DPP – 3(Sound Waves)

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/95

Video Solution on YouTube:- https://youtu.be/3lGsdJJxYok

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/44

Q 1. A tube closed at one end and containing air is excited. It produces the fundamental note of frequency 512 Hz. If the same tube is open at both the ends the fundamental frequency that can be produced is
(a) 1024 Hz (b) 512 Hz
(c) 256 Hz (d) 128 Hz

Q 2. If the frequency of the first overtone of a closed organ pipe of length 33cm is equal to the frequency of the first overtone of an organ pipe open at both the ends, then the length of the open organ pipe will be
(a) 17 cm (b) 88 cm
(c) 22 cm (d) 44 cm

Q 3. The Fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of organ pipe open at both the ends is:
(a) 120 cm (b) 140 cm
(c) 80 cm (d) 100 cm

Q 4. If the length of a closed organ pipe is 1m and velocity of sound is 330 m/s, then the frequency for the second note is
(a) $4 \times \frac{330}{4}$ Hz (b) $3 \times \frac{330}{4}$ Hz
(c) $2 \times \frac{330}{4}$ Hz (d) $2 \times \frac{4}{330}$ Hz

Q 5. A resonance air column in resonance tube resonates with a tuning fork of 512 Hz at length 17.4 cm. Neglecting the end correction, deduce the speed of sound in air.
(a) 330 m/s (b) 356 m/s
(c) 315 m/s (d) 412 m/s

Q 6. A resonance air column shows resonance with a tuning fork of frequency 256 Hz at column lengths 33.4 cm and 101.8 cm. find end-correction
(a) 0.8 cm (b) 1.6 cm
(c) 0.5 cm (d) 0.18 cm

Q 7. In a resonance tube experiment to determine the speed of sound in air, a pipe of diameter 5cm is used. The air column in pipe resonates with a tuning fork of frequency 480Hz when the minimum length of the air column is 16cm. If the speed of sound in air at room temperature = 6η (in m/sec). Find η

(a) 53 (b) 44

(c) 56 (d) 60

Q 8. The frequency of two forks are 320 Hz and 320.1 Hz. The number of beats heard in 1 minute is

(a) 1 (b) 6

(c) 60 (d) none of these

Q 9. A closed air column 32cm long is in resonance with a tuning fork . Another open air column of length 66cm is in resonance with another tuning fork . If the two forks produce 8 beats/s when sounded together , find the speed of sound in the air (Consider fundamental frequencies only)

(a) 337.92 m/s (b) 357.90 m/s

(c) 318.90 m/s (d) 409.80 m/s

Q 10. In a resonance pipe the first and second resonance are obtained at depths 22.7 cm and 70.2 cm respectively. What will be the end correction?

(a) 1.05 cm (b) 0.15 cm

(c) 115.5 cm (d) 92.5 cm

Q 11. An open tube is in resonance (fundamental frequency) with string (frequency of vibration of tube is n_o). If tube is dipped in water so that 75% of length of tube is inside water, then the ratio of the new fundamental frequency of tube to string now will be

(a) 1 (b) 2

(c) $\frac{2}{3}$ (d) $\frac{3}{2}$

Q 12. An organ pipe P_1 closed at one end and vibrating in its first overtone pipe P_2 open at booth ends vibrating in its third overtone are in resonance with a given tuning fork. The ratio of the lengths of P_1 to that of P_2 is

(a) $\frac{3}{8}$ (b) $\frac{1}{3}$

(c) $\frac{1}{2}$ (d) $\frac{8}{3}$

Q 13. 5 beats / second are heard when a tuning fork is sounded with a sonometer wire under tension when the length of the sonometer wire is either 0.95 m or 1 m The frequency of the fork will be :

(a) 251 Hz (b) 150 Hz

(c) 300 Hz (d) 195 Hz

Q 14. A tuning fork vibrating with a sonometer having 20 cm wire produces 5 beats per second. The beat frequency does not change if the length of the wire is changed to 21 cm. The frequency of the tuning fork (in Hertz) must be

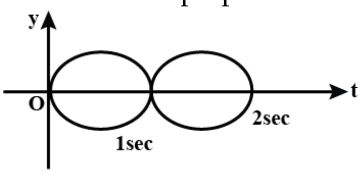
(a) 200 (b) 210

(c) 205 (d) 215

Q 15. Two tuning forks A and B vibrating simultaneously produce 5 beats. Frequency of B is 512 Hz. it is seen that of one arm of A is filed, then the number of beats increases. Frequency of A will be
(a) 502 Hz (b) 507 Hz
(c) 517 Hz (d) 522 Hz

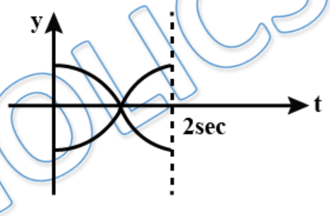
Q 16. A tuning fork gives 5 beats with another tuning fork of frequency 100 Hz. When the first tuning fork is loaded with wax, then the number of beats remains unchanged, then what will be the frequency of the first tuning fork
(a) 95 Hz (b) 100 Hz
(c) 105 Hz (d) 110 Hz

Q 17. Two sound sources of frequency 9Hz and 11Hz are sounded together then which plot is correct after superposition of sound waves.

(a) 

(b) 

(c) 

(d) 

Q 18. On producing the waves of frequency 1000 Hz in a Kundt's tube the total distance between 6 successive nodes is 85 cm. Speed of sound in the gas filled in the tube is
(a) 330 m/s (b) 340 m/s
(c) 350 m/s (d) 300 m/s

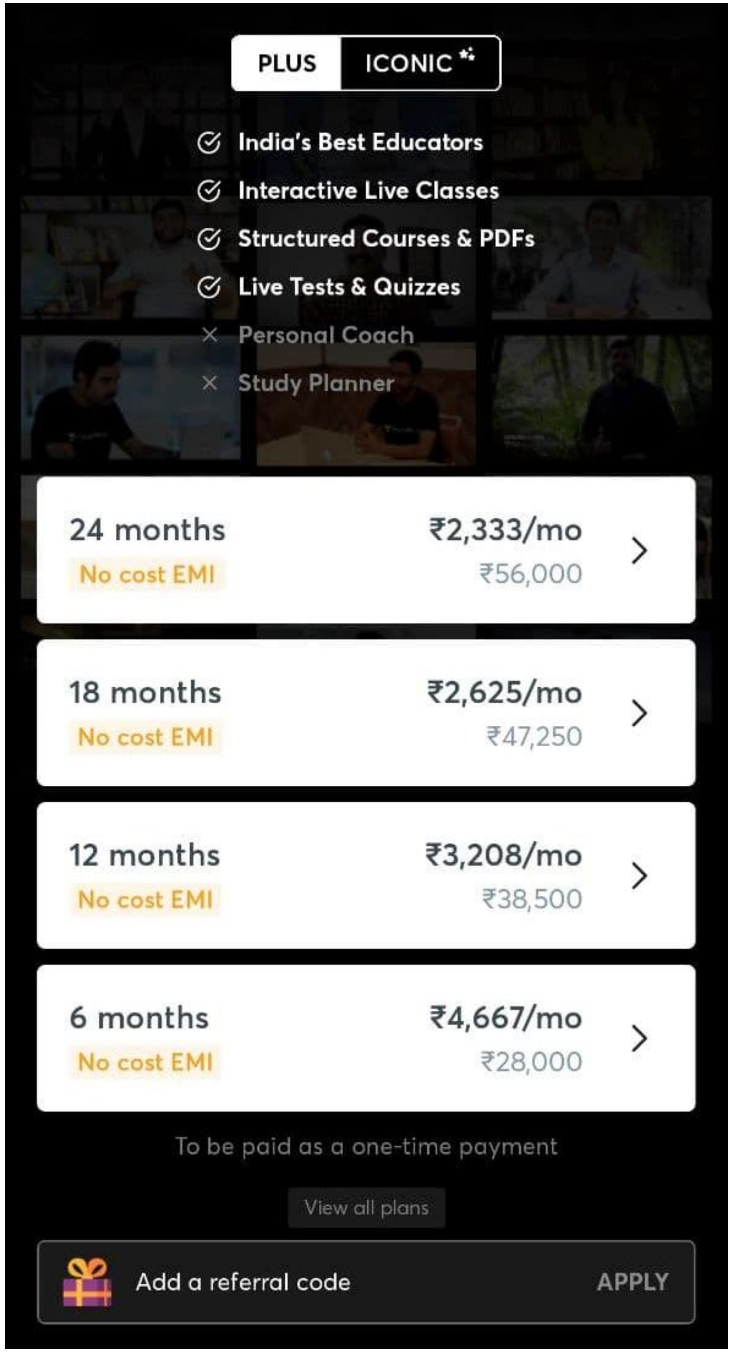
Q 19. Two tuning forks have frequencies 380 and 384 Hz respectively. When they are sounded together they produce 4 beats. After hearing the maximum sound how long will it take to hear the minimum sound
(a) $\frac{1}{2}$ sec (b) $\frac{1}{4}$ sec
(c) $\frac{1}{8}$ sec (d) $\frac{1}{16}$ sec

Q 20. The displacement at a point due to two waves are given by $y_1 = 2\sin(50\pi t)$ and $y_2 = 3\sin(58\pi t)$ number of beats produced per second is
(a) 8 (b) 4
(c) 58 (d) 50

Physicsaholics

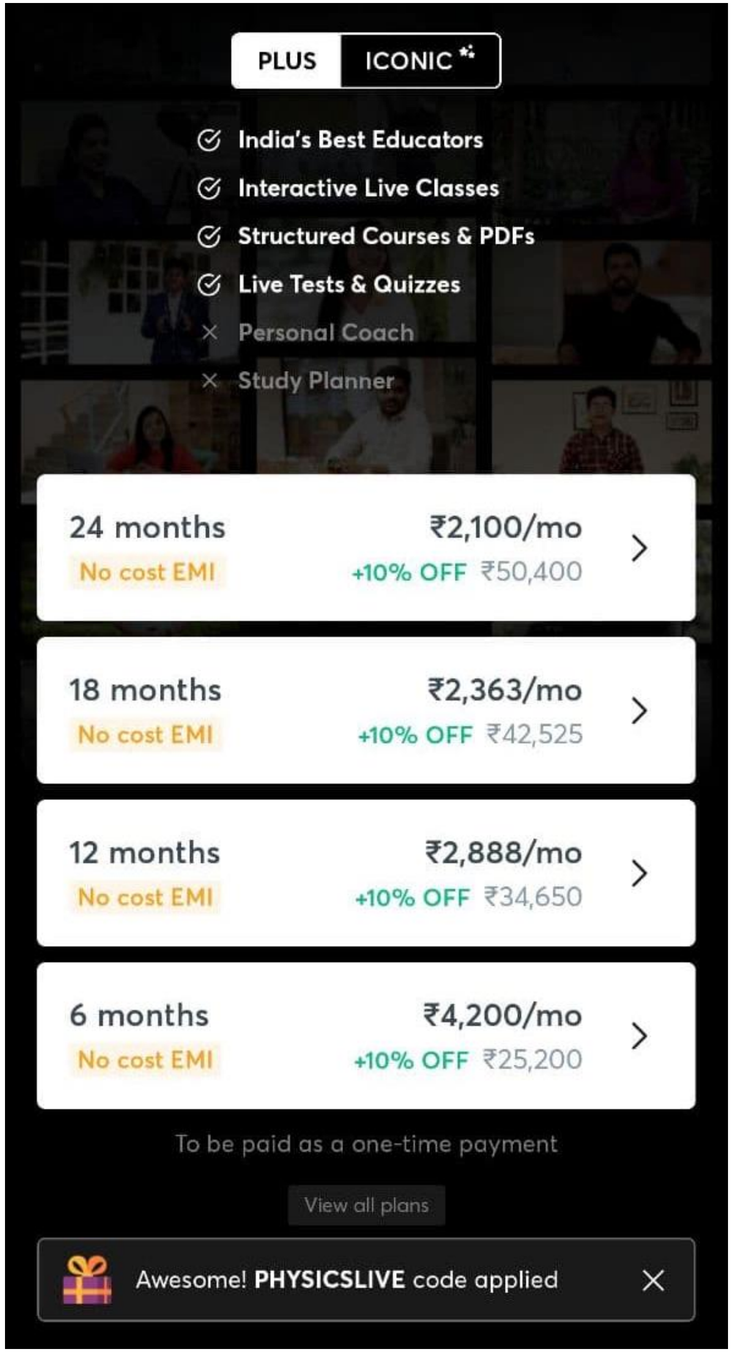
Answer Key

Q.1 a	Q.2 d	Q.3 a	Q.4 b	Q.5 b
Q.6 a	Q.7 c	Q.8 b	Q.9 a	Q.10 a
Q.11 b	Q.12 a	Q.13 d	Q.14 c	Q.15 c
Q.16 c	Q.17 b	Q.18 b	Q.19 c	Q.20 b



PHYSICSLIVE

Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS.



Written Solution

DPP-3 Sound Waves: Standing Sound Waves and Beats

By Physicsaholics Team

Solution: 1

tube is closed at one end

so; $f = (2n+1)\frac{v}{4l}$

fundamental frequency $(n=0)$

$f_0 = \frac{v}{4l} = 512\ Hz$ — (1)

when this tube is open at both ends

means; $l' = l$

$f_0' = \frac{v}{2l}$ — (2)

$\frac{(1)}{(2)} \Rightarrow \frac{f_0}{f_0'} = \frac{v/4l}{v/2l} = \frac{1}{2}$

$f_0' = 2 f_0$

$f_0 = 512\ Hz$

$\boxed{f_0' = 1024\ Hz}$ Ans

Ans. a

Solution: 2

for closed organ pipe

$$f = (2n+1)\frac{v}{4l}$$

1st overtone = 3rd harmonic = second mod

so; $f = (2\times1+1)\frac{v}{4l}$

$$f = \frac{3v}{4l}$$

$l = 33$ cm.

for open organ pipe

$$f' = \frac{nv}{2l'}$$

1st overtune = 2nd harmonic

so, $f' = \frac{2v}{2l'} = \frac{v}{l'}$

$f = f'$

$$\frac{3v}{4l} = \frac{v}{l'}$$

$$l' = \frac{4l}{3} = \frac{4}{3}\times 33$$

$$\boxed{l' = 44\text{ cm}}$$ Ans

Ans. d

Solution: 3

⇒ for closed pipe

$l_1 = 20$ cm

$f = (2n+1)\frac{V}{4l}$

fundamental frequency (n=0)

$f_1 = \frac{V}{4l_1}$

⇒ for open pipe

$l_2 = ?$

$f = \frac{nV}{2l}$

2^{nd} overtune = 3^{rd} harmonic

$f_2 = \frac{3V}{2l_2}$

given; $f_1 = f_2$

$\frac{V}{{}_2 4 l_1} = \frac{3V}{2l_2}$

$l_2 = 6l_1$

$l_2 = 6 \times 20$

$l_2 = 120$ cm Ans.

Ans. a

Solution: 4

for closed organ pipe

$$f = (2n+1)\frac{v}{4l}$$

f for 2^{nd} note; $n=1$

$$f = (2\times1+1)\frac{v}{4l}$$

$$= \frac{3v}{4l}$$

$$f = \frac{3\times330}{4\times1}$$

$$\boxed{f = \frac{3\times330}{4}}\ Hz \quad \text{Ans}$$

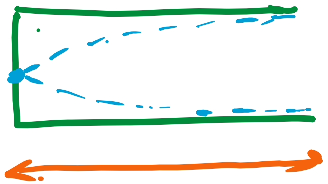
Ans. b

Solution: 5

at resonance

frequency of air column = frequency of fork

$f = 512\ Hz$



$l = \lambda/4$

$\lambda = 4l = 4 \times 17.4\ cm$

$\lambda = 69.6\ cm$

$v = f\lambda$

$v = 512 \times (69.6 \times 10^{-2})$

$v = 512 \times 0.696$

$v = 356.352$

$v \approx 356\ m/s$ Ans

Ans. b

Solution: 6

$f = 256$ Hz

$l_1 = 33.4$ cm

$l_2 = 101.8$ cm

Let end correction $= e$

so; $l_1 + e = \lambda/4$ —— (1)

& $l_2 + e = 3\lambda/4$ —— (2)

$3\times(1) - (2) \Rightarrow 3[l_1 + e] - [l_2 + e] = 3\left(\frac{\lambda}{4}\right) - \frac{3\lambda}{4}$

$3l_1 + 3e - l_2 - e = 0$

$2e = l_2 - 3l_1$

$$\boxed{e = \frac{l_2 - 3l_1}{2}}$$

so; $e = \frac{101.8\text{ cm} - 3(33.4\text{ cm})}{2}$

$e = \frac{1.6}{2}$ cm

$\boxed{e = 0.8\text{ cm}}$ Ans

Ans. a

Solution: 7

$f = 480\ Hz$

$l_1 = 16 cm = 0.16\ m$

$r = \frac{d}{2} = \frac{5}{2} = 2.5 cm$

$e = 0.6r = 0.6 \times 2.5 = 1.5\ cm$

$e = 0.015\ m$

$\because e = \frac{l_2 - 3l_1}{2}$

so, $0.015 = \frac{l_2 - 3(0.16)}{2}$

$l_2 = 0.03 + 0.48$

$l_2 = 0.51\ m$ or 53 cm

so, speed of sound in air

$V = 2(l_2 - l_1) f$

$= 2(0.51 - 0.16) \times 480$

$V = 336\ m/s$ Ans

Ans. c

Solution: 8

∵ $f_1 = 320\ Hz$

$f_2 = 320.1\ Hz$

so; Beat frequency $= \Delta f$

$\Delta f = f_2 - f_1 = 320.1 - 320.0$

$\Delta f = 0.1\ Hz$

or 0.1 beats per sec.

so; no. of beats heard in 1 sec = 0.1

so; no. of beats heard in 1 min or 60 sec will be $= 0.1 \times 60$

$= 6$ beats.

Ans

Ans. b

Solution: 9

⇒ closed air column

$l_1 = 32\ cm = 0.32 m$

$$f = (2n+1)\frac{v}{4l}$$

fundamental frequency

$$f_1 = \frac{v}{4l_1}$$

⇒ open air column

$l_2 = 66\ cm = 0.66 m$

$$f_2 = \frac{nv}{2l_2}$$

fundamental frequency

$$f_2 = \frac{v}{2l_2}$$

given; beat frequency = 8 beats/s

so; $\Delta f = 8$

$$f_1 - f_2 = 8$$

$$\frac{v}{4l_1} - \frac{v}{2l_2} = 8$$

$$\frac{v}{2}\left(\frac{1}{2l_1} - \frac{1}{l_2}\right) = 8$$

$$\Rightarrow \frac{v}{2}\left(\frac{l_2 - 2l_1}{2l_1 l_2}\right) = 8 \Rightarrow v = \frac{32 l_1 l_2}{l_2 - 2l_1}$$

$$v = \frac{32(0.32 \times 0.66)}{0.66 - 2(0.32)} = \frac{32 \times 32 \times 66 \times 10^{-4}}{0.66 - 0.64}$$

$$= \frac{32 \times 32 \times 66 \times 10^{-4}}{0.02} = 337.92\ m/s$$

$$\boxed{v = 33792\ cm/s}$$ Ans.

Ans. a

Solution: 10

$$e = \frac{l_2 - 3l_1}{2}$$

$$e = \frac{70.2 - 3(22.7)}{2}$$

$$= \frac{70.2 - 68.1}{2}$$

$$e = \frac{2.1}{2}$$

$$e = 1.05 \text{ cm}$$ Ans

Ans. a

Solution: 11

Let initial length of open tube = L

so; fundamental frequency; $f = \frac{V}{2L} = n_0$ [given] —(1)

Now 75% is dipped in water

so; effective remaining length = 25% of $L = \frac{L}{4}$

& one end is closed.

so; new fundamental frequency $f' = \frac{V}{4(L/4)} = (2n+1)\frac{V}{L}$

$f' = \frac{V}{L}$ —(2)

$\frac{(1)}{(2)} \Rightarrow \frac{n_0}{f'} = \frac{V/2L}{V/L} = \frac{1}{2}$

$\Rightarrow \boxed{\frac{f'}{n_0} = \frac{2}{1}}$ Ans.

Ans. b

Solution: 12

P_1, closed at one end

first overtone; $f_1 = \frac{3v}{4l_1}$

P_2, open at both ends

third overtone; $f_2 = \frac{4v}{2l} = \frac{2v}{l_2}$

$\Rightarrow$ $\because$ both are in resonance with same tuning fork

so; they are in resonance.

so; $f_1 = f_2$

$$\frac{3v}{4l_1} = \frac{2v}{l_2}$$

$$\boxed{\frac{l_1}{l_2} = \frac{3}{8}}$$ Ans

Ans. a

Solution: 13

when length $l_1 = 0.95$ m

frequency of sonometer wire $f = \frac{V}{2l}$

so; for $l_1 = 0.95$ m

$$f_1 = \frac{V}{2l_1}$$

for $l_2 = 1$ m

$$f_2 = \frac{V}{2l_2}$$

$\left[\because l_2 > l_1 \text{ so; } f_1 > f_2\right]$

Now let frequency of tuning fork $= f$

and beat frequency $= 5$ beat/s

so; $f_1 - f = 5$

$\Rightarrow f_1 = 5 + f$ —(1)

and $f - f_2 = 5$

$\Rightarrow f_2 = f - 5$ —(2)

so; $\frac{f_1}{f_2} = \frac{5+f}{f-5}$

$$\frac{V/2l_1}{V/2l_2} = \frac{5+f}{f-5} = \frac{l_2}{l_1}$$

$$\frac{5+f}{f-5} = \frac{1}{0.95} = \frac{100}{95}$$

$$475 + 95f = 100f - 500$$

$$975 = 5f \Rightarrow \boxed{f = 195 \text{ Hz}}$$ Ans

Ans. d

Solution: 14

when length $l_1 = 20\,cm$

frequency of sonometer wire $f = \frac{v}{2l}$

so; for $l_1 = 20\,cm$

$$f_1 = \frac{v}{2l_1}$$

for $l_2 = 21\,cm$

$$f_2 = \frac{v}{2l_2} \quad \left[\because l_2 > l_1 \text{ so; } f_1 > f_2\right]$$

Now let frequency of tuning fork $= f$

and beat frequency $= 5$ beat/s

so; $f_1 - f = 5$

$\Rightarrow f_1 = 5 + f$ — (1)

and $f - f_2 = 5$

$\Rightarrow f_2 = f - 5$ — (2)

so; $\frac{f_1}{f_2} = \frac{5+f}{f-5}$

$$\frac{v/2l_1}{v/2l_2} = \frac{5+f}{f-5} = \frac{l_2}{l_1}$$

$$\frac{5+f}{f-5} = \frac{21}{20}$$

$$100 + 20f = 21f - 105$$

$$\boxed{f = 205\ Hz} \text{ Ans.}$$

Ans. c

Solution: 15

$\Delta f = 5$ Hz

$f_B = 512$ Hz

let initially; frequency of 'A' $= f_A$

$\because f = \frac{v}{2l} = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

when fork is filed
$\mu \downarrow \Rightarrow f_A \uparrow$

and given that; $\Delta f \uparrow$

so; Δf can increase.

if $f_A > f_B$

so; $f_A - f_B = 5$

$f_A = f_B + 5$

$f_A = 512 + 5$

$f_A = 517$ Hz Ans

Ans. c

Solution: 16

Let frequency of first tuning fork = f_1

and that of 2^{nd} is = $f_2 = 100$ Hz

$\Delta f = 5$ Hz [given]

when wax is loaded on 1^{st} tuning fork $f_1 \downarrow$

and given that Δf = constant

means; initially $\Rightarrow f_1 > f_2$ & $\Delta f = 5$

finally $\Rightarrow f_2 < f_1'$ & $\Delta f = 5$

so; initially; $\Delta f = f_1 - f_2 = 5$

$f_1 - f_2 = 5$

$f_1 = f_2 + 5$

$f_1 = 100 + 5$

$\boxed{f_1 = 105 \text{ Hz}}$ Ans

Ans. c

Solution: 17

$f_1 = 9$ Hz

$f_2 = 11$ Hz

after superposition;

$\Delta f = 11 - 9$

$\Delta f = 2$ Hz = Beat frequency

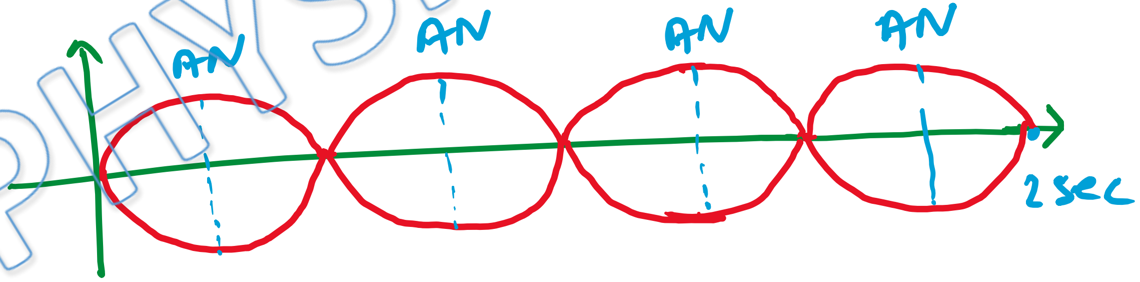
Beat frequency = max. sound frequency = Antinode frequency.

so; if $\Delta f = 2$ Hz → 1 beat in 0.5 sec

$T = \frac{1}{\Delta f} = \frac{1}{2}$ sec or 2 beats in 1 sec

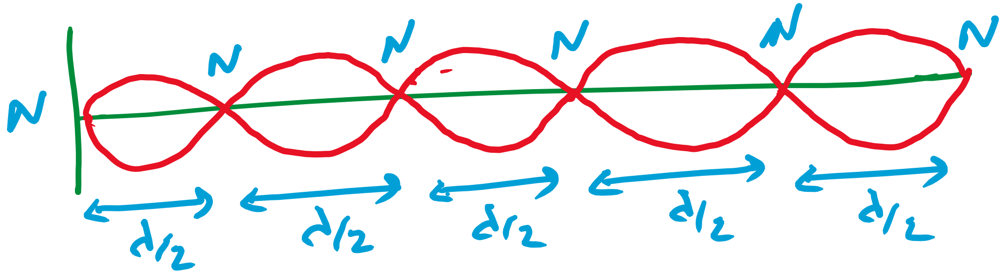
or 4 beats in 2 sec.

so;



Ans. b

Solution: 18



distance btwn two successive Nodes = $\frac{5d}{2}$

so; $\frac{5d}{2} = 85\ \text{cm}$

$d = 2 \times \frac{85}{5} = 2 \times 17$

$\boxed{d = 34\ \text{cm}}$

given; $f = 1000\ \text{Hz}$

so; $v = f d = 1000 \times (34 \times 10^{-2}\ \text{m})$

$\boxed{v = 340\ \text{m/s}}$ Ans

Ans. b

Solution: 19

∵ Beat frequency = 4 Hz

time periods of hearing Beats $= \frac{1}{4}$ sec

∵ Beat means ⇒ max sound.

so; time between two successive max. sound $= \frac{1}{4}$ sec

so; time between two successive max. & min sound $= \frac{1}{2}\left(\frac{1}{4}\text{ sec}\right)$

$= \frac{1}{8}$ sec

Ans

Ans. c

Solution: 20

$y_1 = 2\sin(50\pi t)$

$\omega_1 = 50\pi = 2\pi f_1$

$\Rightarrow f_1 = 25\ Hz$

And; $y_2 = 3\sin(58\pi t)$

$\omega_2 = 58\pi = 2\pi f_2$

$f_2 = 29\ Hz$

So; beat frequency $= \Delta f$

$\Delta f = f_2 - f_1 = 29 - 25$

$\boxed{\Delta f = 4\ Hz}$

or 4 beats per second. Ans

Ans. b

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/95

Video Solution on YouTube:- https://youtu.be/3lGsdJJxYok

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/44

Chalo Niklo