1 → $y = 3\cos\pi(50t - x)$

$y = A\cos(\omega t - kx)$

$\Rightarrow k = \pi \Rightarrow \frac{2\pi}{\lambda} = \pi \Rightarrow \lambda = 2$ units $\Rightarrow$ (b)

2 → $y = 0.08 \sin \frac{2\pi}{\lambda}(200t - x)$.

$\Rightarrow \omega = \frac{2\pi}{\lambda} \cdot 200 = 2\pi f$.

$\Rightarrow f\lambda = 200$

$\Rightarrow v = 200 \Rightarrow$ (d)

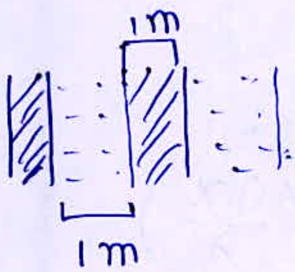
3 → $\Delta\phi = 60^\circ = \frac{\pi}{3}$ radians.

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

$(x_2 - x_1) = \frac{\pi}{3k}$ where, $k = \frac{2\pi}{\lambda} = \frac{2\pi f}{v}$

$k = \frac{2\pi \cdot 500}{360} = \frac{1000\pi}{360}$

$\Rightarrow x_2 - x_1 = \frac{\cancel{\pi} \times \cancel{360}^{12}}{\cancel{3} \times 100\cancel{0}\cancel{\pi}} = \frac{3}{25}$ m or 12 cm. $\Rightarrow$ (b)

4 → 

$\Rightarrow \lambda = 2$m

$\Rightarrow v = f\lambda = 720$ m/s – (a)

5→ $v \propto \sqrt{T}$

$$\frac{V_2}{V_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{303}{283}}$$

$\Rightarrow V_2 > V_1$

$\Rightarrow t_2 < t_1$ (as distance travelled is same).

$\Rightarrow$ (a) Only option.

6→ $y = 0.07 \sin(12\pi x - 3000\pi t)$

$\Rightarrow K = 12\pi = \frac{2\pi}{\lambda} \Rightarrow \lambda = \frac{1}{6}$.

$\omega = 3000\pi = 2\pi f \Rightarrow f = 1500$

$\Rightarrow v = \lambda f = 250\ m/s. \Rightarrow$ (a)

7→ $y = 25 \cos(2\pi t - \pi x)$

$\Rightarrow \omega = 2\pi \Rightarrow f = 1$

$A = 25$

$\Rightarrow$ (a)

8→ $\omega = 600 = 2\pi f \Rightarrow f = \frac{300}{\pi} \Rightarrow v = 300$

$K = 2 = \frac{2\pi}{\lambda} \Rightarrow \lambda = \pi$

$\Rightarrow$ (b)

9→ $y = A\cos^2\left(2\pi n t - 2\pi \frac{x}{\lambda}\right)$

$= \frac{A}{2}\left(1 + \cos\left(4\pi n t - \frac{4\pi x}{\lambda}\right)\right)$

$\Rightarrow$ Amplitude $= A/2$

$\omega = 4\pi n = 2\pi f \Rightarrow f = 2n$

$K = \frac{4\pi}{\lambda} = \frac{2\pi}{\text{wavelength}} \Rightarrow$ wavelength $= \frac{\lambda}{2} \Rightarrow$ (A)

10 →

Question not correct.

Data missing.

11 → $v \propto \sqrt{T}$

$\Rightarrow \frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} = 2 = \sqrt{\frac{T_2}{273}}$

$\Rightarrow T_2 = 273 \times 4 = 1092\,°K.$

$\Rightarrow$ (C)

12 → $f = \frac{v}{\lambda} = \frac{360}{60} = 6$

travelling in + x direction $\Rightarrow y = A \sin(\omega t - kx)$

$\Rightarrow$ (C)

13 → Spherical wave emanate from a point

$\Rightarrow I \propto \frac{1}{r^2}$

$\Rightarrow A \propto \frac{1}{r} \Rightarrow$ (d)

14 → $\frac{50\cancel{0}}{33\cancel{0}} \approx 15 \Rightarrow$ (d) closest.

15 → $y = 0.25 \sin(100t + 0.25x)$.

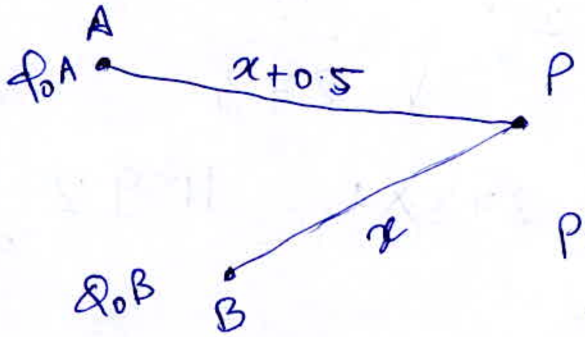
$\omega = 100 = 2\pi f$

$K = 0.25 = \frac{2\pi}{\lambda}$

$\Rightarrow V = \frac{\omega}{K} = 400 \, m/s$, $f = \frac{50}{\pi}$ Hz $\Rightarrow$ (a)

16 → $\frac{2\pi}{\lambda} = \cancel{316}\,62.4 \Rightarrow \lambda = \frac{2\pi}{\cancel{316}\,62.4} \approx 0.1$ unit $\Rightarrow$ (b)

17 →



$\phi_{0A} = \phi_{0B} + \frac{\pi}{3}$

Phase of wave emanated at A at location P.

$\phi_{0A} + K(x + 0.5)$

Similary at B

$\phi_{0B} + K(x)$.

$\Rightarrow$ phase diff. $= \phi_{0A} - \phi_{0B} + K \times 0.5$

$= \frac{\pi}{3} + \frac{\pi}{\lambda}$

$\lambda = 1 \Rightarrow \Delta\phi = \frac{4\pi}{3}$.

$A = \sqrt{A^2 + A^2 + 2A^2 \cos\frac{4\pi}{3}} = A \Rightarrow$ (d)

18 - ∵ Beat frequency = $f_1 - f_2 = 4\,Hz$

$\Rightarrow$ time interval = $\frac{1}{4}$ sec. $\Rightarrow$ (a)

19 - $\lambda_1 = 50\,cm$, $\lambda_2 = 51\,cm$

$|f_2 - f_1| = 12$

$$\frac{v}{50} - \frac{v}{51} = 12.$$

$$v = \frac{12 \cdot 50 \cdot 51}{100} = 306\ m/s \Rightarrow (a)$$

20 -

$\frac{\lambda}{2} = L$ $\qquad$ $\frac{\lambda}{4} = \frac{L}{2}$

$\Rightarrow f_2 = f_0 \Rightarrow$ (b)

20 - Pressure variation is out of phase with amplitude. so, at displacement node we will have max^n pressure variation $\Rightarrow$ (d)

22- $y_1 = A\sin(\omega t - kx)$ $y_2 = A\sin(\omega t - kx - \theta)$

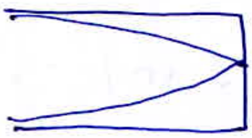
$$A = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\theta}$$

$$= \sqrt{A^2 + A^2 + 2A^2\cos\theta}$$

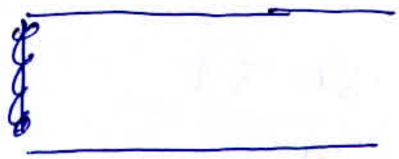
$$= A\sqrt{2}\sqrt{1+\cos\theta}$$

$$= 2A\cos\frac{\theta}{2} \Rightarrow (a)$$

23 →



L_1



L_2

$L_1 = \frac{\lambda}{4}$ $L_2 = \frac{\lambda}{2}$

same freq ⇒ same wavelength

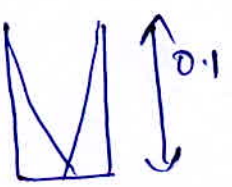
$\Rightarrow \frac{L_1}{L_2} = \frac{1}{2} \Rightarrow (a)$

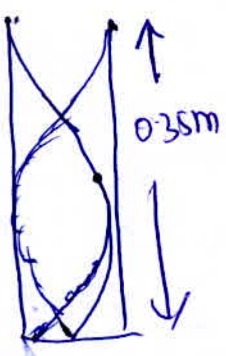
24 → $\frac{\lambda}{2} = 46 - 16 = 30$ cm

$\Rightarrow \lambda = 0.6$ m

$v = f\lambda = 300$ m/s ⇒ (b)

25 →





$\lambda_1 \propto 0.1 + e$

$\lambda_2 \propto 0.35 + e$

$\lambda_2 = 3\lambda_1$

$\Rightarrow 0.35 + e = 3 \times 0.1 + 3e$

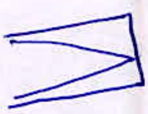
$\Rightarrow e = 0.0025 \Rightarrow (b)$

26 → Same as Q.20 $\Rightarrow$ (a).

27 → $L = 42\,m$.

$\Rightarrow \frac{\lambda}{4} = 42 \Rightarrow \lambda = 168\,m$

$f = \frac{v}{\lambda} \Rightarrow \frac{332}{168} \approx 2\,Hz. \Rightarrow$ (a)

28 →  $L = \frac{\lambda}{4} = \frac{v}{4f} \Rightarrow \frac{v}{4n} \Rightarrow$ (a).

29 → $\frac{V_1}{2L_1} = \frac{3V_2}{4L_2}$

$V_1 = \sqrt{\frac{T}{\mu_1}} = \sqrt{\frac{T}{\rho \cdot \pi r_1^2}} \Rightarrow V_1 \propto \frac{1}{r_1}$

$\Rightarrow \frac{L_1}{L_2} = \frac{2V_1}{3V_2} = \frac{2r_2}{3r_1} = \frac{1}{3} \Rightarrow$ (b)

30 → $T_2 = 1.44\,T_1$

$\Rightarrow V_2 = 1.2\,V_1$

$l_2 = 0.6\,l_1$

$f = \frac{v}{4L} \Rightarrow \frac{f_2}{f_1} = \frac{v_2}{v_1}\frac{L_1}{L_2} = \frac{1.2}{0.6} = 2$

$\Rightarrow$ (a).

31 → $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{T}{\rho \cdot \pi r^2}}$

$f = \frac{v}{4L} = \sqrt{\frac{T}{\rho \pi r^2}} \cdot \frac{1}{4L}$

$f \propto \frac{\sqrt{T}}{\sqrt{\rho}\, r L}$

$\Rightarrow \frac{f_2}{f_1} = \sqrt{\frac{T_2}{T_1} \frac{\rho_1}{\rho_2}} \frac{r_1 L_1}{r_2 L_2} = \sqrt{\frac{8}{1} \frac{2}{1}} \frac{1}{4} \frac{35}{36}$

$= \frac{35}{36}$

$\Rightarrow f_1 = 360$ (higher frequency).

beat freq $= f_1 - f_2 = f_1 \left(1 - \frac{f_2}{f_1}\right)$

$= 360 \left(1 - \frac{35}{36}\right)$

$= 360 \cdot \frac{1}{36} = 10\,Hz$

$\Rightarrow$ (d)

32 ⇒ $V = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{10 \cdot \cancel{10} 9.8}{9.8 \times 10^{-3}}} = 100 \text{ m/s}.$

frequency of vibration ⇒ $\frac{n_1 V}{2L} = n_1 \cdot \frac{100}{2} = n_1 \cdot 50.$

⇒ frequency of vibration can be 50, 100, 150, 200, 250, . . .

fundamental mode ⇒ 50 Hz.

So, answer can be b, c, d

but best answer (b.)

33 ⇒ $T \uparrow \Rightarrow V \uparrow \Rightarrow f \uparrow$

beat freq. decreased on increasing f of piano

⇒ frequency of piano was less than freq. of fork.

⇒ 256 − 5 ⇒ (d)

34 → fund. frequency in closed organ pipe is half of fund. frequency in open organ pipe ⇒ (b)

35 → Before, 5 antinodes ⇒ $L = \frac{5\lambda}{2} = \frac{5}{2} \cdot \frac{V_1}{f}.$

after, 3 " ⇒ $L = \frac{3}{2}\lambda = \frac{3}{2}\frac{V_2}{f}$

f, same in both ⇒ $5V_1 = 3V_2$

$5\sqrt{9g} = 3\sqrt{Mg}$

$\Rightarrow M = 25 \text{ kg}.$

36 → $T_2 = 1.69\,T_1$

$\Rightarrow V_2 = 1.3\,V_1$

for f to be constant. length must be increased by same factor ⇒ 30% ⇒ (b).

37 → waxing decreases the freq. of tuning fork
⇒ unknown fork must be having larger freq.
⇒ 292 cps ⇒ (b)

38 → $V_2 = \sqrt{1.02}\,V_1$. $\quad \frac{f_2}{f_1} = \frac{V_2}{V_1} = \sqrt{1.02}$

$f_2 - f_1 = 5$

$f_1\left(\frac{f_2}{f_1} - 1\right) = 5$

$f_1\left(\sqrt{1.02} - 1\right) = 5$

$\Rightarrow f_1 = \frac{5}{\sqrt{1.02} - 1} = \frac{5}{1 + \frac{1}{2}\times 0.02 - 1} = 500\text{ Hz} \Rightarrow (c)$

39 → $\frac{V}{4L_S} - \frac{V}{4L_L} = 4$

$\frac{V}{4}\left(\frac{1}{L_S} - 1\right) = 4 \Rightarrow \frac{1}{L_S} = \frac{16}{V} + 1$

$= \frac{16}{300} + 1$

$\Rightarrow L_S = \frac{300}{316}\text{ m} \Rightarrow (b) \quad \frac{1}{L_S} = \frac{316}{300}$

40 →

$f \quad f+4 \quad f+8 \quad \ldots\ldots\ldots \quad f+36$

$$f + 36 = 2f$$

$$\Rightarrow f = 36 \Rightarrow (d)$$

41 → $A = \sqrt{A^2 + A^2 + 2A^2 \cos\theta}$

$$\Rightarrow \theta = \frac{2\pi}{3} \Rightarrow (b)$$

42 → At same time with diff. velocities $\Rightarrow$ (d)

43 → for stationary wave

$$y = 2a \sin kx \cos \omega t$$

$y = 0$ for diff $x \Rightarrow \omega t = \frac{\pi}{2}$ or same.

$$v = \frac{dy}{dt} = -2a\omega \sin \omega t \sin kx$$

ωt is same for all, x is diff

$\Rightarrow v$ is diff $\Rightarrow$ (d)

44 → Only slightly diff. frequencies $\Rightarrow$ (b)

45 → (a)

46 →

$$n' = \left(\frac{V + V_0}{V - V_s}\right) n \Rightarrow n = n' \frac{(V - V_s)}{V + V_0}$$

$$= 435 \cdot \frac{27\cancel{0}}{37\cancel{0}} \approx 320$$

$$\Rightarrow (a)$$

47 → $n' = \left(\frac{v+v_0}{v-v_s}\right) n = 3n \Rightarrow$ (d)

48 → apparent freq. of police siren.

$n_1' = \frac{320-V_m}{320-22} \cdot 176$.

apparent freq. of stationary siren

$n_2' = \left(\frac{320+V_m}{320}\right) 165$

$\Rightarrow 176\left(\frac{320-V_m}{298}\right) = \left(\frac{320+V_m}{320}\right) \cdot 165$

$320 - V_m = (320+V_m)\left(\frac{165}{320} \times \frac{298}{176}\right)$

$= (320+V_m) \times 0.873$

$\Rightarrow 40.625 = 1.873 V_m$

$\Rightarrow V_m \approx 21.69$ m/s $\Rightarrow$ (b)

49 → $\Rightarrow n' = 1.2n$ $\Rightarrow$ (a)

wavelength does not change

50 → when it comes towards observer

$$n_1 = \left(\frac{v}{v - v_s}\right) n$$

when it goes away

$$n_2 = \left(\frac{v}{v + v_s}\right) n$$

$$\frac{n_1}{n_2} = \frac{5}{3} \Rightarrow \frac{v + v_s}{v - v_s} = \frac{5}{3} \Rightarrow v_s = \frac{v}{4} = \frac{340}{4} = 85\,m/s$$

$\Rightarrow$ (C)

51 → $$n' = \left(\frac{v + v_0}{v - v_0}\right) n$$

~~one octave higher~~

one octave higher ⇒ double freq.

$$\Rightarrow \frac{v + v_0}{v - v_0} = 2$$

$$\Rightarrow v + v_0 = 2v - 2v_0$$

$$\Rightarrow v_0 = v/3 \Rightarrow \text{(C)}$$

52 → $$n' = \left(\frac{345 + 5}{345 - 5}\right) \cdot 272 = \frac{350}{340} \cdot 272$$

$$n' - n = \frac{10}{340} \cdot 272 = 8 \Rightarrow \text{(C)}$$

53 → $n' - n = \left(\frac{355+5}{355-5} - 1\right)165$

$= \frac{\cancel{10} \times \overset{33}{\cancel{165}}}{\underset{7}{\cancel{350}}} \approx 5 \Rightarrow (b)$

54 → $n' = \left(\frac{V}{V - V_S}\right)n \Rightarrow \frac{V}{V - V_S} = 2$

$\Rightarrow V = 2V - 2V_S$

$\Rightarrow V_S = V/2 \Rightarrow (c)$

55 → $n' = \left(\frac{V+15}{V-20}\right) \cdot 600 = \frac{355 \cdot \overset{15}{\cancel{600}}}{\underset{8}{\cancel{320}}} \simeq 666 \Rightarrow (d)$

56 → $(2n+1)\frac{V}{4L} = 5 \cdot 50 = 250\,Hz \Rightarrow (c)$

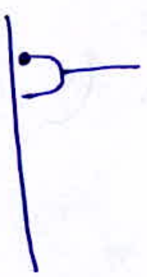
57 → same f^n

$\Rightarrow y_1 = 10^{-6} \cos\left(100t + \frac{x}{50} + 0.5 - \frac{\pi}{2}\right)$

$\Rightarrow \Delta\phi = \left|0.5 - \frac{\pi}{2}\right| = 1.07 \Rightarrow (a)$

58 → (d) Only one distinct frequency is produced so both will hear same quality & pitch

59 →



$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 0.1}{10}} = \sqrt{\frac{2}{100}} = \frac{1}{10}\sqrt{2}$

8 oscillation in this time.

$\Rightarrow T = \frac{\sqrt{2}}{80}$.

$\Rightarrow f = \frac{80}{\sqrt{2}} = 40\sqrt{2} = 56\,Hz \Rightarrow (d)$

Level-02

1 → Transverse waves can travel in solids only ⇒ (c).

2 → Wavelength changes, frequency remains constant.
⇒ (b)

3 → speed = freq. wavelength = $n \cdot (4ab)$ ⇒ I correct.
medium at a will be in the same phase at d after $T/4$
⇒ II wrong

At b, phase is π.
e " " $\frac{5\pi}{2}$ ⇒ $\Delta\phi = 3\pi/2$ ⇒ III correct
⇒ (c)

4 → for freq. 4 times, v has to be 4 times ⇒ T 16 times ⇒ (b)

5 → freq = $\frac{360\cancel{0}}{12\cancel{0}}$ = 30 Hz
⇒ $\lambda = \frac{v}{n} = \frac{76\cancel{0}}{3\cancel{0}}$ = 25.3m ⇒ (b)

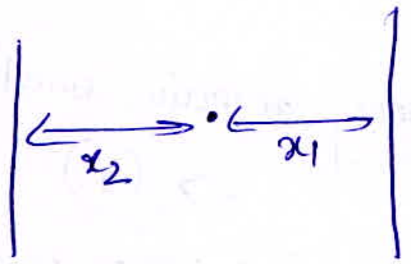
6 → $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{\cancel{60.5}^{12.1} \times \cancel{4} \times 1000}{0.03\cancel{5}5}}$
= 110 m/s ⇒ (c)

7 → (a).

8 → $I \propto p^2$
⇒ Intensity will become 9 times ⇒ (a)

9 → $v = \sqrt{\frac{\gamma RT}{M}} \Rightarrow \frac{V_2}{V_1} = \sqrt{\frac{m_1}{m_2}} \Rightarrow (b)$

10 →



$\frac{2x_1}{V} = 1.5 \quad , \quad \frac{2x_2}{V} = 3.5$

$\frac{2(x_1+x_2)}{V} = 5$

$x_1 + x_2 = \frac{5}{2} \cdot 340 = 850\,m \Rightarrow (b)$

11 → $\frac{V_2}{V_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{T+600}{\cancel{600}\,T}} = \sqrt{3}$

$\Rightarrow T + 600 = \cancel{1800}\ 3T$

$\cancel{T = 1200\,K}\quad T = 300\,°K$

$\Rightarrow 27°C \Rightarrow (b)$

12 → $y = A\sin(kx - \omega t)$

$v_{y\,max} = A\omega = 4V$

$A \cdot 2\pi f = 4V$

$\frac{\pi A}{2} = \frac{V}{f} = \lambda \Rightarrow (b)$

13 → Similar to Q.10.

$$\frac{2(x_1+x_2)}{V} = 8$$

$\Rightarrow x_1 + x_2 = 1320\text{ m} \quad \Rightarrow (b)$

14 → velocity is twice as given by $\frac{dy}{dt}$.

$\Rightarrow$ when all particles will be at mean position all particles will have twice speed.

$\Rightarrow \quad K.E_2 = 4\,KE_1$

$\Rightarrow E_2 = 4E_1 \quad \Rightarrow (c)$

15 → as displacement of all the particles will be zero at the time of superposition

$\Rightarrow$ Energy will be purely kinetic $\Rightarrow$ (b)

16 → $f = \frac{V}{2L} \propto \frac{\sqrt{T}}{L}$

$\frac{f_2}{f_1} = \sqrt{\frac{T_2}{T_1}} \cdot \frac{L_1}{L_2} \quad \Rightarrow 2 = \sqrt{\frac{T_2}{T_1}} \cdot \frac{\cancel{4}\,2}{3}$

$\Rightarrow \sqrt{\frac{T_2}{T_1}} = \frac{3}{2}$

$\Rightarrow \frac{T_2}{T_1} = \frac{9}{4} \Rightarrow (d)$

17 → beat frequency $= \frac{30}{3} = 10$

$n_2 - n_1 = 10$

$\frac{V}{\lambda_2} - \frac{V}{\lambda_1} = 10 \qquad V\left(\frac{1}{5} - \frac{1}{6}\right) = 10$

$V = 300\text{ m/s} \quad \Rightarrow (a)$

18 → $f = \frac{3V}{4L} \Rightarrow$ (b)

19 → $\frac{V}{4L} = f$

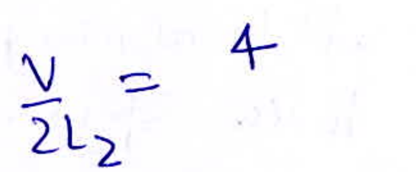
$\frac{V}{2L} = 2f \Rightarrow$ (c)

20 → $\frac{V}{2L_1} - \frac{V}{2L_2} = 4$

$\frac{V}{2}\left(\frac{2.5}{100 \times 102.5}\right) = 4$

$\Rightarrow V = \frac{8 \times 100 \times \cancel{102.5}^{41}}{\cancel{2.5}}$ cm/s

$= 328$ m/s $\Rightarrow$ (C)

21 →  $\Rightarrow$ (a).

22 → for audible $n = 20$ Hz to 20 kHz.

$n = \frac{V}{4L}$

$L \uparrow \Rightarrow n \downarrow$

$\Rightarrow 20 = \frac{336}{4 \cdot L} \Rightarrow L = \frac{\cancel{336}^{\cancel{84}\,21}}{\cancel{4} \cdot \cancel{20}\,5} = 4.2$ m $\Rightarrow$ (b)

other limit $20000 = \frac{336}{4L}$

$\Rightarrow L = \frac{336}{4 \cdot 20000}$ cm, none of the options

23 → $\frac{v}{4L} = n$

$v = 250 \times 4 \times 0.2$

$= 200 m/s \Rightarrow (b)$

25 → $\frac{3v}{4L_1} = \frac{3v}{2L_2} \Rightarrow \frac{L_1}{L_2} = 1:2 \Rightarrow (a)$

24 → distance b/w consecutive nodes $= \frac{\lambda}{2} = \frac{v}{2f}$

$= \frac{16}{2 \cdot n} = \frac{8}{n} \Rightarrow (b)$

26 → $2\pi(f_2 - f_1) = 6$

$\Rightarrow f_2 - f_1 = \frac{3}{\pi} \Rightarrow (c)$

27 → $\frac{5\lambda}{2} = 10 \Rightarrow \lambda = 4m$

$f = \frac{v}{\lambda} = 5 Hz \Rightarrow (c)$

28 → Standing waves are created when opposite direction travelling waves superimpose

$\Rightarrow$ (a) & (d) not possible.

$\Rightarrow$ put $x = 0$ and add → sum should be 0

$\Rightarrow (c)$

29 → (a)

30 → $|f_A - 384| = 6$ $\Rightarrow f_A = 390 \Rightarrow$ (d)

$|f_A' - 384| = 4$.

as frequency decreases on loading the fork.

31 → Tensions → 1 : 4 : 9 : 16

velocities → 1 : 2 : 3 : 4

⇒ frequencies → 1 : 2 : 3 : 4 ⇒ (d)

32 → higher ⇒ (a)

33 → $$\frac{V_1}{2L_1} = \frac{V_2}{4L_2}$$

$$\frac{V_1'}{2L_1} = \frac{3V_2}{4L_2}$$

$$\Rightarrow \frac{V_1}{V_1'} = \frac{1}{3}$$

$$\Rightarrow V_1' = 3V_1$$

$$= \sqrt{T_1'} = 3\sqrt{T_1}$$

$$\Rightarrow \sqrt{T_1 + 8} = 3\sqrt{T_1}$$

$$\Rightarrow T_1 = 8\text{ N} \Rightarrow (c)$$

34 → $\sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\theta}$

θ = phase diff $= \beta_1 - \beta_2 \Rightarrow$ (a)

35 → (a) - Slope is max^m at nodes

⇒ Strain is max^m at nodes ⇒ (a)

36 ⇒ distance b/w two nodes = 10 cm

⇒ $\lambda = 20$ cm

⇒ $v = n\lambda = 20$ m/s ⇒ (b)

37 ⇒ $y_1 = a\sin(\omega t - kx)$

$= a[\sin\omega t \cos kx - \sin kx \cos\omega t]$

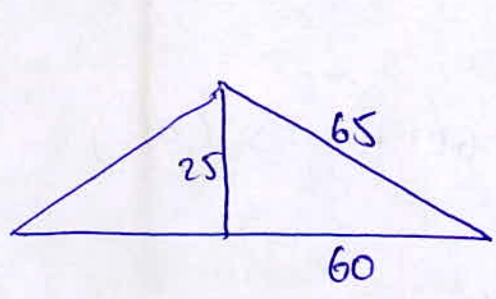
$y_2 = -a[\sin\omega t \cos kx + \cos\omega t \sin kx]$

$y = y_1 + y_2 = -2a\sin kx \cos\omega t$.

there is no diff. b/w this and the one given in question ⇒ (b).

38 ⇒ when waves travelling in same direction are produced ⇒ (b)

39 ⇒ 0° as phase changes continuously, not abruptly ⇒ (a)

40 → 

→ $\Delta x = 10$.

⇒

phase diff $\frac{2\pi}{\lambda}\Delta x + \pi = 2n\pi$

due to reflection

$\Rightarrow \frac{2\pi}{\lambda}\Delta x = (2n-1)\pi$

$\frac{\Delta x}{\lambda} = \frac{2n-1}{2}$

$\Rightarrow \lambda = \frac{2\Delta x}{2n-1}$

$\Delta x = 10$

$\Rightarrow \lambda = \frac{20}{2n-1} \Rightarrow$ (a)

41 $\Rightarrow$ $n' = \left(\frac{V}{V-V_S}\right)n$

$\Rightarrow n_B$ will be max^m

& n_A " " min^m

$\Rightarrow n_B > n_C > n_A$

$n_2 > n_3 > n_1 \Rightarrow$ (b)

42 $\Rightarrow$ Question not printed correctly.

43 $\Rightarrow$ $n' = \frac{V}{V-V_S} \cdot n$

$= \frac{400}{300} \cdot 1200 = 1600 Hz \Rightarrow$ (a)

44 $\Rightarrow$ When the train approaches

$n' = \left(\frac{V}{V-V_T}\right)n$

" " " departs $\Rightarrow$ (a)

$n' = \left(\frac{V}{V+V_T}\right)n$

45 → $n' = \left(\frac{340+20}{340-20}\right) 240 = \frac{\cancel{360}^{90}}{\cancel{320}_{4}} \cdot \cancel{240}^{3}$

$= 270\,Hz \Rightarrow (b)$

46 → It is 16 Hz. Out of the options (a)

47 → $f_1 = \frac{340}{340-34} f$

$f_2 = \frac{340}{340-17} f$

$\Rightarrow \frac{f_1}{f_2} = \frac{323}{316} \approx \frac{19}{18} \Rightarrow (d)$

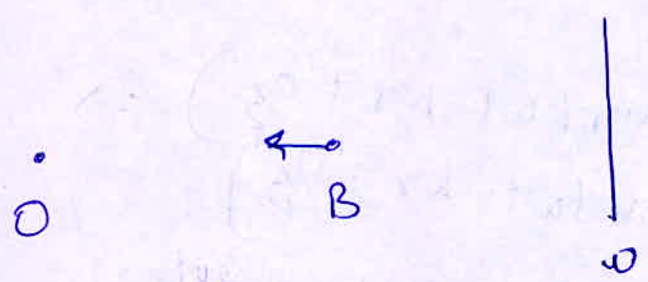
48 → $n' = \frac{\cancel{340}^{20}}{\cancel{306}_{\cancel{18}}} \cdot \cancel{450}^{\cancel{75}\,25} = 500 \Rightarrow (b)$

49 → $108\ km/hr = \cancel{108}^{6} \times \frac{5}{\cancel{18}} = 30\ m/s$

$n' = \frac{330-30}{330+30} \cdot 750$

$= \frac{\cancel{300}^{5}}{\cancel{360}_{6}} \cdot \cancel{750}^{125} = 625 \Rightarrow (b)$

50 →



direct frequency $= \frac{340}{339} \cdot 680$

reflected " $= \frac{340}{341} \cdot 680$

beat freq $= \left(\frac{1}{339} - \frac{1}{341}\right) 340 \cdot 680$

$= \frac{2 \cdot 340 \cdot 680}{339 \cdot 341}$

$\approx 4\,Hz \Rightarrow (d)$

52 → $L \downarrow \rightarrow f \uparrow \Rightarrow$ (c)

51 → $\frac{v}{4L} = 166$

$l = \frac{v}{4 \times 166} \approx \frac{1}{2} = 0.5\,m \Rightarrow (d)$

53 → (a) $M \downarrow \Rightarrow v \uparrow \Rightarrow f \uparrow$

(c) → $L \downarrow \Rightarrow f \uparrow$

(d) → $f' = \frac{v}{2L} \Rightarrow f' = 2f \Rightarrow$ (a), (c), (d)

54 →

55 → $\pi \Rightarrow$ (c)

56 → B → $y = A \sin(\omega t - kx + \pi/2) \Rightarrow$ (b)

C → $y = A \sin(\omega t - kx - \pi/2)$

57 → resonance → very high amp. ⇒ (b)

Assertion & Reason

1 → Sound waves need medium to travel ⇒ (a)

2 → Transverse waves are not produced in liquids & gases as they can not have strain. ⇒ (b)

Light waves are EM waves which are transverse

3 → A is correct
R is correct } but R is not the reason for A
⇒ (b)

4 ⇒ humidity ↑, ρ ↓, v ↑ ⇒ A is correct
R is wrong ⇒ (c)

5 → ocean waves are transverse waves
A is correct R is wrong ⇒ (c)

6 → R is correct explanation of A ⇒ (a)

7 → A → longitudinal waves are there in an organ pipe
⇒ A is wrong.
Air is gas and it possesses only volume elasticity ⇒ e.

8 → T ↑ ⇒ v ↑ ⇒ A is correct.
R is wrong as $v = \sqrt{T}$ ⇒ (c)

9 ⇒ A is correct but ~~the~~ R is wrong
⇒ (c)

10 → particle vel. is a f^n of time ⇒ A is wrong

light waves travel in vacuum ⇒ ~~R wrong~~
(all EM waves.
but for long. & transverse waves R is true ⇒ (e)

11 → $L \downarrow \Rightarrow v \uparrow \Rightarrow n \uparrow \Rightarrow$ pitch keeps on increasing ⇒ A is correct

frequency of man voice is usually lower ⇒ R is wrong.

⇒ (d).

12 → Both are true but R is not the reason for A

⇒ (b)

13 → change in air pressure when T is constant does not affect the speed of sound ⇒ A is false.

R is correct as $v \propto \sqrt{P}$ ⇒ (e)

14 → both A and R are correct and R is correct explanation of A ⇒ (a)

15 → P same, T same ⇒ ρ same.

⇒ $v \propto \sqrt{\gamma}$

$\gamma = 5/3$ for monoatomic

$\gamma = 7/5$ for diatomic

∴ $v_{mono} > v_{diatomic}$ ⇒ A is correct

R is not correct ⇒ (c).

16 → Both A & R are correct and R explains A

⇒ (a)

17 → Both A & R are false ⇒ (d)

18 ⇒ Both A & R correct, R is not the reason for A ⇒ (b)

19 ⇒ open, $n_o = \frac{v}{2L}$ closed, $n_c = \frac{v}{4L}$

n_o is higher ⇒ higher pitch ⇒ (A) is correct

But B is not the reason ⇒ (b)

20 → Both A & R are correct. R is correct explanation of A ⇒ (a).

21 → Beats is not observed by light waves.
Light sources are not always coherent ⇒ (d)

22 ⇒ Pressure is highest at nodes ⇒ loud sound at nodes ⇒ A is correct
Only particles between two nodes vibrate in phase. ⇒ R is wrong

⇒ (c)

23 ⇒ Both are correct. And R is the reason of A ⇒ (a)

24 ⇒ A is correct.
Superposition is valid for all frequencies but beats are formed only for nearly equal frequencies. (c)

25 ⇒ $\nu \propto \frac{V}{L} \propto \frac{\sqrt{T}}{L}$ ⇒ A is correct.

$V \propto \sqrt{T}$, $dV = \frac{1}{2\sqrt{T}} dT$, $dL \propto \alpha\, dT$ } R is correct

} R is correct explanation of A

⇒ (a)

26 → A is correct.
R " " .
but R is not the reason for A ⇒ (b).

27 → Both are wrong ⇒ (d)

28 → Both are correct but R does not explain A ⇒ (b)

29 → A is correct
R is wrong ⇒ (c)

30 → Both are correct and R is the reason for A
⇒ (a).

31 → R is correct, A is wrong ⇒ (e)

Previous year's questions →

1 → $n_1 = \frac{v}{2L_1}$, $n_2 = \frac{v}{2L_2}$, $n_3 = \frac{v}{2L_3}$

$n = \frac{v}{2L}$, where $L = L_1 + L_2 + L_3$

$\Rightarrow L_1 = \frac{v}{2n_1}$, and so on.

$\Rightarrow \frac{v}{2n} = \frac{v}{2n_1} + \frac{v}{2n_2} + \frac{v}{2n_3}$

$\Rightarrow \frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$ [Assuming T in string is same for all the segments] ⇒ (c)

2 → $f = \frac{(2n+1)v}{4L}$, $n = 0, 1, 2, ---$

$\frac{v}{4L} = \frac{\cancel{340}^{\cancel{204}} \times 100}{4 \times 0.\cancel{85}\,8} = 100$

$\Rightarrow f = 100, 300, 500, 700, 900, 1100 \Rightarrow 6 \Rightarrow$ (b)

3 → $n' = \left(\frac{v + v_0}{v + v_s}\right) n = \left(\frac{343+10}{343+5}\right) 1392$

$= \frac{353}{\cancel{348}} \times \cancel{1392}^{4} = 1412\,Hz \Rightarrow$ (a)

4 → $|250 - f| = 4$ $\Rightarrow f = 254$ ⇒ (b)

$|513 - 2f| = 5$

5 → $n' = \left(\frac{330+220}{330-220}\right) \cdot 1000 = 5000\,Hz \Rightarrow$ (c)

6 → Same as Q.1 ⇒ (c)

7 → $K = 15$

$\omega = 60$

$\frac{\omega}{K} = V = 4$

$V = \sqrt{\frac{T}{\mu}} \Rightarrow T = V^2 \mu$

$= 16 \times 3 \times 10^{-4}$

$= 48 \times 10^{-4}$.

8 → Two violins will not behave as coherent sources.

⇒ both are correct and R is correct explanation for A. ⇒ (a)

9 → $B = \frac{\Delta p}{\Delta V / V} = \frac{100 \times 10^3}{0.005 \times 10^{-2}} = \frac{10^{10}}{1.5}$

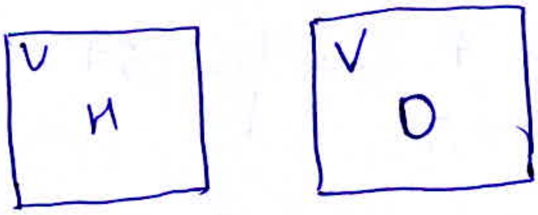
$V = \sqrt{\frac{B}{\rho}} = \sqrt{\frac{10^{10}}{5 \cdot 10^3}} = \sqrt{\frac{10^7}{5}} = 1.414 \times 10^3$ m/s.

⇒ (C)

10 → $V_{p\,max} = A \frac{2\pi V}{\lambda} = 3V$

$\Rightarrow \lambda = \frac{2\pi A}{3}$ ⇒ (d)

11 → $M_o = 16 M_H$



$M_{mix} = \frac{n_{H_2} M_{H_2} + n_{O_2} M_{O_2}}{n_{H_2} + n_{O_2}}$

$M_{mix} = \frac{17 M_H}{2}$ [equal moles as equal volume and equal temp.].

$$\therefore V_{mix} = \sqrt{\frac{\gamma RT}{M_{mix}}}$$

$$\Rightarrow \frac{V_{mix}}{V_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{Mix}}} = \sqrt{\frac{2}{19}} \Rightarrow (b)$$

Basics of mechanical waves

1) $y = 10 \sin\left(\frac{2\pi t}{45} + \alpha\right)$

$5 = 10 \sin\alpha \Rightarrow \sin\alpha = \frac{1}{2} \Rightarrow \alpha = \frac{\pi}{6}$

$y = 10 \sin\left(\frac{2\pi \times \cancel{75}}{\cancel{45}\,63} + \frac{\pi}{6}\right) = 10 \Rightarrow$ phase is $\frac{\pi}{2}$

$\Rightarrow (b)$

2 → $\frac{2\pi}{\lambda}\Delta x = \frac{\pi}{2} = \frac{2\pi}{\lambda} \times 0.8$

$\Rightarrow \lambda = 3.2\, m$.

$V = f\lambda = 12\cancel{0} \times 3.2 = 38\ 4\, m/s \Rightarrow (b)$

3 → $|f_p - 512| = 4$ $f_p' > f_p$ (as tension is increased)

$|f_p' - 512| = 2$

$\Rightarrow f_p = 508 \Rightarrow (d)$

4 → $V_p = A\omega$

$V = \frac{\omega}{K}$ $\Rightarrow A\cancel{\omega} = \frac{\cancel{\omega}}{K} \Rightarrow A = \frac{1}{K} = \frac{\lambda}{2\pi}$

$\Rightarrow \lambda = 8\pi A \Rightarrow$ (c)

5 → wave speed $= \frac{\omega}{k} = \frac{6}{3} = 2 \Rightarrow$ (b)

6 → $y_1 = a_1 \sin\left(\omega t - \frac{2\pi x}{\lambda}\right)$

$y_2 = a_2 \sin\left(\omega t - \frac{2\pi x}{\lambda} + \phi + \frac{\pi}{2}\right)$

$\Rightarrow$ ~~pha~~ phase ~~path~~ diff $= \phi + \frac{\pi}{2}$

path diff $= \frac{\lambda}{2\pi}\left(\phi + \frac{\pi}{2}\right) \Rightarrow$ (b)

7 → velocity changes ⇒ (c).

8 → They transfer energy not momentum
⇒ (a) & (b) ⇒ (d)

9 → $I \propto \frac{1}{r^2}$, $I \propto A^2$

$\Rightarrow A \propto \frac{1}{r}$

$\Rightarrow \frac{A_P}{A_Q} = \frac{r_Q}{r_P} = \frac{9}{4} \Rightarrow$ (d)

10 → if pressure is changed keeping ~~d~~ T constant, speed of sound is not changed
⇒ A is wrong.
R is wrong ⇒ (d)

11 → increase in density of air ⇒ (a)

12 → $V = 25$

$\lambda = 100\, m$.

$\nu = \frac{V}{\lambda} = \frac{1}{4}$ seconds $= 0.25$ seconds ⇒ (d)

13 → $V_G = 4 V_{SO_2}$

$\Rightarrow M_G = \frac{M_{SO_2}}{16} = 4 \Rightarrow$ (a).

14 → Sound waves are longitudinal waves.

Light waves are EM waves.

None of the options are correct.

15 → $V = \sqrt{\frac{K}{\rho}} = \sqrt{\frac{2\times10^9}{1000}} = 10^3\sqrt{2}$

time taken for the wave to reach bottom $= 1s$

$\Rightarrow d = 10^3\sqrt{2}\times 1 = 1414\, m \Rightarrow$ (b).

16 → does not depend upon changes in pressure if temperature remains constant. Closest is (b).

17 → $V \propto \sqrt{T}$

$\frac{V_2}{V_1} = \sqrt{\frac{T_2}{T_1}} \Rightarrow T_2 = 4T_1 \Rightarrow$ (b).

18 → $\lambda = 2m$

$V = 360\, m/s$

$\Rightarrow f = \frac{V}{\lambda} = 180\, Hz \Rightarrow$ (a)

19 $\Rightarrow V \propto \frac{1}{\sqrt{M}} \Rightarrow \frac{V_H}{V_O} = \sqrt{\frac{M_O}{M_H}} = \sqrt{\frac{16}{1}} = 4:1$

$\Rightarrow$ (c).

20 $\Rightarrow$ humidity increases $\Rightarrow$ (c).
density decreas
$\Rightarrow$ v increases

21 $\Rightarrow$ $v \propto \sqrt{T} \Rightarrow$ speed changes. $\Rightarrow$ (c)
wavelength " $\Rightarrow$ (d).

Answer wrong.

22 $\Rightarrow$ $V_{rms} > V_{av} > V_{pm}$. $\Rightarrow$ (b).

23 $\Rightarrow$ Both types of waves are produced as both types of disturbances are created $\Rightarrow$ (c)

24 $\Rightarrow$ $\frac{V_2}{V_1} = \sqrt{\frac{T_2}{T_1}} \Rightarrow \frac{T_2}{T_1} = 4$

$T_2 = 4 \times 300 = 1200\,K$
$= 927^\circ C \Rightarrow$ (d)

25 $\Rightarrow$ frequency does not change on change in medium

$f = 60\,KHz$

$\lambda = \frac{v}{f} = \frac{33\cancel{0}}{6\cancel{0} \times 1\cancel{000}\,1000} = \frac{5.5}{1000}\,m = 5.5\,mm$

$\Rightarrow$ (a)

26 :- 2π $\Rightarrow$ (c)

27 $\rightarrow$ Both are correct. R is correct reason for A $\Rightarrow$ (a)

28 $\rightarrow$ $\cancel{\frac{v_2}{v}} = \cancel{\sqrt{\frac{\gamma_2 R T_2}{M_2}}}$ when oxygen ~~densit~~ dissociates, density remains same.

$PV = nRT$.

$P_2 V = n_2 R T_2 \Rightarrow \frac{P_2}{P} = \frac{n_2}{n} \cdot \frac{T_2}{T} = 4$

$\Rightarrow \frac{V_2}{V_0} = \sqrt{\frac{P_2}{P}} = 2 \Rightarrow V_2 = 2V \Rightarrow$ (b)

29 $\rightarrow$ $\frac{V_2}{V_1} = \sqrt{\frac{T_2}{273}} = 3$

$\Rightarrow T_2 = 9 \times 273 = 2457$ K

$= 2184\,^\circ C \Rightarrow$ (d).

—x—x—

Progressive waves.

1 $\rightarrow$ We can not say anything about them doing interference, so none of these $\Rightarrow$ (d).

2 $\rightarrow$ $\Delta\phi = \frac{2\pi}{\lambda}\Delta x = \frac{\pi}{3}$

$\Rightarrow \Delta x = \frac{\lambda}{6} = \frac{v}{6f}$

$= \frac{300}{6 \times 500} = 0.1$ m

$\Rightarrow$ (b)

3 → $y = 5\sin\left(\frac{t}{0.04} - \frac{x}{4}\right)$

speed of wave. $v = \frac{\omega}{k} = \frac{4}{0.04} = 100 cm/s. = 1 m/s$

max^m vel. of particles in wave. $= \frac{5 \times 0.04}{0.04}$... $= 125 cm/s. = 1.25 m/s \Rightarrow (d).$

4 → $3\Delta x = \frac{\pi}{3}$

$\Rightarrow \Delta x = \frac{\pi}{9} m$ — (a).

5 → $v_y = A\omega \cos(\omega t - kx)$

$k(x_1 - x_2) = \pi$

$k\Delta x = \pi = \frac{2\pi}{\lambda}\Delta x$

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

6 → (a)

as $v = \frac{\omega}{k} = \frac{100}{1} = 100 m/s.$

7 → $k = \pi = \frac{2\pi}{\lambda} \Rightarrow \lambda = 2 \Rightarrow$ (c)

8 → +ve x.

$\omega = 2\pi = 2\pi f \Rightarrow f = 1 \Rightarrow$ (c)

9 →

$\omega = 50\pi = \frac{2\pi}{T} \Rightarrow T = \frac{1}{25} = 0.04 sec$

$\Rightarrow (a)$

10 → $y = 4\cos^2\left(\frac{t}{2}\right)\sin 1000t$

$= 2\left(1+\cos t\right)\sin 1000t$

$= \underbrace{2\sin 1000t}_{1} + \underbrace{2\cos t \sin 1000t}_{2}$

$\Rightarrow 3 \Rightarrow$ (b).

11 → Pressure ~~[illegible]~~ ⇒ (d)

$I \propto P^2 \Rightarrow P \propto \sqrt{I}$

12 → $\Delta\phi = 2\pi \times 0.1 (\Delta x)$

$= 2\pi \times 0.1 \times 2 = 0.4\pi$

$= \frac{2}{5} \times 180 = 72^\circ \Rightarrow (d)$

13 → $\frac{T}{4} = 0.17 \Rightarrow T = 0.68$

$f = \frac{1}{T} = \frac{1}{0.68} \Rightarrow$ (a).

14 → B leads A by $\pi/2$ and C lags ⇒ (c).

15 → $v = \frac{\omega}{K} = \frac{8}{1/8} = 64$ cm/s in $+x$

⇒ (d)

30
40

5 → $A = \sqrt{a^2 + b^2 + 2ab\cos\left(\frac{2\pi}{\lambda}\cdot\frac{\lambda}{2}\right)}$

$= \sqrt{a^2 + b^2 - 2ab}$

$= |a - b| \Rightarrow (a)$

option is misprinted

6 → $\Delta\phi = \pi/2$.

$A = \sqrt{A^2 + A^2 + 2A^2\cos\pi/2} = A\sqrt{2}$.

frequency remains same ⇒ $A\sqrt{2}, \omega \Rightarrow (d)$

$I_1 = 4I$
$I_2 = I$

$\sqrt{I_{max}} = \sqrt{I_1} + \sqrt{I_2}$
$2\sqrt{I} + \sqrt{I} = 3\sqrt{I}$

$I_{max} = 9I$.

$\sqrt{I_{min}} = \sqrt{4I} - \sqrt{I}$
$= \sqrt{I}$

$I_{min} = I$.

7 → $dB = \cancel{2}0\log\frac{I_1}{I_{ref}}$.

$dB_1 = \cancel{2}0\log\frac{9I}{I_{ref}}$

$dB_2 = \cancel{2}0\log\frac{I_0}{I_{ref}}$

~~diff = 10 log 9~~

$diff = 10\log 9 = 20\log 3 \Rightarrow (b)$

8 → $f_1 = \frac{v}{4L}$ | $f_2 = \frac{3v}{4L}$ | $f_3 = \frac{5v}{4L}$ ⇒ ~~[illegible]~~ ⇒ (a)

$\lambda_1 : \lambda_2 : \lambda_3 = $ ~~[illegible]~~

$\lambda_1 = 4L \quad \lambda_2 = \frac{4L}{3} \quad \lambda_3 = \frac{4L}{5}$ $\quad 1 : \frac{1}{3} : \frac{1}{5}$

$15 : 5 : 3$

9 → $\Delta\phi = \frac{2\pi \Delta x}{\lambda}$

$$\Delta x = \frac{\Delta\phi}{2\pi} \cdot \lambda = \frac{\pi}{3 \cdot 2\pi} \cdot \lambda = \frac{\lambda}{6}$$

⇒ (a)

10 → $I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 = 16I$

$I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2 = 4I$

ratio $= 4:1$ ⇒ (c)

11 → $I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

$I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$

$= 2(I_1 + I_2)$ ⇒ (d).

12 → $I \propto A^2$

$A \propto \sqrt{I}$ ⇒ $3:1$ ⇒ (c)

13 → phase change of 180°.
Both velocity of particles and wave get reversed.
⇒ (a)

14 → $A_t = \frac{2v_2}{v_1 + v_2} A_i$, $\quad A_r = \frac{v_2 - v_1}{v_1 + v_2} \cdot A_i$

$v \propto \frac{1}{\sqrt{\mu}}$ ⇒ $v\sqrt{\mu} = $ constant
(As T same) ⇒ $5v_1 = 3v_2$ ⇒ $v_1 = \frac{3v_2}{5}$ ⇒ $A_r = \frac{1}{4} A_i$

15 → $I \propto A^2 v$

$$\frac{I_1}{I_2} = \frac{A_1^2 v_1}{A_2^2 v_2} \quad \because \; v_1 = \frac{75}{0.25} = 300, \; v_2 = \frac{150}{0.5} = 300$$

$$\Rightarrow \frac{I_1}{I_2} = \frac{25}{100} = \frac{1}{4} \Rightarrow \text{(c)}.$$

16 → $y = A \sin \omega t$

$z = B \cos \omega t$

$$\frac{y^2}{A^2} + \frac{z^2}{B^2} = 1 \Rightarrow \text{(d)}.$$

17 → Question needs to be more precised.

Beats

1) → $1.02f - 0.97f = 6.$

$\Rightarrow 0.05f = 6$

$f = 120\,Hz$ ~~(b)~~.

frequency of $A = 1.02 \times 120$

$= 122.4\,Hz$

$\Rightarrow (c).$

2 → $f \propto v \propto \sqrt{T} \Rightarrow f = c\sqrt{T}$

$f_2 - f_1 = 3/2$

$c(\sqrt{1.01T} - \sqrt{T}) = 1.5$

$c\sqrt{T}(\sqrt{1.01} - 1] = 1.5$

$f = c\sqrt{T} = \left(\frac{0.01}{2}\right) = 1.5$

$f = 300\,Hz \Rightarrow (b)$

3 → $\frac{v}{4L_1} - \frac{v}{4L_2} = 5$

$\frac{300}{4}\left(\frac{1}{0.1} - \frac{1}{L_2}\right) = 5$

$\Rightarrow 10 - \frac{1}{L_2} = \frac{20}{300} \Rightarrow \frac{1}{L_2} = 10 - \frac{2}{30}.$

$L_2 = \frac{30}{298} \approx 10.06\,cm$

$\Rightarrow (a)$

4 → $y = -0.8 A \sin(\omega t + kx) \Rightarrow$ (b).

5 → $1.015 f_c - 0.975 f_c = 12$

$\Rightarrow 0.04 f_c = 12$

$f_c = 300\text{ Hz} \Rightarrow$ (d)

6 → Both are correct but R is not the reason for A ⇒ (b)

7 → $v = \sqrt{\frac{T}{\mu}}$

$\left| \frac{v_1}{2L_1} - \frac{v_2}{2L_2} \right| = \text{beat freq}$

$\cancel{\left| \frac{1}{2\sqrt{\mu}} \left(\frac{\sqrt{T_1}}{L_1} - \frac{\sqrt{T_2}}{L_2} \right) \right| =}$

$\cancel{= \frac{1}{2\sqrt{10^{-3}\text{ kg m}^{-1}}} \sqrt{20} \left(\frac{1}{.491} - \frac{1}{0.516} \right)}$

$\cancel{= 100\sqrt{10} \left(\frac{0.025}{0.25} \right)}$

$\cancel{= \frac{1}{2} \sqrt{20.10^3} \left(\frac{0.025}{0.25} \right)}$

$\frac{v}{2} \left(\frac{1}{L_1} - \frac{1}{L_2} \right)$

$\frac{1}{2} \sqrt{\frac{T}{\mu}} \left(\frac{1}{0.491} - \frac{1}{0.516} \right)$

$\frac{1}{2} \sqrt{\frac{20}{10^{-3}}} \frac{0.025}{0.25}$

$= \frac{1}{2} \sqrt{200}$

$= \frac{10}{\sqrt{2}} = 5\sqrt{2}$

≈ 7

$\Rightarrow$ (b)

8 → possible ~~cases~~ no. of beats 1, 2.
max^m beats 2 per second
⇒ beat freq = 2 ⇒ (c).

9 → $f_1 = 1000$
$f_2 = 1004$ ⇒ beats = 4 ⇒ (c)

10 → interference ⇒ (a)

11 → $n_A - n_B = n_1$ — ①
$n_A - n_C = n_2$ — ②
② − ① ⇒ $n_B - n_C = n_2 - n_1$ ⇒ (c)

12 → $\frac{330}{5}$ $\frac{\cancel{3300}\,300}{\cancel{55}\,5}$

66 − 60 = 6 ⇒ (d)

13 → beat freq = $f_1 - f_2$
time period = $\frac{1}{f_1 - f_2}$ ⇒ (d)

14 → frequency slightly diff, amp. same ⇒ (a)

15 → frequency ~~decrease~~ increase on filing prong.
$f_p = 246$ ⇒ (a).

16 → Resonance occurs for lengths 13, 41, 69 cm lengths.
taking end correction into account.

$$\frac{V}{4L_1} = \frac{3V}{4L_2} = \frac{5V}{4L_3} = f.$$

$$f = \frac{350}{4 \times 0.14} = \frac{350}{0.56} \approx 625\ Hz$$

⇒ (b)

17 → $T = \frac{1}{256}$

$t = \frac{\cancel{32}}{\cancel{256}_{8}} = \frac{1}{8}$ sec

$\Rightarrow l = vt = 344 \times \frac{1}{8} = 43 \Rightarrow$ (b)

18 → $f_1 = 250$, $f_2 = 253$

⇒ beat frq $= 3 \Rightarrow$ in a minute
$3 \times 60 = 180 \Rightarrow$ (b)

19 → $$\frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{I_1} + \sqrt{I_2}}{\sqrt{I_1} - \sqrt{I_2}}\right)^2 = \left(\frac{7}{1}\right)^2 \Rightarrow (b)$$

20 → $f \quad f-3 \quad f-6 \quad - - - - - \quad f-75$

$f = 2(f-75)$

$f = 150$

$18^{th} \to f - 17 \times 3 \qquad 150 - 51 = 99\ Hz \Rightarrow$ (b)

21 → T same means v same.

$$\frac{f_2}{f_1} = \frac{L_1}{L_2} = \frac{L}{0.98 L}$$

beats $f_2 - f_1 = f_1\left(\frac{f_2}{f_1} - 1\right)$

$$= 392\left(\frac{1}{0.98} - 1\right)$$

$$= \frac{\cancel{392}^{4} \times 0.02}{\cancel{0.98}} = 8 \Rightarrow \text{(c)}.$$

22 → $T_1 > T_2$

$\Rightarrow f_1 > f_2$ beat freq $= f_1 - f_2$.

T_1 can be decreased so that f_1 decreases to $2f_2 - f_1$ again $f_b = f_2 - 2f_2 + f_1$
$= f_1 - f_2$

or T_2 can be increased so that f_2 changes to $2f_1 - f_2$

again $f_b = f_1 - f_2 \Rightarrow$ (a) (c)

23 → when beats are produced resultant amplitude $= 2A$. $\to I \propto A^2 \Rightarrow I_{max} = 4A^2$

~~$dB_{max} = 10 \log_{10} \frac{4A^2}{I_{ref}}$~~

Max^m intensity is 4 times so loudness is 4 times
$\Rightarrow$ (C)

24 → 768 → 256 × 3

512 → 256 × 1

256 → 256 × 1

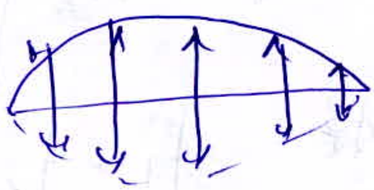
So, it will not resonate with 738 ⇒ (b).

— × — × —

Stationary waves.

1 → ~~Both~~ Both are correct and R is correct explanation of A ⇒ (a)

2 → b/w two nodes vibrate in same phase.



⇒ (b).

3 → $l = n\frac{\lambda}{2} \Rightarrow \lambda = \frac{2l}{n} \Rightarrow$ (c).

4 → 1092°K, in previous questions ⇒ (c)

$= 819°C$

5 → $\nu_1 = \frac{V_1}{2L_1} = \frac{1}{2L_1}\sqrt{\frac{T_1}{\mu_1}}$

$$\frac{\nu_1}{\nu_2} = \frac{\sqrt{\mu_2}\ L_2}{\sqrt{\mu_1}\ L_1} = \frac{\sqrt{\rho \cdot \pi R_2^2}\ L_2}{\sqrt{\rho \pi R_1^2}\ L_1} = \frac{R_2 L_2}{R_1 L_1} = 1 \Rightarrow (d)$$

6 → same amp, travelling in opp.
and no phase diff ⇒ (b)

7 → $n = \frac{v}{4L}$

$\frac{v}{L} = 4n \Rightarrow \frac{L}{v} = \frac{1}{4n} = 0.01$

$\Rightarrow n = \frac{1}{4 \times 0.01} = 25 \Rightarrow (a)$

8 → $n_1 = \frac{v}{4L_1}$, $n_2 = \frac{v}{2L_2}$

$\Rightarrow L_1 = \frac{v}{4n_1}$, $L_2 = \frac{v}{2n_2}$

$n = \frac{v}{4(L_1 + L_2)}$

$= \frac{v}{4\left(\frac{v}{4n_1} + \frac{v}{2n_2}\right)}$

$= \frac{n_1 n_2}{n_2 + 2n_1} \Rightarrow (a).$

9 → $\frac{v}{2L} > \frac{v}{4L} \Rightarrow (c)$

10 → $f = \frac{v}{2L} = \frac{1}{2L}\sqrt{\frac{T}{\mu}} = \frac{1}{2L}\sqrt{\frac{T\cancel{4}}{\rho \cdot \pi D^2}}$

$\propto \frac{1}{LD} \Rightarrow (a)$

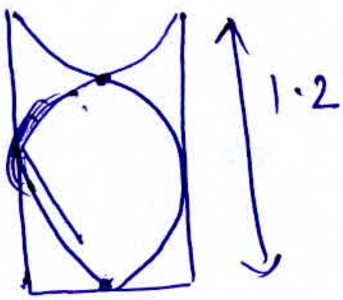
11 → $f_1 = \frac{v}{2L}$

$f_2 = \frac{v}{4 \cdot \frac{L}{4}} = \frac{v}{L}$

$\Rightarrow \frac{f_1}{f_2} = \frac{1}{2} \Rightarrow$ (c)

12 → $f_2 = 2f_1 = 1024\,Hz \Rightarrow$ (C)

13 →



displacement node = 0.4 m from open end

⇒ pressure variation max^m at " ⇒ (a)

14 → $\frac{v}{4L} = 450$

$\Rightarrow v = 4 \times 0.4 \times 450$

$= 720.0 \Rightarrow$ (b)

15 → $v = 128\ m/s$

$\lambda = 0.8\ m$.

+ve x dirn

$y = A \sin(kx - \omega t)$

$= 0.02 \sin\left(\frac{2\pi \times 10x}{0/8} - 2\pi \times \frac{\cancel{1280}\,160}{\cancel{0.8}}\, t\right)$

$= 0.02 \sin(2.5\pi x - 320\pi t) \Rightarrow$ (d)

16 → $f_0 = \frac{v}{2L}$

$f_2 = \frac{v}{4 \cdot L/2} = \frac{v}{2L} = f \Rightarrow$ (c)

17 → less damping, sharper resonance (c).

18 → $y = 2a \cos kx \sin \omega t.$

for $I_{max} \to A_{max} \to \cos kx$ is max^m $\Rightarrow$ (a).

19 → On reflection already phase diff of π.

$\frac{2\cancel{\pi}}{\lambda} \cdot 2x = \cancel{\pi}$

$\Rightarrow x = \frac{\lambda}{4} = \frac{\cancel{42}\,\cancel{336}\,21}{4 \times \cancel{256}\,\cancel{32}\,16}$

$= \frac{21}{64}\,m = 32.8\,cm \Rightarrow$ (a)

20 → (c)

21 → $L_1 = 22.7 + e$ $\quad L_2 = 70.2 + e.$

$22.7 + e = \frac{\lambda}{4}$ $\quad 70.2 + e = \frac{3\lambda}{4}$

$\Rightarrow 70.2 + e = 3(22.7 + e)$

$70.2 + e = 68.1 + 3e$

$\Rightarrow 2e = 2.1 \Rightarrow e = 1.05\,cm \Rightarrow$ (a)

22 → $\frac{v}{2L} = 390$

$$\frac{v}{4 \cdot \frac{3L}{4}} = \frac{v}{3L} = \frac{2}{3} \cdot \frac{v}{2L} = \frac{2}{3} \times 390$$

$$= 260 \text{ Hz}$$

$\Rightarrow$ (a).

23 → $\frac{nv}{2L} = 420$

$$\frac{(n+1)v}{2L} = 490.$$

$$\frac{n+1}{n} = \frac{490}{420}$$

$$\frac{1}{n} = \frac{70}{420} = \frac{1}{6} \Rightarrow n = 6$$

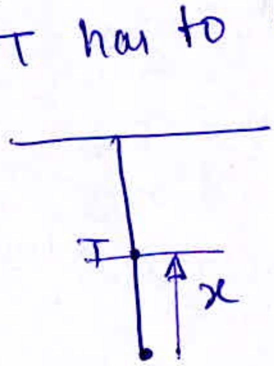
$$\frac{\cancel{6} \cdot 3}{\cancel{2}L} \sqrt{\frac{\cancel{3.6}^{9} \times 10^{2} \times 10^{\cancel{4}\,2}}{0.00\cancel{4}}} = 420.$$

$$\frac{3}{L} \cdot 3 \times 10^{2} = 420$$

$$L = \frac{\cancel{900}^{30}}{\cancel{420}_{14}} = 2.14 \Rightarrow (b)$$

24 → $f \propto \sqrt{T}$

T has to be made 1.44 times $\Rightarrow$ (a)

25 → 

$T_x = 4xg.$

$$v = \sqrt{\frac{T}{4}} = \sqrt{\frac{4xg}{4}} = \sqrt{xg}$$

$\Rightarrow v \propto \sqrt{x} \Rightarrow$ (e)

26 → Same as Q.32 page 27.

27 → $(2n+1)\frac{V}{4L} = 340$

$\Rightarrow \frac{4L}{2n+1} = \frac{V}{340} = \frac{340}{340} = 1$

$L = \left(\frac{2n+1}{4}\right) m$

$= \frac{3}{4} m$ or $\frac{5}{4} m$.

$\Rightarrow 0.75 m$

water height $= 1.2 - 0.75$

$= 0.45 m \Rightarrow$ (a)

28 → $f = \frac{V}{2L}$ $f' = \frac{V}{4 \cdot L/2} = \frac{V}{2L}$

$\Rightarrow f = f' \Rightarrow$ (a).

29 → f doubles when T becomes 4 times

$\Rightarrow$ (a)

30 → $(2n+1)\frac{V}{4L} = \frac{332(2n+1)}{4 \times 0.2} = \frac{\cancel{332}^{83} \times \cancel{10}^{5}}{\cancel{8}_{2}} (2n+1)$

$= 415 \Rightarrow$ (d).

31 → wider pipe will have higher length due to larger end correction.
$\Rightarrow n_A < n_B \Rightarrow$ (c).

32 → increase in all directions ⇔ pascals law
$\Rightarrow$ (c)

33 → $9T \Rightarrow$ (d)

34 → $n \propto \frac{1}{L}$

$$\frac{n_2}{n_1} = \frac{L_1}{L_2} = \frac{1}{1.01}$$

$$\frac{n_1 - n_2}{n_1} = \frac{0.01}{1.01}$$

% change $\frac{n_1 - n_2}{n_1} \times 100 = \frac{1}{1.01} \Rightarrow$ (a)

35 → $\frac{V}{4L_1} = \frac{V}{2L_2} \Rightarrow \frac{L_1}{L_2} = \frac{1}{2} \Rightarrow$ (a)

36 → $\frac{n_2}{n_1} = \frac{L_1}{L_2}$

$n_2 = \frac{\cancel{256}^{16} \cdot 25}{\cancel{16}} = 400\,Hz \Rightarrow$ (b)

37 → $f_2 = \frac{1}{2L_2}\sqrt{\frac{T_2}{\mu_2}} = \frac{1}{2L_2}\sqrt{\frac{T_2}{\rho \cdot \pi R_2^2}}$

$= \frac{1}{2L_2 R_2}\sqrt{\frac{T_2}{\rho \pi}}$

$\Rightarrow f \propto \frac{\sqrt{T_2}}{R_2}$

$\frac{f_2}{f_1} = \sqrt{\frac{T_2}{T_1}} \cdot \frac{R_1}{R_2} = \sqrt{\frac{1}{2}} \cdot \frac{1}{2}$

$\Rightarrow$ (d)

38 → $\frac{v}{2L}, \frac{2v}{2L}, \frac{3v}{2L}$

$n \quad 2n \quad 3n \quad 4n \Rightarrow$ (a)

39 → $f = C\sqrt{T}$

$f_2 = C\sqrt{T_2} = C\sqrt{1.01T}$.

$f_2 - f_1 = C\sqrt{T}\left(1 + \frac{1}{2} \times 0.01 - 1\right)$

$f_2 - f_1 = C\sqrt{T} \times 0.005$

$\Rightarrow C\sqrt{T} = \frac{\cancel{1.5}\ 0.3}{0.005} \times 1000 = 300\,Hz \Rightarrow$ (a)

40 → $v = \sqrt{\frac{1.6}{10^{-2}/0.4}} = \sqrt{64} = 8\,m/s$.

for constructive interference of successive waves second pulse must be created ~~before~~ when first return back, ~~~~

$\Rightarrow t = 0.1$ second $\Rightarrow$ (d).

40 → Kundt's tube ⇒ (b)

42 → 1500, 4500, 7500, 10500, 13500, 16500, 19500

⇒ 6 overtones ⇒ (c).

43 → $\frac{2\pi}{\lambda} = \frac{\pi}{3} \Rightarrow \lambda = 6.$

distance b/w two nodes = $\frac{\lambda}{2} = 3m. \Rightarrow$ (c).

44 → half of I overtone ⇒ 160 Hz ⇒ (b)

45 → 4 loops ⇒ $L = 2\lambda$.

6 loops ⇒ $L = 3\lambda'$

$\Rightarrow \lambda' = \frac{2\lambda}{3}$

frequency is fixed ⇒ $v \propto \lambda$

$\Rightarrow v' = \frac{2}{3} v$

$\Rightarrow \sqrt{T'} = \frac{2}{3}\sqrt{T}$

$T' = \frac{4}{9} \times \cancel{65}^{7.22} g = 28.88 \times g$

So, weight to be removed = $65 - 28.88$

$= 37.12\ g$

$\simeq 0.0037$ kg-wt $\Rightarrow$ (c)

45 → tuning fork and string are in resonance

$\Rightarrow 1:1 \Rightarrow$ (c)

47 → $L \uparrow \Rightarrow n \downarrow$

$\Rightarrow n_1 - n_2 = 2$

$\frac{v}{2L_1} - \frac{v}{2L_2} = 2$

$\Rightarrow \frac{v}{2L_1}\left(1 - \frac{L_1}{L_2}\right) = 2$

$1 - \frac{L_1}{L_2} = \frac{2}{n_1}$

$\Rightarrow \frac{L_1}{L_2} = 1 - \frac{2}{n_1} = 1 - \frac{2}{250} = \frac{248}{250} \Rightarrow$ (a)

48 → $\frac{v}{4\times 1} - \frac{v}{4\times 1.01} = \frac{16}{20}$

$\frac{v \times 0.01}{4\times 1} = \frac{16}{20.5} \Rightarrow v = \frac{16\times 100}{5}^{\times 1.01} = \cancel{320\ m/s}$

$= 320 \times 1.01 = 323.2$ m/s $\Rightarrow$ (c)

49 → Assuming Tension is same in both cases.
mass per unit length decreases.

$$f_1 = \frac{v_1}{2L}, \quad f_2 = \frac{v_2}{4L} = \frac{1}{4L}\sqrt{\frac{T}{\mu_2}}$$

$$\Rightarrow \frac{f_2}{f_1} = \frac{1}{2}\sqrt{\frac{\mu_1}{\mu_2}} = \frac{\sqrt{2}}{2} = \frac{1}{\sqrt{2}}.$$

$$\Rightarrow f_2 = \frac{f}{\sqrt{2}} \approx 0.7f \Rightarrow (b).$$

50 → $\lambda = 1\,m$
open pipe - second overtone → $\Rightarrow l = \frac{3\lambda}{2} = 1.5\,m$
$\Rightarrow (c)$

51 → Same as Q. 31, page 26.

<u>Doppler's effect →</u>

1 → $n' = \left(\frac{V}{V-50}\right)n = 1000$

$$n'' = \left(\frac{V}{V+50}\right)n$$

$$\Rightarrow \frac{n''}{1000} = \frac{V-50}{V+50} = \frac{300}{400} \Rightarrow n'' = 750\,Hz \Rightarrow (a)$$

2 → Apparent freq.

$$n' = \left(\frac{V}{V - V_s\cos\theta}\right)n = \left(\frac{340}{340 - \frac{100}{3}\cdot\frac{3}{5}}\right) \times 640 = \frac{340 \times 640}{320}$$

$= 680\,Hz \Rightarrow (b)$

3 → $\left(\frac{V}{V-15}\right) n_A = \left(\frac{V}{V-30}\right) n_B$.

$\Rightarrow n_A = \frac{V-15}{V-30} \times 504$.

$\Rightarrow n_A > 504 \Rightarrow$ (a).

4 → $n' = \frac{6V/5\, n}{V} = \frac{6n}{5}$.

$\Rightarrow$ % chang = 20 %. $\Rightarrow$ (c).

5 → data insufficient $\Rightarrow$ (d).

6 → $n' = \left(\frac{330+60}{330-60}\right)n = \left(\frac{390}{300}\right)n$

$\Rightarrow \frac{n'}{n} = 1.3$

$\Rightarrow$ fraction change = $\frac{3}{10}$ $\Rightarrow$ (b).

7 → 5 m/s. 25 m/s, O, A, B $\Rightarrow n_B' = \left(\frac{340+25}{340}\right) 500$

$n_A' = \left(\frac{350-25}{350}\right) 500$

$n_B' = \frac{365}{340} \cdot 500$, $n_A' = \left(\frac{325}{350}\right) \cdot 500$

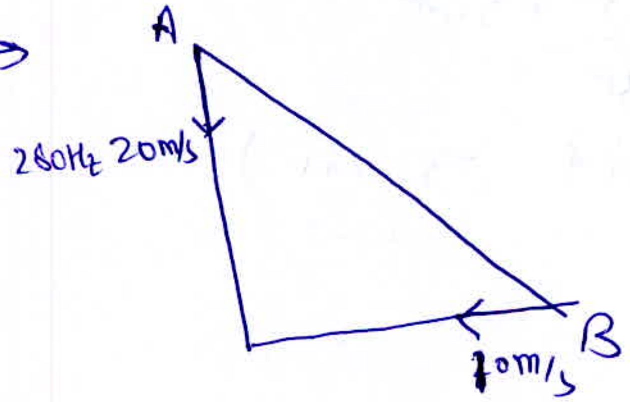
$= 500\left(1 + \frac{25}{340}\right)$ $n_A' = 500\left(1 - \frac{25}{350}\right)$

diff $= 500\left[\frac{25}{340} + \frac{25}{350}\right] =$ ~~$\frac{500 \times 25 \times 69}{34 \times 350}$~~

$$= \frac{50\cancel{0} \times \overset{5}{\cancel{25}} \times 69\cancel{0}}{34\cancel{0} \times \underset{7}{\cancel{35}}\cancel{0}} \approx \frac{500}{7} \approx 71.4$$

$\Rightarrow$ (a).

8 $\rightarrow$



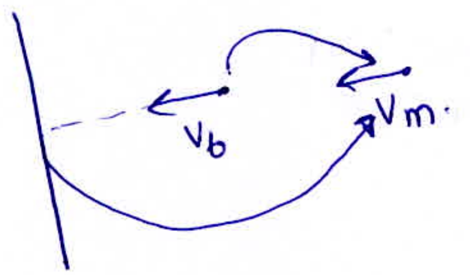
$$n' = \left(\frac{V + 5\sqrt{2}}{V - 10\sqrt{2}}\right) 280$$

if $V = 330$ m/s (which should be given)

$$n' = \frac{337.07 \times 280}{315.86} = 298$$

$\Rightarrow$ (b)

9 $\rightarrow$



$$f_1 = \left(\frac{V + V_m}{V + V_b}\right) f.$$

$$f_2 = \left(\frac{V + V_m}{V - V_b}\right) f$$

$\Rightarrow$ beat freq $= (V + V_m) f \left(\frac{1}{V - V_b} - \frac{1}{V + V_b}\right)$

$$= \frac{(V + V_m) f . 2V_b}{V^2 - V_b^2} \Rightarrow (c)$$

10 $\rightarrow$ $f' = \left(\frac{330 + 30}{330 - 30}\right) 600 = 720$ Hz $\Rightarrow$ (c)

11 → $f' = \frac{4V/3}{V} f = \frac{4}{3} f$

⇒ % increase = 33% ⇒ (a).

12 → 1 ← 2

$f_1 = \left(\frac{V+u}{V}\right) f$, $f_2 = \left(\frac{V-u}{V}\right) f$

⇒ $f_b = \frac{2uf}{V} = \frac{2u}{\lambda}$ ⇒ (a)

13 → $f' = \left(\frac{V+V_T}{V+V_T}\right) f = f$ ⇒ (b)

14 → (c)

15 → Assuming source to be at rest.

$\left(\frac{V+u}{V}\right) f - \left(\frac{V-u}{V}\right) f = 0.02 f$

$\Rightarrow \frac{2u\cancel{f}}{V} = 0.02 \cancel{f}$

$\Rightarrow u = 0.01\,V \Rightarrow 3\,m/s$ ⇒ (d)

16 → 500 Hz exactly as no velocity of approach or separation is there. ⇒ (c).

17 → 20 % ⇒ (d)

18 → $f' = \frac{6}{5} f$ or $1.2 f$.

wavelength remains same ⇒ (d)

19 → Same as Q. 15

20 → $f' = \frac{350+50}{350-50} \times 1.2\, kHz$

$= 1.6\, kHz$ ⇒ (c).

21 → $f' = \left(\frac{v}{v - \frac{v}{20}}\right) f = \frac{20}{19} f$

$\Rightarrow f' = \frac{20}{19}$.

⇒ every $\frac{19}{20}$ seconds ⇒ (c).

22 → $f' = \left(\frac{V + Va}{V - Va}\right) 5000 \times 10^6$

$\frac{V + Va}{V - Va} = \frac{\cancel{500}\, 5\times10^9 + 10^5}{\cancel{50} \cdot 5\times10^9} = \frac{50001}{50000}$

$\cancel{50V + 50Va = 51V - 50Va}$

$\cancel{100Va = V}$

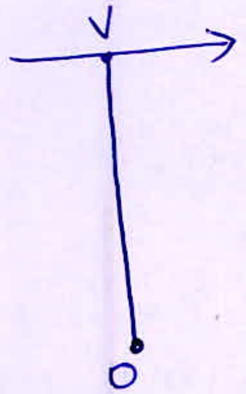
$\cancel{\Rightarrow Va = \frac{V}{101} = \frac{3\times10^8}{101}\, m/s = 3\times10^3\, km}$

$Va = \frac{V}{100000} = \frac{3\times10^8}{10^5} = 3\times10^3\, m/s$

$= 3\, km/s$ ⇒ (c)

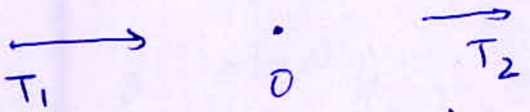
23 → $\frac{f'}{f} = \frac{v}{9v/10} = \frac{10}{9} \Rightarrow$ (d).

24 →



$v_1 = 0 \Rightarrow$ (a)

25 →



$f_1 = \left(\frac{v}{v-4}\right)f$, $f_2 = \left(\frac{v}{v+4}\right)f$.

$f_b = f_1 - f_2 = vf\left(\frac{1}{v-4} - \frac{1}{v+4}\right)$

$= \frac{vf\,8}{(v\cancel{4})^2} = \frac{\cancel{320}\cdot\cancel{8}^{2}\cdot\cancel{240}^{3}}{\cancel{320}\cdot\cancel{320}\,\cancel{4}} = 6Hz$

$\Rightarrow$ (b).

26 →

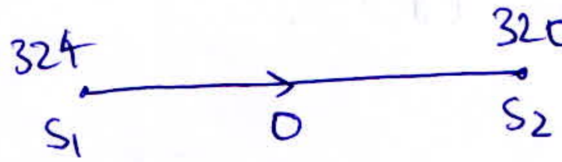
$2x = v$

$2(510-\cancel{x}) = 2v$

$510 - \frac{v}{2} = v$

$510 = \frac{3v}{2} \Rightarrow v = \frac{1020}{3} = 340 \Rightarrow$ (b)

27 →



$$f_1 = \left(\frac{V - V_0}{V}\right)324, \quad f_2 = \left(\frac{V + V_0}{V}\right)320$$

$$\Rightarrow (V - V_0)324 = (V + V_0)320.$$

$$\Rightarrow 4V = 644 V_0.$$

$$\Rightarrow V_0 = \frac{V}{161} = \frac{344}{161} \simeq 2.1\,m/s \Rightarrow (d)$$

28 → $n' = n\left(\frac{V + V_0}{V}\right) \Rightarrow (a).$

29 → $n' = \frac{33\cancel{0}}{31\cancel{0}} \times 440 = \frac{14520}{31}$

$= 46\ldots \Rightarrow (d)$

30 → unchanged ⇒ (c).

31 → (c)

32 → $n_1 = \left(\frac{3\cancel{00}}{1\cancel{00}}\right) 400 = 1200\,Hz$ (approachy)

$n_2 = \left(\frac{3\cancel{00}}{\cancel{5}\cancel{00}}\right) \cancel{400}^{\,80} = 240\,Hz$ (recedes).

$\Rightarrow 960\,Hz \Rightarrow (d)$

Musical sounds & acoustics of buildings.

1) $dB = 10\log_{10}\frac{I}{I_{ref}}$.

$$dB_2 - dB_1 = 20 = 10\log_{10}\frac{I_2}{I_{ref}} - 10\log_{10}\frac{I_1}{I_{ref}}$$

$$\Rightarrow \quad 2 = \log_{10}\frac{I_2}{I_1}.$$

$$\Rightarrow \frac{I_2}{I_1} = 10^2 = 100 \Rightarrow (d)$$

2 → $d \cdot 60 = 10\log_{10}\frac{I_1}{I_{ref}}$

$$30 = 10\log_{10}\frac{I_2}{I_{ref}}$$

subtract

$$\Rightarrow 30 = 10\log_{10}\frac{I_1}{I_2}$$

$$\Rightarrow \frac{I_1}{I_2} = 10^3 = 1000 \Rightarrow (a).$$

3 → Waves will travel double distances, so it will take double time to reduce intensity by the required amount ⇒ (a)

4 → T changes v changes; reveration time changes.
v " reverbration time changes.

5 → pitch depends on frequency.
If freq. of both waves is same (assumed, although not given)
⇒ pitch is same
Intensity $\propto A^2$
⇒ same pitch, diff. intensity ⇒ (a)

6 → frequency content ⇒ (d)

7 → $T \propto V$ ⇒ (b)