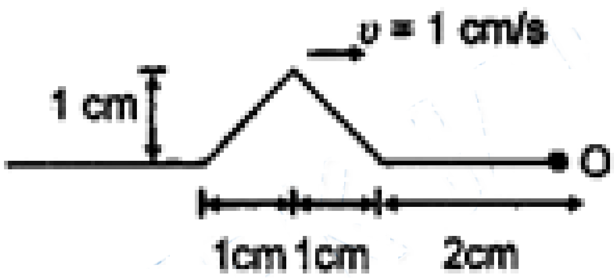
DPP – 3 (Waves)

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/92

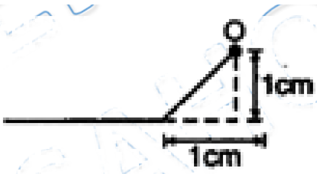
Video Solution on YouTube:- https://youtu.be/4XqLWlnF0jE

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/38

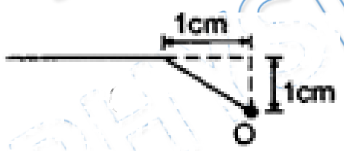
Q 1. A wave pulse on a string has the dimension shown in figure. The wave speed is v = 1 cm/s. If point O is a free end. The shape of wave at time t = 3 s is :



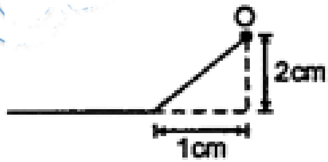
(a)



(b)



(c)



(d)

Q 2. Equations of two progressive waves at a certain point in a medium are given by $y_1 = a \sin(\omega t + \phi_1)$ and $y_2 = a \sin(\omega t + \phi_2)$. If amplitude and time period of resultant wave formed by the superposition of these two waves is same as that of both the waves, then $\phi_1 - \phi_2$ is:

(a) $\frac{\pi}{3}$ (b) $\frac{2\pi}{3}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{4}$

Q 3. Three waveforms travelling along a straight line have the forms: $2A\,sin\left(kx - \omega t + \frac{\pi}{3}\right)$, $\sqrt{3}A\,cos\left(kx - \omega t - \frac{\pi}{3}\right)$, $2\sqrt{3}A\,cos\left(kx - \omega t + \frac{\pi}{3}\right)$ the amplitude of the resulting waveform is

(a) $\left(2 + 3\sqrt{3}A\right)$ (b) $\sqrt{31}A$

(c) $\sqrt{19}A$ (d) $\left(2 - \sqrt{3}A\right)A.$

Q 4. A long wire PQR is made by joining two wires PQ and QR of equal radii. PQ has a length 4.8 m and mass 0.06 kg. QR has length 2.56 m and mass 0.2 kg. The wire PQR is under a tension of 80 N. A sinusoidal wave pulse of amplitude 3.5 cm is sent along the wire PQ from the end P. No power is dissipated during the propagation of wave pulse. Find amplitude (in mm) of reflected pulse from junction Q.

(a) 15 (b) 3.5 (c) 25 (d) 30

Q 5. When a wave pulse travelling in a string is reflected from a rigid wall to which string is tied as shown in figure. For this situation two statements are given below. (1) The reflected pulse will be in same orientation of incident pulse due to a phase change of p radians (2)During reflection the wall exert a force on string in upward direction For the above given two statements choose the correct option given below

(a) Only (1) is true (b) Only (2) is true
(c) Both are true (d) Both are wrong

Q 6. A travelling transverse wave is partly reflected and partly transmitted from joint of two strings. Let a_i, a_r. and a_t be the amplitudes of incident wave, reflected wave and transmitted wave and I_i, I_r and I_t, be the corresponding power. Then choose the correct alternative

(a) $\frac{I_i}{I_r} = \left(\frac{a_i}{a_r}\right)^2$ (b) $\frac{I_i}{I_t} = \left(\frac{a_i}{a_t}\right)^2$
(c) $\frac{I_r}{I_t} = \left(\frac{a_r}{a_t}\right)^2$ (d) All of these

Q 7. Two pulses in a stretched string, whose centres are initially 8 cm apart, are moving towards each other as shown in the figure. The speed of each pulse is 2cm/s. After 2 s the total energy of the pulses will be

(a) zero
(b) purely kinetic
(c) purely potential
(d) partially kinetic and partially potential

Q 8. A travelling transverse wave has speeds 50 m/s and 200 m/s in two different strings A and B connected with each other. Such a wave incidences from string A to string B. Find the ratio of amplitudes of the reflected and transmitted waves.

(a) $\frac{3}{8}$ (b) $\frac{5}{8}$
(c) $\frac{2}{5}$ (d) $\frac{3}{5}$

Q 9. Two strings A and B are connected together end to end as shown in the figure. The ratio of mass per unit length $\frac{\mu_B}{\mu_A} = 4$. The tension in the string is same. A travelling wave is coming from the string A towards string B. if the fraction of the power of the incident wave that goes in sting B is $\frac{n}{9}$ the value of n is:

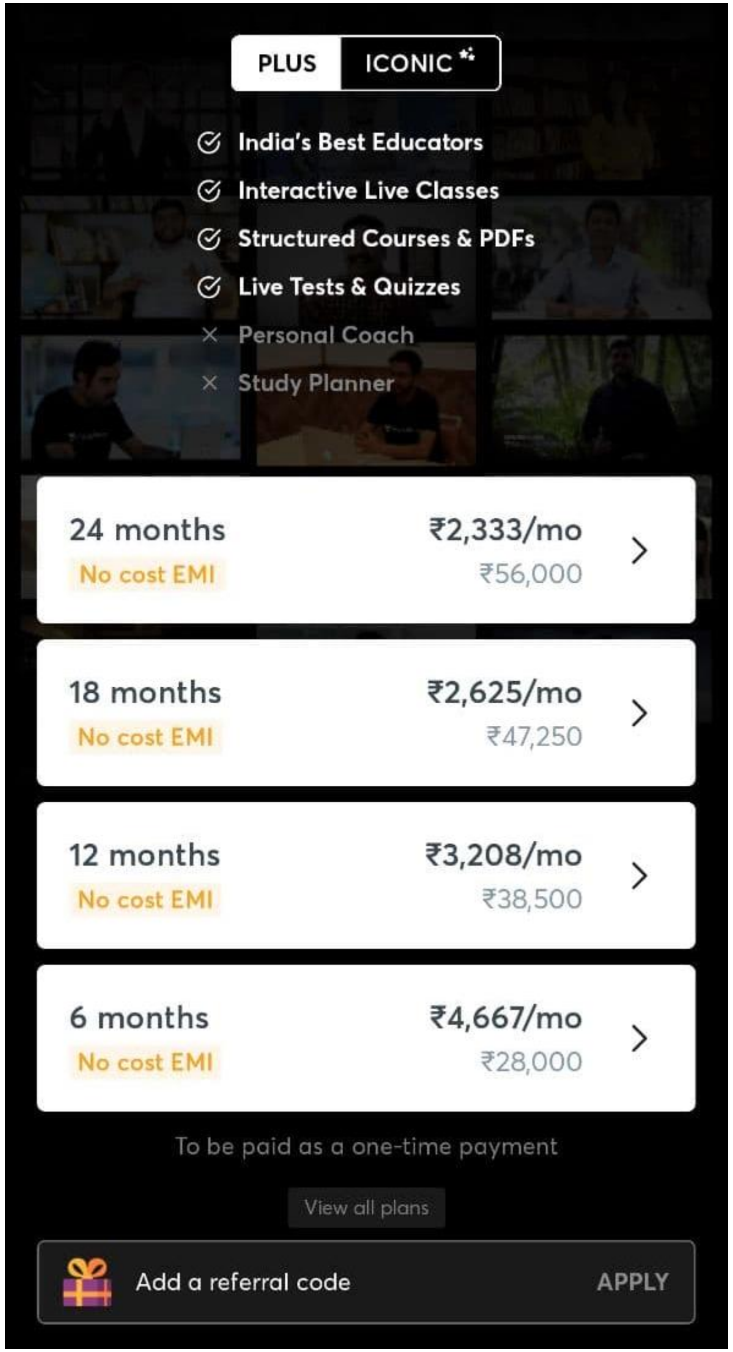
(a) 2 (b) 5 (c) 8 (d) 7

Q 10. Two strings with linear mass densities $\mu_1 = 0.1\ kg/m$ and $\mu_2 = 0.3\ kg/m$ re joined seamlesly. They are under tension of 20N. A travelling wave of triangular shape is moving from lighter to heavier string.
(a) The reflection coefficient at interface is zero
(b) The reflection coefficient at interface is $2 + \sqrt{3}$
(c) The transmission coefficient at interface is 1
(d) The transmission coefficient at interface is $\sqrt{3} - 1$

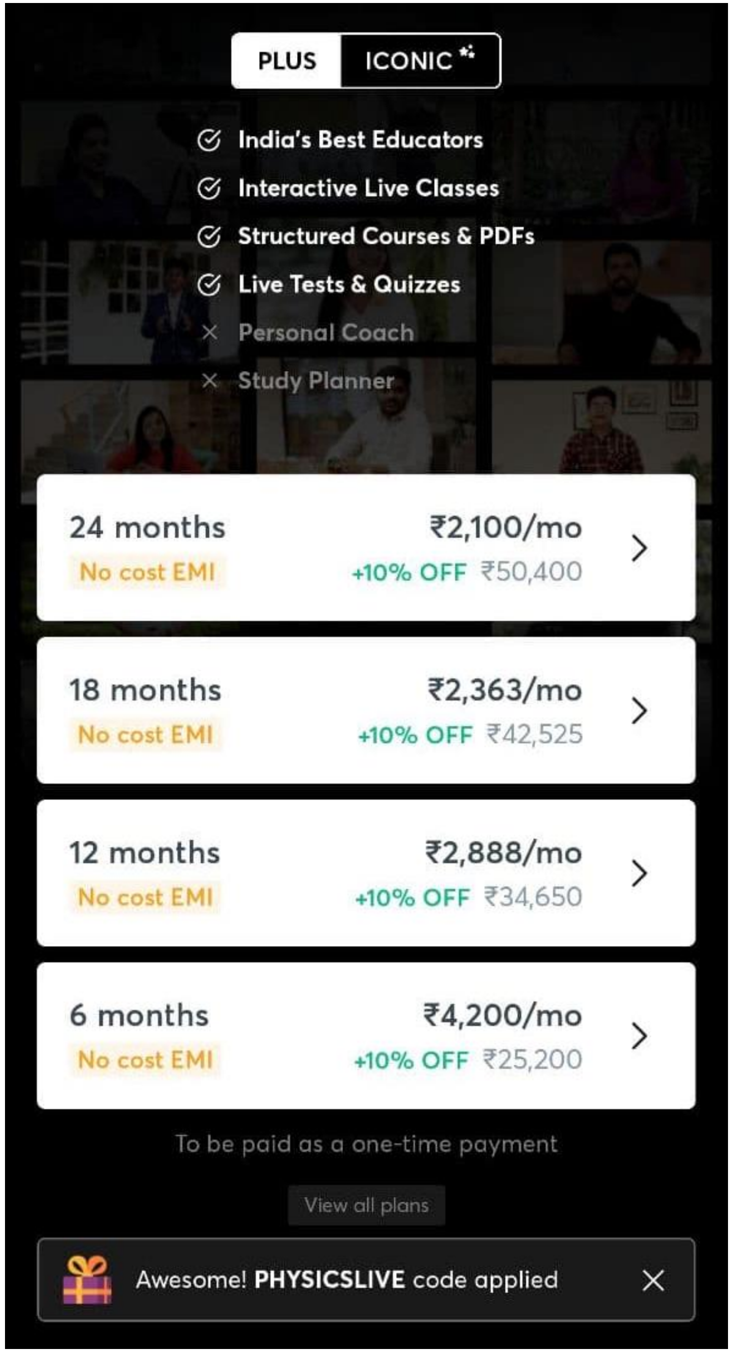
Q 11. If A_i , A_r and A_t are amplitudes of incident wave ,reflected wave and transmitted wave respectively. Then
(a) $A_i + A_r = A_t$
(b) $A_i - A_r = A_t$
(c) $A_i + A_t = A_r$
(d) None of these

Answer Key

Q.1 d	**Q.2 b**	**Q.3 c**	**Q.4 a**	**Q.5 d**
Q.6 a	**Q.7 b**	**Q.8 a**	**Q.9 c**	**Q.10 d**
Q.11 a				



PHYSICSLIVE



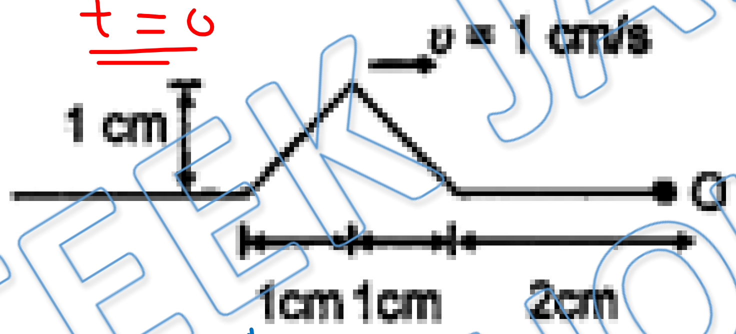
Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS.

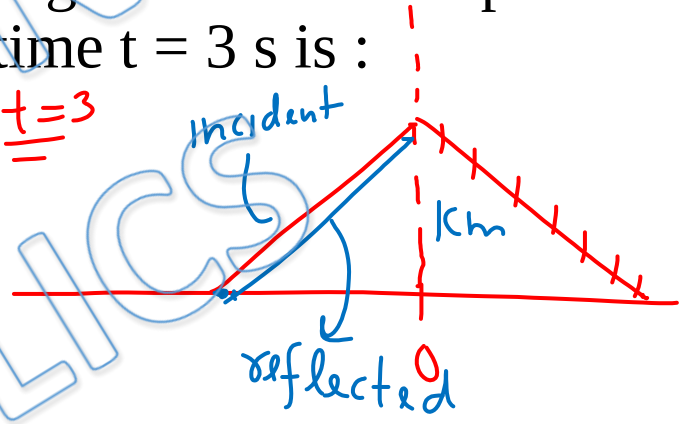
Written Solution

DPP-3 Waves: Superposition of Wave, Reflection & Transmission

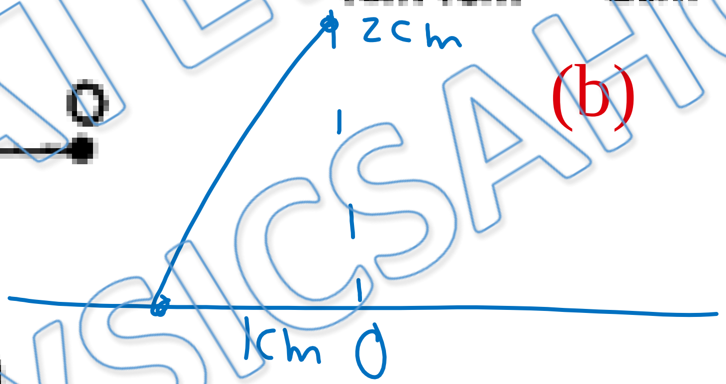
By Physicsaholics Team

Q1) A wave pulse on a string has the dimension shown in figure. The wave speed is v = 1 cm/s. If point O is a free end. The shape of wave at time t = 3 s is :

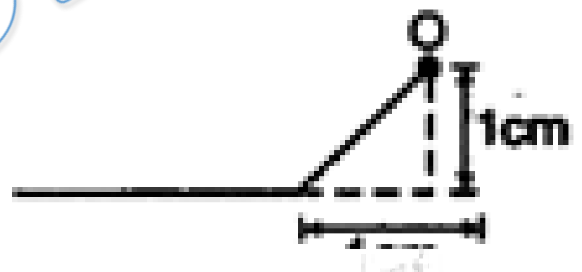




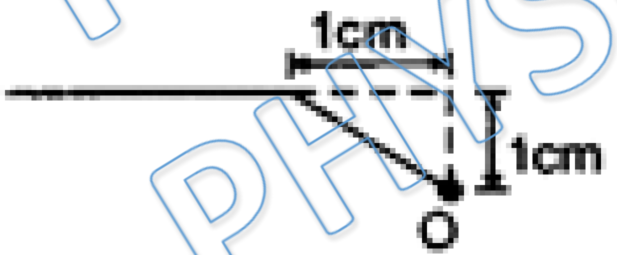
(a)



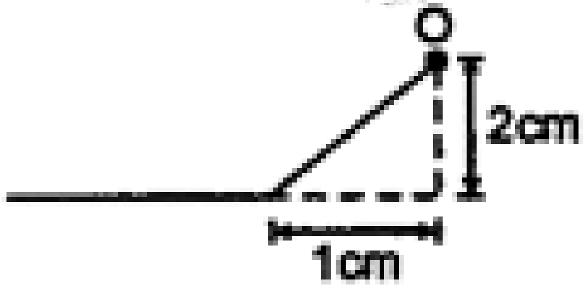
(b)



(c)



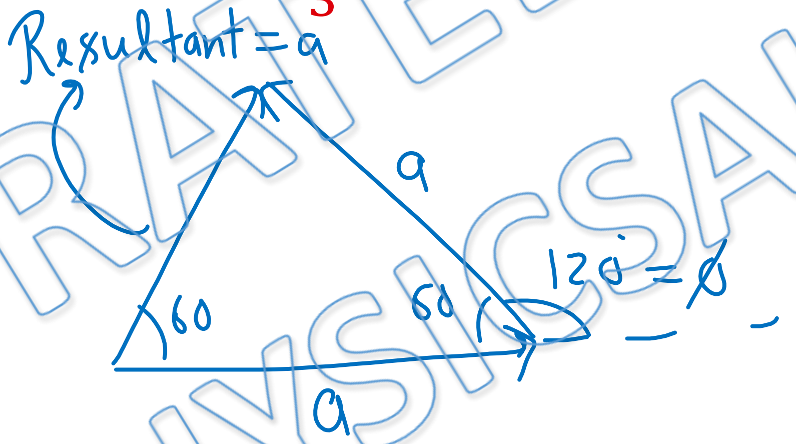
(d)



Q2) Equations of two progressive waves at a certain point in a medium are given by $y_1 = a \sin(\omega t + \phi_1)$ and $y_2 = a \sin(\omega t + \phi_2)$. If amplitude and time period of resultant wave formed by the superposition of these two waves is same as that of both the waves, then $\phi_1 - \phi_2$ is:

$$\phi = (\omega t + \phi_1) - (\omega t + \phi_2) = \phi_1 - \phi_2$$

(a) $\frac{\pi}{3}$ (b) $\frac{2\pi}{3}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{4}$

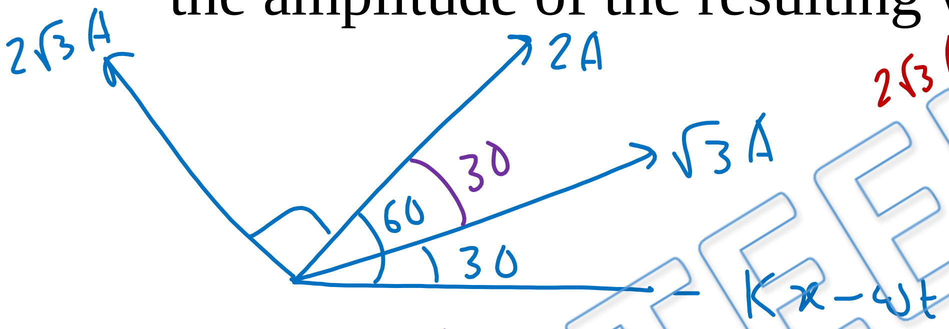


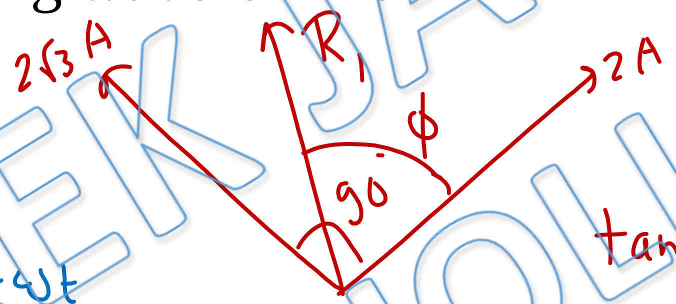
Q3) Three waveforms travelling along a straight line have the forms:

$$2A\sin\left(kx-\omega t+\frac{\pi}{3}\right),\ \sqrt{3}A\cos\left(kx-\omega t-\frac{\pi}{3}\right),\ 2\sqrt{3}A\cos\left(kx-\omega t+\frac{\pi}{3}\right)$$

the amplitude of the resulting waveform is

$\sqrt{3}A\sin\left(kx-\omega t-\frac{\pi}{3}+\frac{\pi}{2}\right)$ $\qquad 2\sqrt{3}A\sin\left(kx-\omega t+\frac{\pi}{2}+\frac{\pi}{3}\right)$





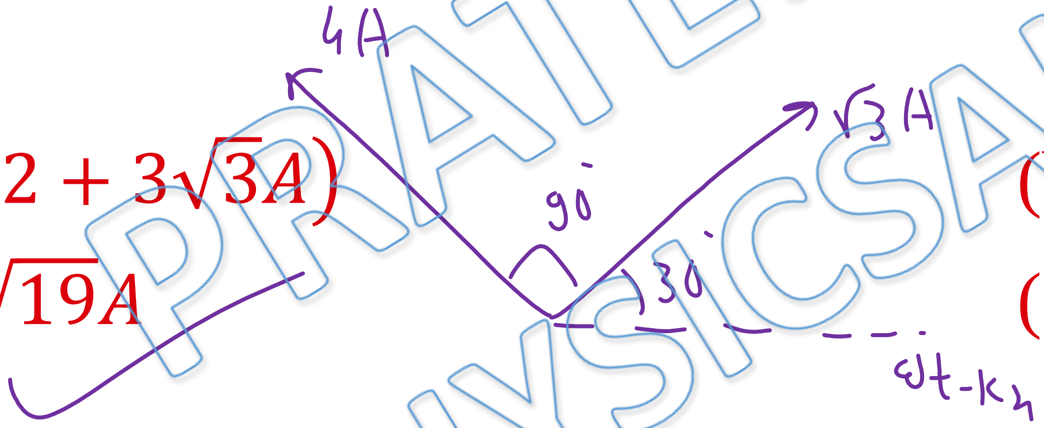
$\tan\phi = \frac{2\sqrt{3}A}{2A} = \sqrt{3}$

$\phi = 60$

(a) $(2+3\sqrt{3}A)$

(b) $\sqrt{31}A$

$R_1 = \sqrt{4A^2+12A^2} = 4A$

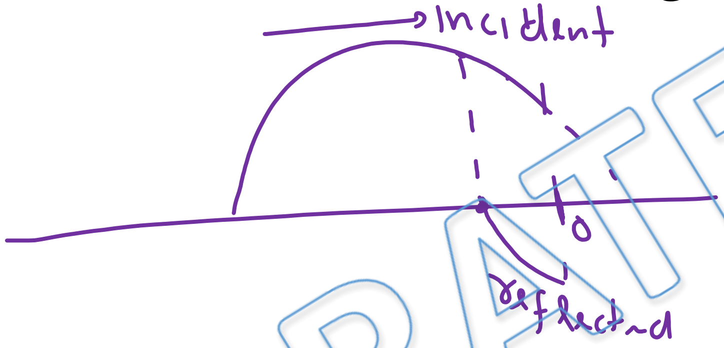


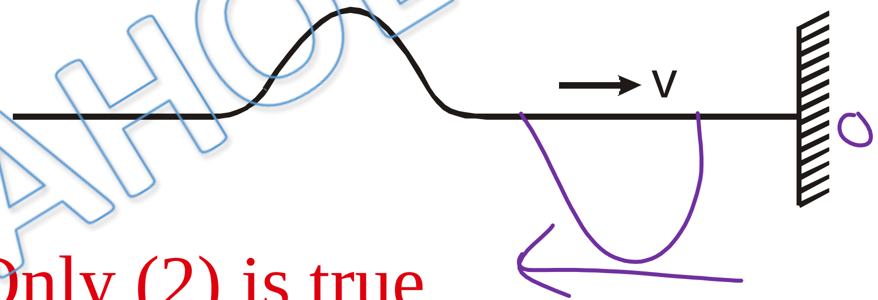
(c) $\sqrt{19}A$

(d) $(2-\sqrt{3}A)A.$

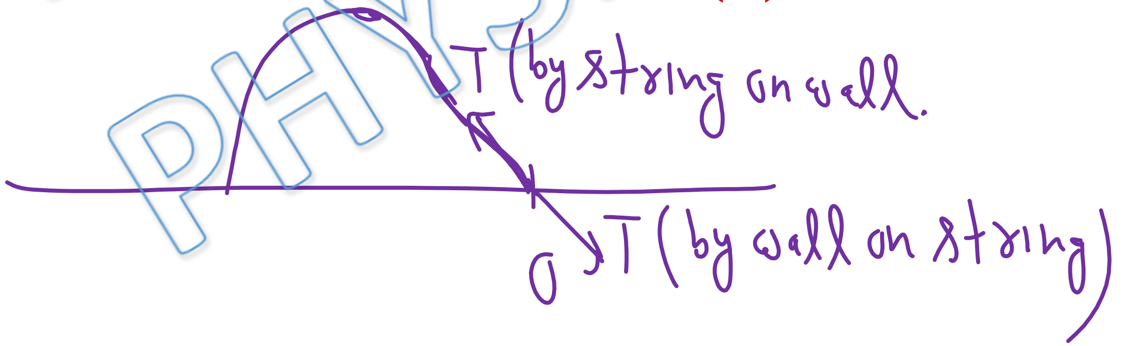
$R = \sqrt{(\sqrt{3}A)^2+(4A)^2} = A\sqrt{19}$

Q5) When a wave pulse travelling in a string is reflected from a rigid wall to which string is tied as shown in figure. For this situation two statements are given below. (1) The reflected pulse will be in same orientation of incident pulse due to a phase change of π radians (2)During reflection the wall exert a force on string in upward direction For the above given two statements choose the correct option given below.

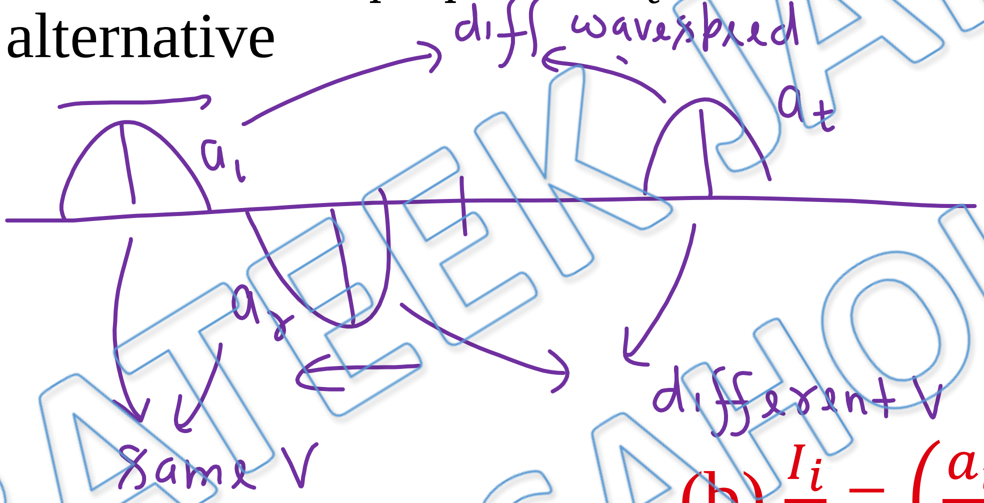




(a) Only (1) is true
(b) Only (2) is true
(c) Both are true
(d) Both are wrong



Q6) A travelling transverse wave is partly reflected and partly transmitted from joint of two strings. Let a_i, a_r. and a_t be the amplitudes of incident wave, reflected wave and transmitted wave and I_i, I_r and I_t, be the corresponding power. Then choose the correct alternative



$$P = \frac{F A^2 \omega^2}{2V}$$

(a) $\frac{I_i}{I_r} = \left(\frac{a_i}{a_r}\right)^2$

(b) $\frac{I_i}{I_t} = \left(\frac{a_i}{a_t}\right)^2$

(c) $\frac{I_r}{I_t} = \left(\frac{a_r}{a_t}\right)^2$

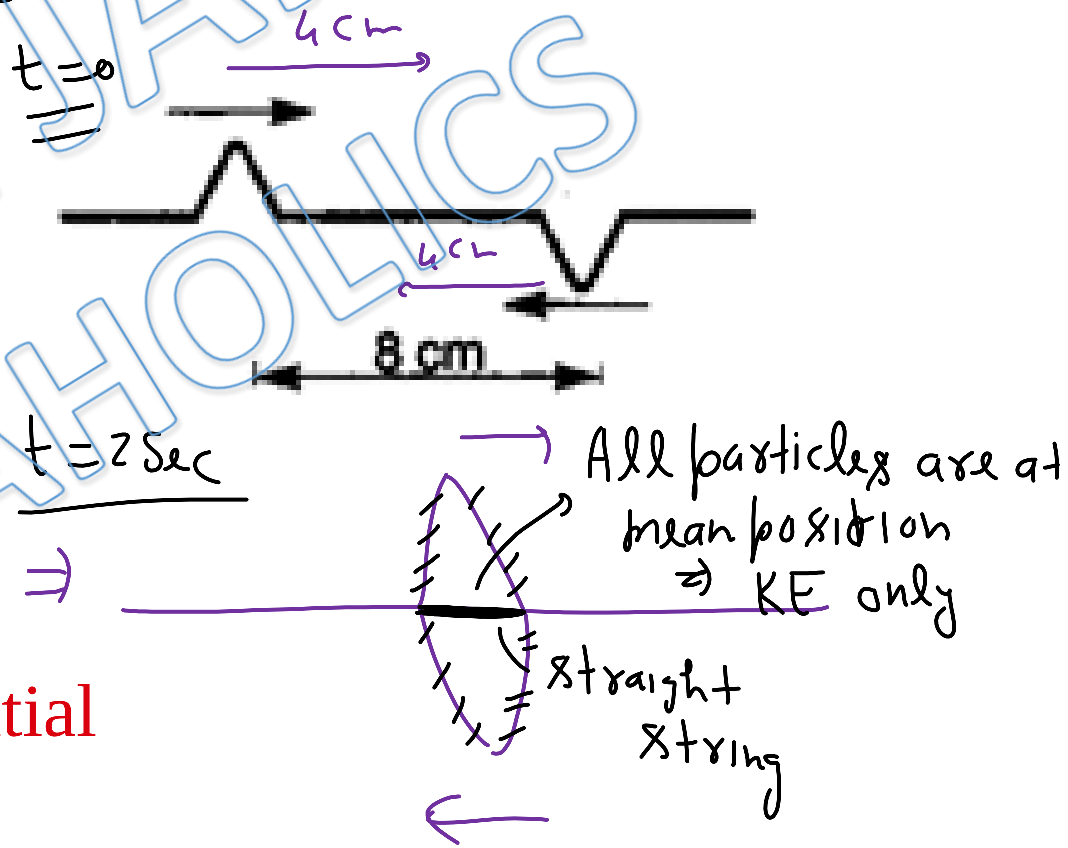
(d) All of these

$$\frac{I_i}{I_r} = \left(\frac{A_i}{A_r}\right)^2$$

$$\frac{I_i}{I_t} = \left(\frac{A_i}{A_r}\right)^2 \left(\frac{V_t}{V_i}\right)^2$$

$$\frac{I_r}{I_t} = \left(\frac{A_r}{A_t}\right)^2 \left(\frac{V_t}{V_r}\right)^2$$

Q7) Two pulses in a stretched string, whose centres are initially 8 cm apart, are moving towards each other as shown in the figure. The speed of each pulse is 2cm/s. After 2 s the total energy of the pulses will be



(a) zero

(b) purely kinetic

(c) purely potential

(d) partially kinetic and partially potential

Q8) A travelling transverse wave has speeds 50 m/s and 200 m/s in two different strings A and B connected with each other. Such a wave incidences from string A to string B. Find the ratio of amplitudes of the reflected and transmitted waves.

(a) $\frac{3}{8}$ (b) $\frac{5}{8}$

(c) $\frac{2}{5}$ (d) $\frac{3}{5}$

$$A_r = \frac{V_2 - V_1}{V_2 + V_1} A_i$$

$$A_t = \frac{2V_2}{V_2 + V_1} A_i$$

$$\frac{A_r}{A_t} = \frac{V_2 - V_1}{2V_2} = \frac{200 - 50}{400}$$

$$= 3/8$$

Q9) Two strings A and B are connected together end to end as shown in the figure. The ratio of mass per unit length $\frac{\mu_B}{\mu_A} = 4$. The tension in the string is same. A travelling wave is coming from the string A towards string B. if the fraction of the power of the incident wave that goes in sting B is $\frac{n}{9}$ the value of n is:

(a) 2
(b) 5
(c) 8
(d) 7

reflected Amplitude

$$A_r = \frac{V_2 - V_1}{V_2 + V_1} A_1 = \frac{\sqrt{\mu_A} - \sqrt{\mu_B}}{\sqrt{\mu_A} + \sqrt{\mu_B}} A = \frac{1 - \sqrt{\frac{\mu_B}{\mu_A}}}{1 + \sqrt{\frac{\mu_B}{\mu_A}}} A$$

$$A_r = \frac{1-2}{1+2} A = -A/3$$

incident

$A \longrightarrow A/3$ (reflected)

$E \longrightarrow E/9$ (reflected)

transmitted $= E - E/9 = 8E/9$

Q10) Two strings with linear mass densities $\mu_1 = 0.1\, kg/m$ and $\mu_2 = 0.3\, kg/m$ re joined seamlesly. They are under tension of 20N. A travelling wave of triangular shape is moving from lighter to heavier string.

$$\frac{V_1}{V_2} = \sqrt{\frac{\mu_2}{\mu_1}} = \sqrt{\frac{.3}{.1}} = \sqrt{3}$$

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

(a) The reflection coefficient at interface is zero

(b) The reflection coefficient at interface is $2 + \sqrt{3}$

(c) The transmission coefficient at interface is 1

(d) The transmission coefficient at interface is $\sqrt{3} - 1$

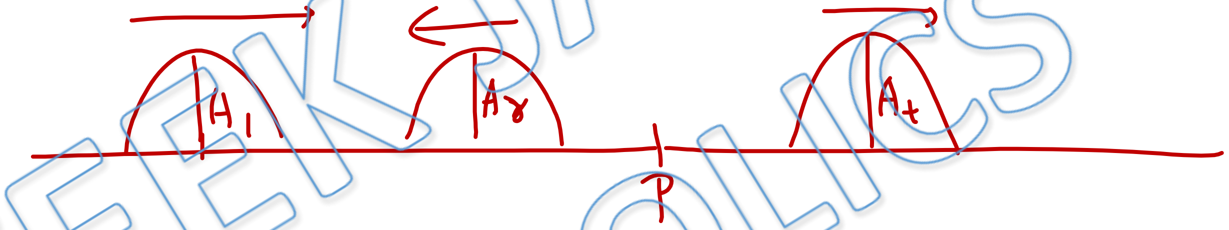
reflection Coefficient

$$= \left|\frac{V_2 - V_1}{V_2 + V_1}\right| = \left|\frac{1 - V_1/V_2}{1 + V_1/V_2}\right| = \frac{\sqrt{3} - 1}{\sqrt{3} + 1} \times \frac{\sqrt{3} - 1}{\sqrt{3} - 1} = \frac{3 + 1 - 2\sqrt{3}}{2} = \frac{4 - 2\sqrt{3}}{2} = 2 - \sqrt{3}$$

$$A_t = \frac{2V_2}{V_2 + V_1} A_i = \frac{2}{1 + V_1/V_2} A_i$$

Trans Coff $= \dfrac{2}{1 + \sqrt{3}} \times \dfrac{\sqrt{3} - 1}{\sqrt{3} - 1} = \dfrac{2(\sqrt{3} - 1)}{3 - 1}$

Q11) If A_i , A_r and A_t are amplitudes of incident wave ,reflected wave and transmitted wave respectively. Then



(a) $A_i + A_r = A_t$ ✓

(b) A_i - A_r = A_t

(c) $A_i + A_t = A_r$

(d) None of these

when amplitude of incident reaches to P

There is only one wave right to P

but there are two waves left to P

$$\underbrace{A_i + A_r}_{\text{Displacement of particle just left to P}} = A_t$$

A_t → Displacement of particle just right to P

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/92

Video Solution on YouTube:- https://youtu.be/4XqLWlnF0jE

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/38

Chalo Niklo