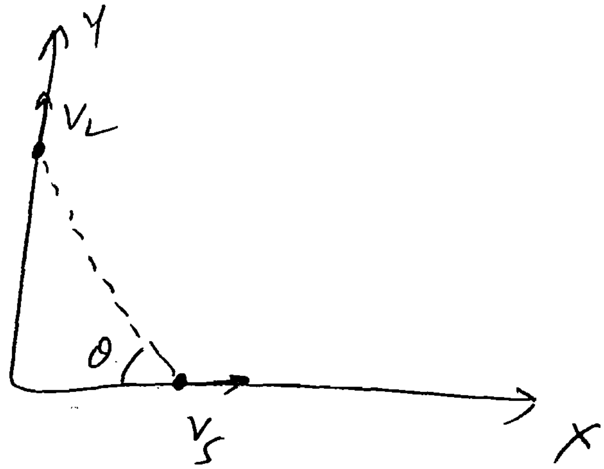
Q. (B

Q. (D

~~Q.4~~ Q.4 Omit

Q.5
(B)

46
ΣI



θ = constant here
so apparent frequency remains constant.

Q.6
(D)

47
ΣI

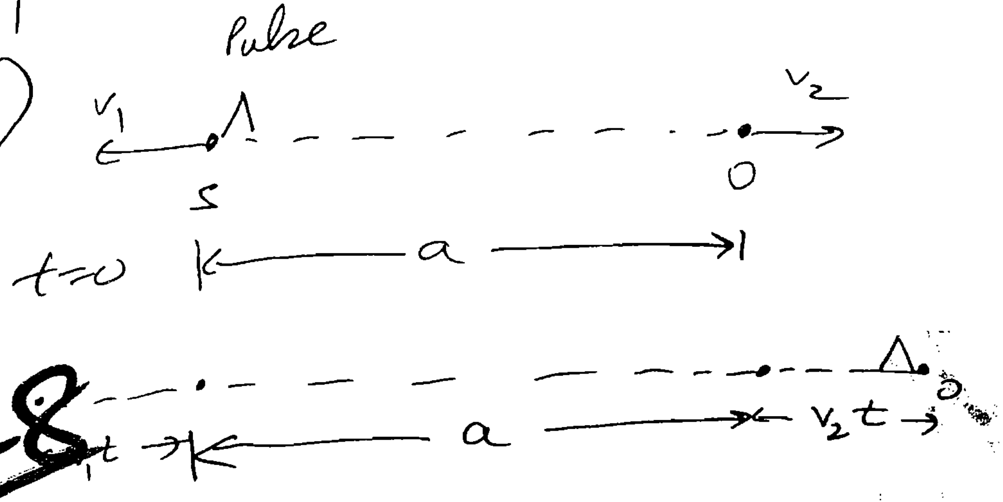
$$f' = \left(\frac{334-2}{334}\right) f_0 \times \left(\frac{334}{334+2}\right)$$

$$= \frac{332}{336} \times 334$$

$$\simeq 330 \text{ Hz}$$

2.7

(c)



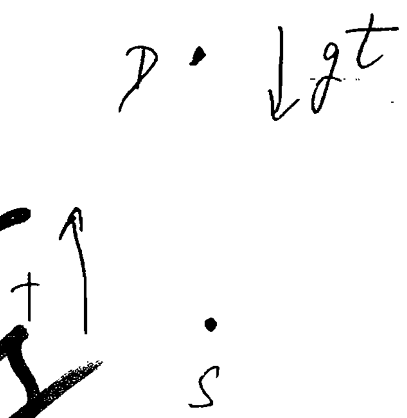
48

$$v_s t = (a + v_2 t)$$

$$(v_s - v_2)t = a$$

$$\text{or } t = \frac{a}{(v_s - v_2)}$$

2.8



49

$$f' = \left(\frac{c - v_2}{c - v_s}\right) f_0$$

$$= \left(\frac{c + gt}{c}\right) f_0$$

$$f' = \cancel{1 \mp \left(\frac{g}{c}\right)}\, f_0 + \left(\frac{f_0 g}{c}\right) t$$

$$\frac{f_0 \cdot g}{c} = \text{slope}$$

Here slope $= \dfrac{1000}{30}$

or

$$\frac{1000 \times 10}{c} = \frac{1000}{30}$$

$$\Rightarrow \quad c = 300\ m/s$$

Q. 9
(A)

$$f' = \left(\frac{c + at}{c}\right) \cdot f_0$$

$\frac{50}{81}$

Q.10 One second after its fuel,
(A)

speed of source = 10 m/s

5/6

Before crossing

S ↓ $10 \frac{m}{s}$

L ↑ $2 \frac{m}{s}$

$$f_1 = \left(\frac{330+2}{330-10}\right) \times 150 = 155.625 \text{ Hz}$$

After crossing

L ↑ $2 \frac{m}{s}$

S ↓ $10 \frac{m}{s}$

$$f_2 = \left(\frac{330-2}{330+10}\right) \times 150 \simeq 145$$

$$f_1 - f_2 \simeq 12$$

Q.

(A)

Q.

(B)

1

Q.11

(A) $\frac{52}{\&\mathrm{I}}$ $\lambda = \frac{c+u}{f}$

Here wind speed increases the speed of sound.

Q.12

(B, C) $\frac{3D}{\&\mathrm{II}}$

.625 Hz

(Rest) A (500 Hz) $\quad$ 25 m/s $\rightarrow$ O $\quad$ 50 m/s $\rightarrow$ B (500 Hz)

[redacted] $c = 350\,m/s$

Apparent frequency of whistle B as heard by observer $= \left(\frac{c - v_L}{c - v_s}\right) \cdot f_0$

.5

$= \left(\frac{350+25}{350+50}\right) \times 500$

$\simeq 469\ Hz$

Also apparent frequency of whistle as heard by observer $= \left(\frac{350-25}{350}\right) \times 500$

$= \frac{325}{350} \times 500 = \cancel{428.6\,Hz}$ $\cancel{464.3}$ $464.5\,Hz$

$\Rightarrow \Delta f = 4.5\,Hz$

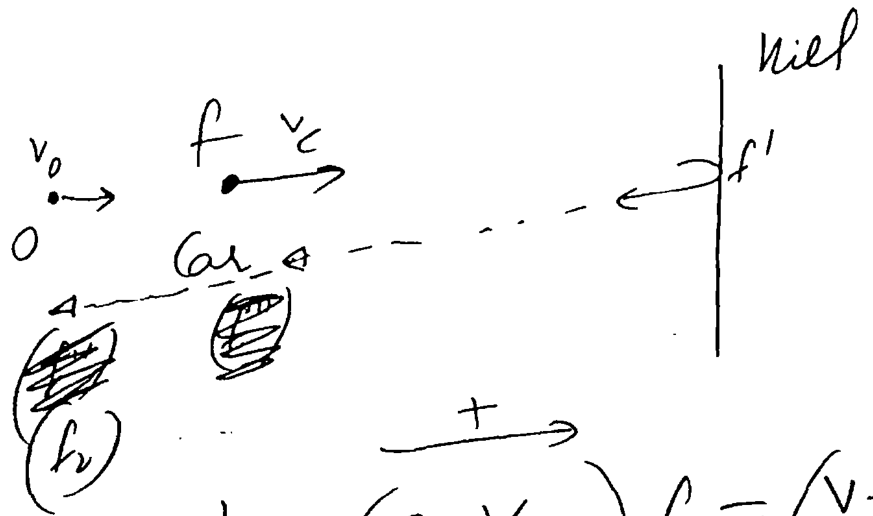
Q.13 (C) **31/Ex II**

$\lambda' = (C - V_s)T$

Q.14 (B, C) **32/Ex II**

$\lambda' = (C - V_s)T$

$= \frac{V - V_c}{f}$



$$f' = \left(\frac{c - v_L}{c - v_S}\right) \cdot f_0 = \left(\frac{V - 0}{V - V_c}\right) \cdot f$$

$$= \frac{Vf}{V - V_c}$$

Then,

$$f_2 = \left(\frac{c - v_L}{c - v_S}\right) \cdot f_0$$

$$= \left(\frac{V + V_0}{V}\right) \cdot f'$$

$$= \left(\frac{V + V_0}{V}\right) \left(\frac{Vf}{V - V_c}\right)$$

$$f_2 = \left(\frac{V + V_0}{V - V_c}\right) f$$

Now, observer hears the frequency of the car directly. Q.1 (D)

$$f_1 = \left(\frac{V+V_0}{V+V_c}\right)\cdot f$$

and hears the

echo of the car's "horn" from the hill (f_2) Q.2 (A)

$$\cancel{f_2 = \left(\frac{V+V_0}{V}\right)\cdot f''}$$

$$\cancel{= \left(\frac{V+V_0}{V}\right)\cdot\left(\frac{V+V_c}{V-V_c}\right)\cdot f}$$

Beat frequency $= \left|\left(f_2 - f_1\right)\right| = \dfrac{2V_c f(V+V_0)}{V^2 - V_c^2}$

Exercise - IV

Q.1 (D) 53 & I $90 - 40 = 50 = 10 \log_{10} \frac{I_x}{I_y}$

$$I_x = 10^5 I_y$$

Q. 2 (A) 54 & I

$$160 = 10 \log_{10} \frac{(I_{Jet}/100^2)}{I_0}$$

$$120 = 10 \log_{10} \frac{(I_{Jet}/h^2)}{I_0}$$

$$\Rightarrow 40 = 10 \log_{10} \frac{h^2}{100^2}$$

$$\log_{10} \frac{h}{100} = 2$$

$$h = 100 \times 10^2 = 10000\ m = 10\ km$$

?.3
(D)

$$A_r = \left(\frac{V_2 - V_1}{V_1 + V_2}\right) A_i$$

Q.33/
Ex I

$$A_t = \left(\frac{2V_2}{V_1 + V_2}\right) A_i$$

A_t is always +ve, whereas
A_r can be -ve if $(V_1 > V_2)$.

Q.5
(A, C

Q.6

?.4
(A, B, C, D)

$$V = \sqrt{\frac{\gamma R T}{M}}$$

34/
Ex I

$V \propto \sqrt{T}$

M depends on density of air,
~~M~~ M also depends on humidity.

Q.5 (A, C, D) 35 ~~Ex II~~

Use: $\Delta P = -B \frac{\partial \xi}{\partial x}$

Q.6 — Q.11

36—41 / Ex II

Use: $\frac{\partial y}{\partial t} = -v \frac{\partial y}{\partial x}$

and

$$\Delta P = -B \frac{\partial y}{\partial x}$$

$P_{compression} = P_0 + \Delta P_{max}$

$P_{rarefaction} = P_0 - \Delta P_{max}$

Q.6 (A, B)

Q.7 (C)

Q.8 (A)

Q.9 (A, [illegible]

Q.10 (A, D,

Q.11 (C,

dity.

Q.12 (B, C) #42/EII

For graph A,
velocity of sound is independent of pressure as $\frac{P}{\rho}$ is constant at a given temperature.

For graph B,

$$v = \sqrt{\frac{\gamma RT}{M}} \text{ or } v^2 \propto T$$

For graph C,

$$v = \sqrt{\frac{T}{\mu}}$$

For graph D, $f = \frac{c}{2L}$

At $L \to 0$, $f \to \infty$

Q.13 ~~43~~ Organ pipe must
(c) have anti-nodes at
closed ends

4

Na Mg Al Si P Cl Ar

C

D