Physicsaholics

DPP – 1 (Waves)

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

Video Solution on YouTube:- https://youtu.be/APC3Mcm8SF0

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

Q 1. A harmonic wave is travelling on a stretched string. At any particular instant, the smallest distance between two particles having same displacement equal to half of amplitude is 4 cm. Find smallest separation between two particles which have same values of displacement equal to amplitude

(a) 4 cm (b)12 cm (c) 24 cm (d)8 cm

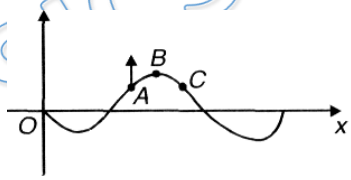
Q 2. Two corks are 10 m apart in a lake. Each goes up and down with period 5 s. And it is observed that when one is at its highest point, other one is at lowest point. The possible speed of wave is

(a) 2.5 m/s (b)5 m/s (c) 40 m/s (d)4 m/s

Q 3. If maximum speed of particle in a medium carrying a travelling wave is V_0, then find speed of particle when its displacement is half of maximum value

(a) $\frac{V_0}{2}$ (b) $\sqrt{3}\frac{V_0}{4}$ (c) $\sqrt{3}\frac{V_0}{2}$ (d) V_0

Q 4. At any instant, wave travelling along a string is shown in figure. Here point A is moving upwards. Which of following statement is true?



(a)Wave is travelling to right

(b)Displacement amplitude of wave is equal to displacement of B at this instant

(c)At this instant C also directed upward

(d)None of these

Q 5. The amplitude of wave disturbance propagating in positive x-axis is given by $y = \frac{1}{1+x^2}$ at t = 0 and $y = \frac{1}{1+(x-1)^2}$ at t = 2s, where x and y are in metres. The shape of the disturbance does not change during the propagation. The velocity of the wave is:

(a) 1 m/s (b) 0.5 m/s (c) 2 m/s (d) 4 m/s

Q 6. Which of the following functions of x and t represents a progressive wave

(a) y = sin (4t – 3x) (b) $y = \frac{1}{4+(4t+3x)^2}$

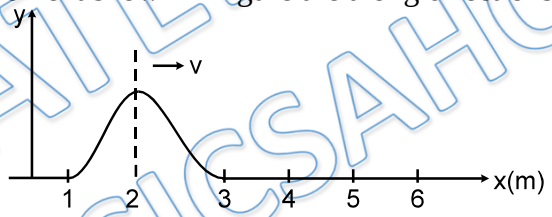
(c) $y = \frac{1}{4t+3x}$ (d) all of these

Q 7. $Y(x,t) = \frac{0.8}{[(4x-5t)^2+5]}$ represents a moving pulse where x and y are in metres and tin second. Then:
(a) pulse is moving in positive x-direction
(b) in 2 s it will travel a distance of 2.5 m
(c) its maximum displacement is 0.16 m
(d) it is a symmetric pulse

Q 8. A wave pulse moving in the positive x-direction along the x-axis is represented by the wavefunction y (x, t) = $\frac{2.0}{(x-3.0t)^2+1}$, where x and y are in centimeters and t is in seconds. Then
(a) The speed of particle at time t = 1 sec. and x = 3cm is zero.
(b) The speed of particle at time t = 1 sec. and x = 3cm is 2 cm/s.
(c) The speed of the pulse is 3.0 cm/s
(d) The speed of the pulse is 0.33 cm/s

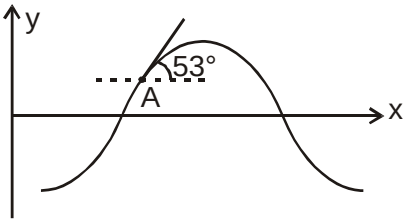
Q 9. The equation of a practical travelling wave is /are
(a) A tan (wt - kx)
(b) A $\sin^2$ (wt - kx)
(c) A sin(wt - kx) cos(wt - kx)
(d) none

Q 10. Wave pulse on a string shown in figure is moving to the right without changing shape. Consider two particles at positions x_1 = 1.5 m and x_2 = 2.5 m. Their transverse velocities at the moment shown in figure are along directions:



(a) positive y–axis and positive y–axis respectively
(b) negative y–axis and positive y–axis respectively
(c) positive y–axis and negative y–axis respectively
(d) negative y–axis and negative y–axis respectively

Q 11. y-x curve at an instant for a wave travelling along x axis on a string is shown. Slope at the point A on the curve, as shown, is 53°.



(a) Transverse velocity of the particle at point A is positive if the wave is travelling along positive x axis.
(b) Transverse velocity of the particle at point A is positive if the wave is travelling along negative x axis of the particle at point A
(c) Magnitude of transverse velocity of the particle at point A is greater than wave speed.

(d) Magnitude of transverse velocity of the particle at point A is lesser than wave speed.

Comprehension (Q 12. TO Q 14.)

A pulse is started at a time t = 0 along the +x direction with speed 10 m/sec on a long, taut string. The shape of the pulse at t = 0 is given by function f(x) with

$$f(x)=\begin{cases}\frac{x}{4}+1 & \text{for} \quad -4<x\le 0\\ -x+1 & \text{for} \quad 0<x<1\\ 0 & \text{otherwise}\end{cases}$$

here f and x are in centimeter

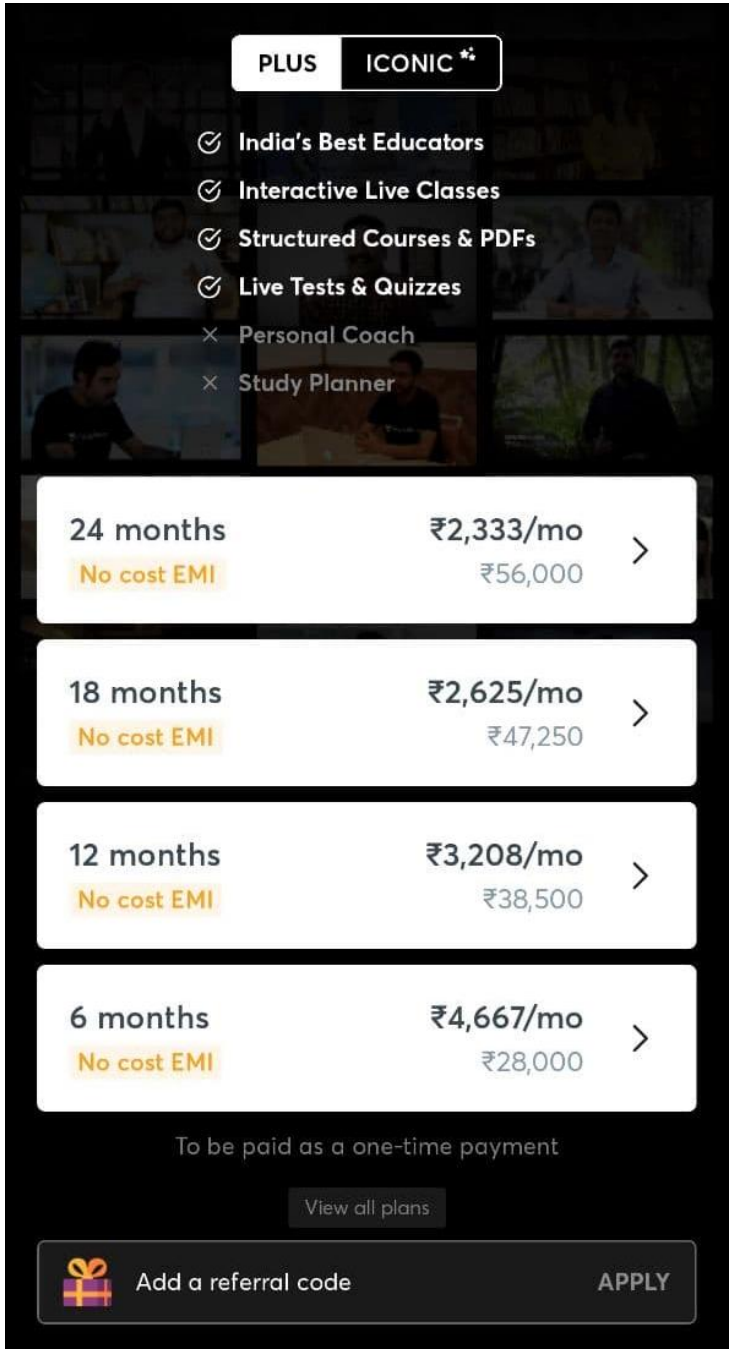
Q 12. The shape of the string is drawn at t = 0 and the area of the pulse enclosed by the string and the x-axis is measured. It will be equal to
(a) 2 cm^2 (b) 2.5 cm^2 (c) 4 cm^2 (d) 5 cm^2

Q 13. The vertical displacement of the particle of the string at x = 7 cm and t = 0.01 s will be
(a) 0.75 cm (b) 0.5 cm (c) 0.25 cm (d) zero

Q 14. The transverse velocity of the particle at x = 13 cm and t = 0.015 s will be
(a) –250 cm/s (b) –500 cm/s
(c) 500 cm/s (d) –1000 cm/s

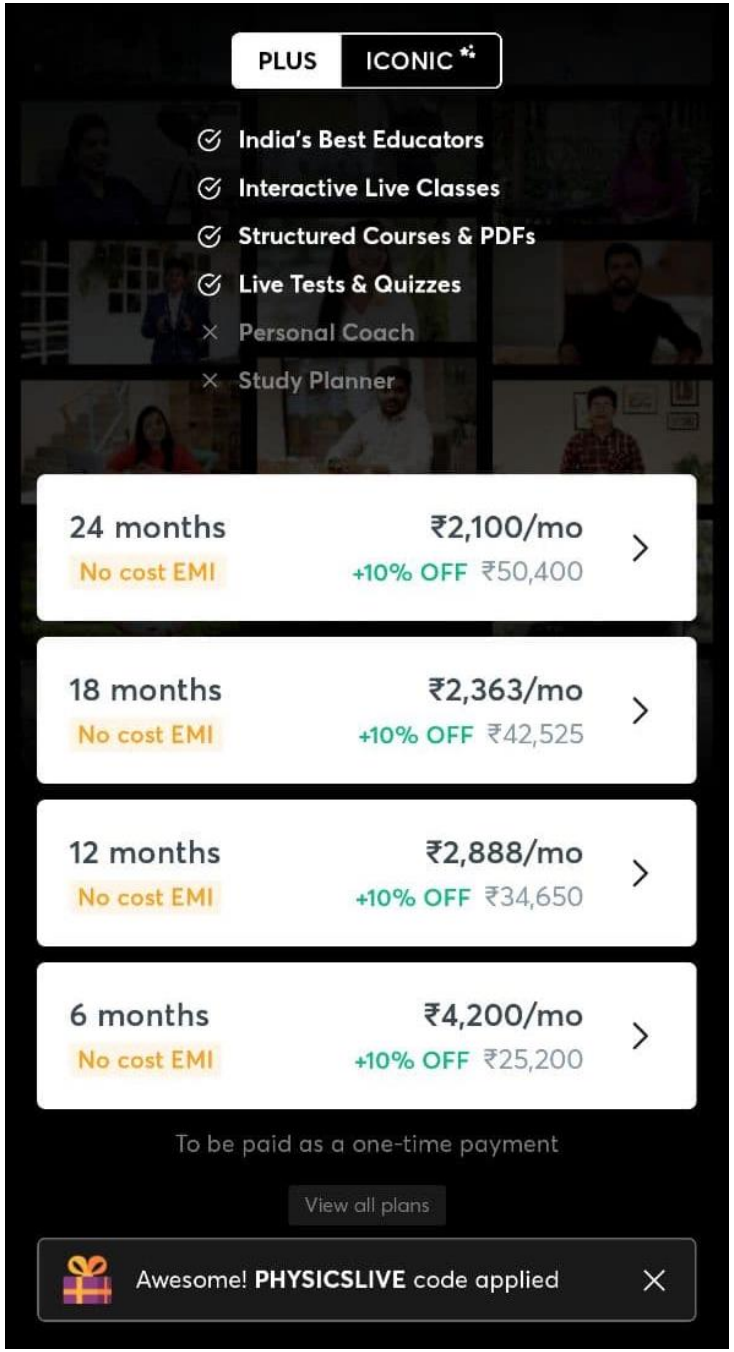
Answer Key

Q.1 b	**Q.2 d**	**Q.3 c**	**Q.4 b**	**Q.5 b**
Q.6 a, b	**Q.7 a, b, c, d**	**Q.8 a,c**	**Q.9 b,c**	**Q.10 b**
Q.11 b, c	**Q.12 b**	**Q.13 c**	**Q.14 a**	



PHYSICSLIVE

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

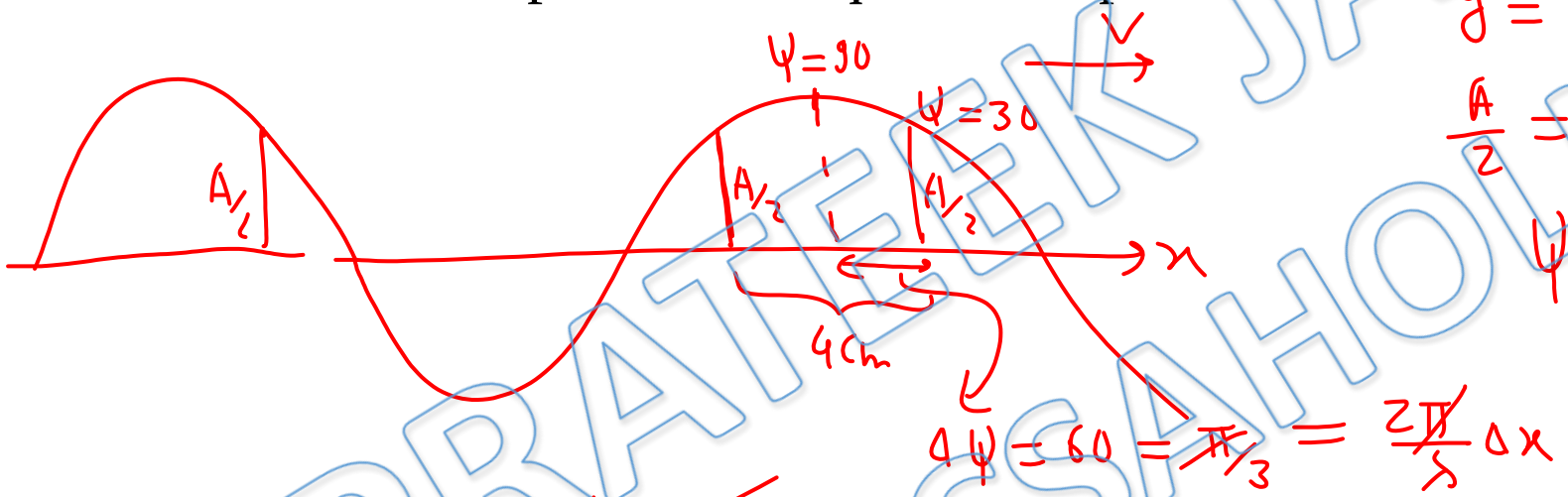


Written Solution

DPP-1 Waves: Equation of travelling Wave and Wave & Particle Velocity

By Physicsaholics Team

Q1) A harmonic wave is travelling on a stretched string. At any particular instant, the smallest distance between two particles having same displacement equal to half of amplitude is 4 cm. Find smallest separation between two particles which have same values of displacement equal to amplitude



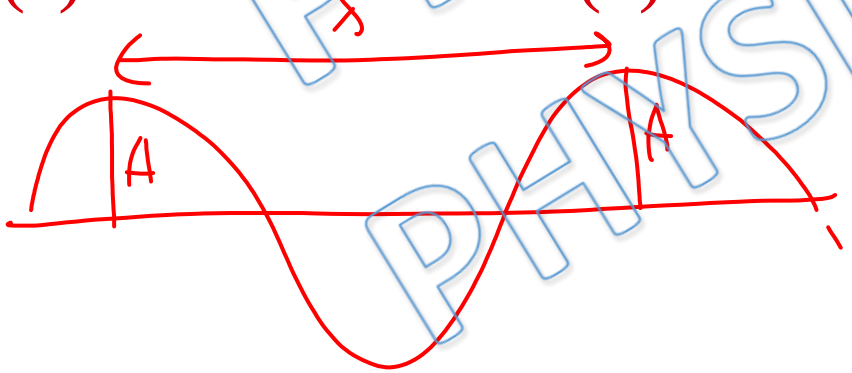
$y = A\sin\psi$

$\frac{A}{2} = A\sin\psi \Rightarrow \sin\psi = \frac{1}{2}$

$\psi = 30^\circ, 150^\circ,$

$\Delta\psi = 60 = \pi/3 = \frac{2\pi}{\lambda}\Delta x$

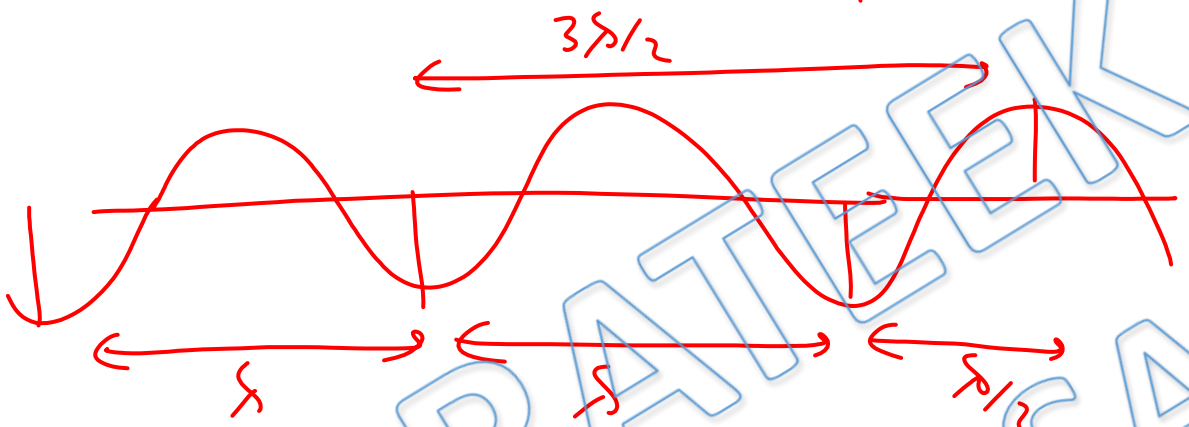
(a) 4 cm (b)12 cm (c) 24 cm (d)8 cm



$\frac{1}{3} = \frac{2\times 2}{\lambda}$

$\lambda = 12\text{cm}$

Q2) Two corks are 10 m apart in a lake. Each goes up and down with period 5 s. And it is observed that when one is at its highest point, other one is at lowest point. The possible speed of wave is



$T = 5\ Sec$

distance b/w particles $= (2n+1)\lambda/2 = 10$

$\lambda = \frac{20}{2n+1}$

$T = 5$

(a) 2.5 m/s (b)5 m/s (c) 40 m/s (d)4 m/s

$V = \frac{\lambda}{T} = \frac{4}{2n+1}$ where $n = 0, 1, 2, 3 \ldots$

$n = 0 \Rightarrow V = 4$

Q3) If maximum speed of particle in a medium carrying a travelling wave is V_0, then find speed of particle when its displacement is half of maximum value

Sine wave

$$V_{p_{max}} = A\omega = V_0$$

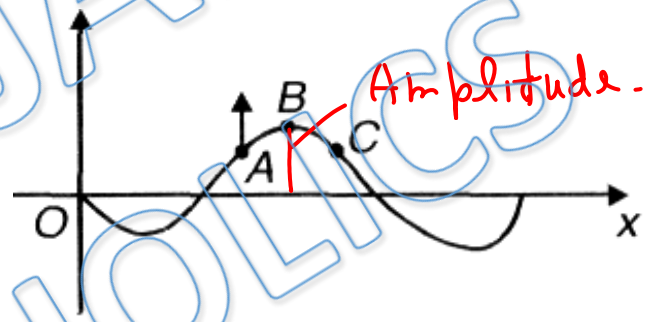
$$V = \omega\sqrt{A^2 - x^2}$$

$$= \omega\sqrt{A^2 - A^2/4}$$

$$= \frac{\sqrt{3}}{2}\omega A = \frac{\sqrt{3}}{2}V_0$$

(a) $\frac{V_0}{2}$ (b) $\sqrt{3}\frac{V_0}{4}$ (c) $\sqrt{3}\frac{V_0}{2}$ (d) V_0

Q4) At any instant, wave travelling along a string is shown in figure. Here point A is moving upwards. Which of following statement is true?



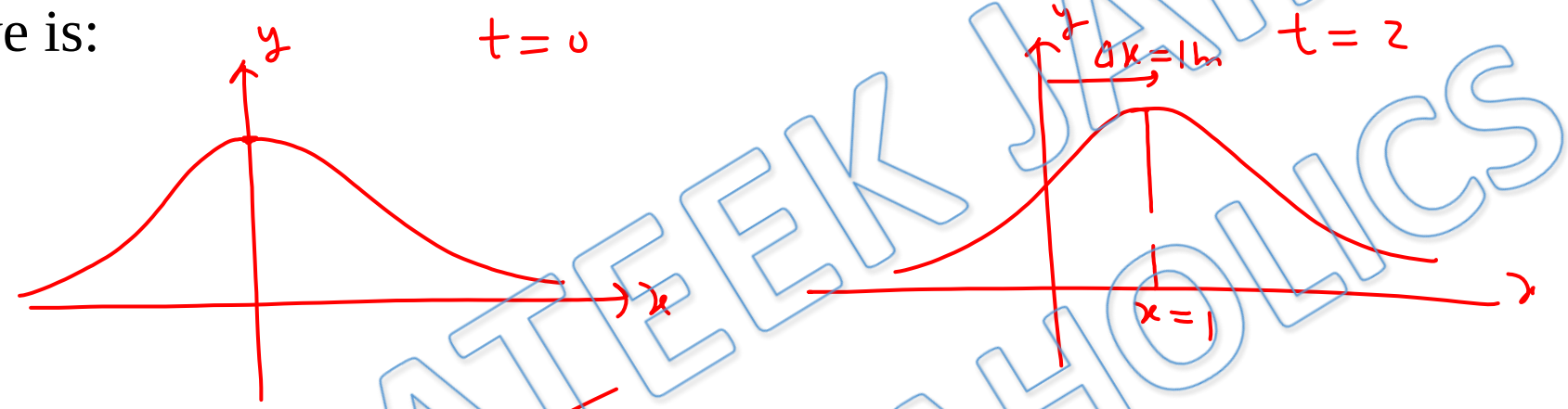
(a)Wave is travelling to right

(b)Displacement amplitude of wave is equal to displacement of B at this instant

(c)At this instant C also directed upward

(d)None of these

Q5) The amplitude of wave disturbance propagating in positive x-axis is given by $y = \frac{1}{1+x^2}$ at t = 0 and $y = \frac{1}{1+(x-1)^2}$ at t = 2s, where x and y are in metres. The shape of the disturbance does not change during the propagation. The velocity of the wave is:



(a) 1 m/s (b) 0.5 m/s (c) 2 m/s (d) 4 m/s

$V = \frac{\Delta x}{\Delta t} = \frac{1}{2} = .5\ m/sec$

Q6) Which of the following functions of x and t represents a progressive wave

$y = f\left(t \pm \frac{x}{v}\right)$

$= f(\omega t \pm kx)$

for any value of (x, t) y should not be ∞

(a) $y = \sin(4t - 3x)$

(b) $y = \frac{1}{4+(4t+3x)^2}$

(c) $y = \frac{1}{4t+3x}$ → at $t=0, x=0$, $y=\infty$

(d) all of these

Q7) $Y(x,t) = \frac{0.8}{[(4x-5t)^2+5]}$ represents a moving pulse where x and y are in metres and tin second. Then:

$y = \frac{8}{[5+25(\frac{4}{5}x+t)^2]}$

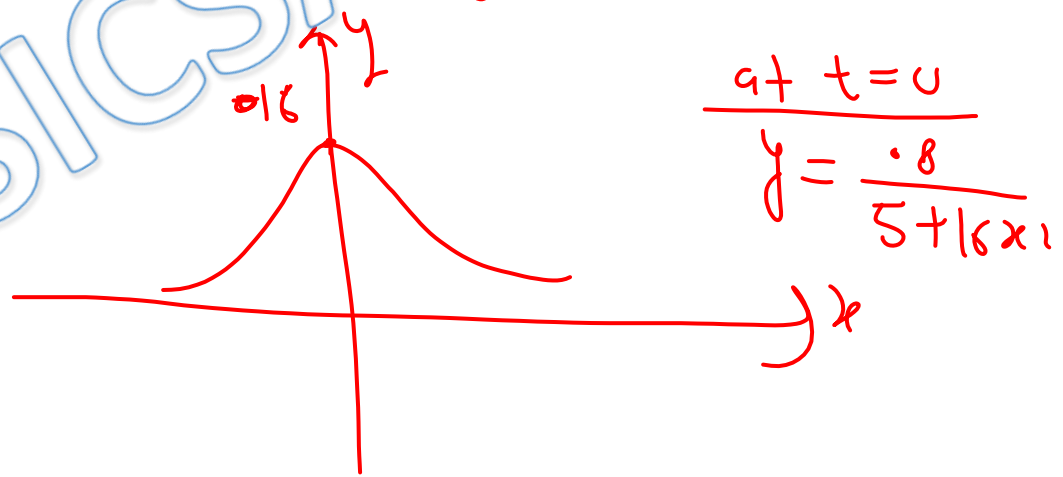
$v = 5/4 \Rightarrow \Delta x = vt = \frac{5}{4} \times 2 = 2.5\,m$

(a) pulse is moving in positive x-direction

(b) in 2 s it will travel a distance of 2.5 m

(c) its maximum displacement is 0.16 m $y_{max} = \frac{.80}{5} = .16m$

(d) it is a symmetric pulse



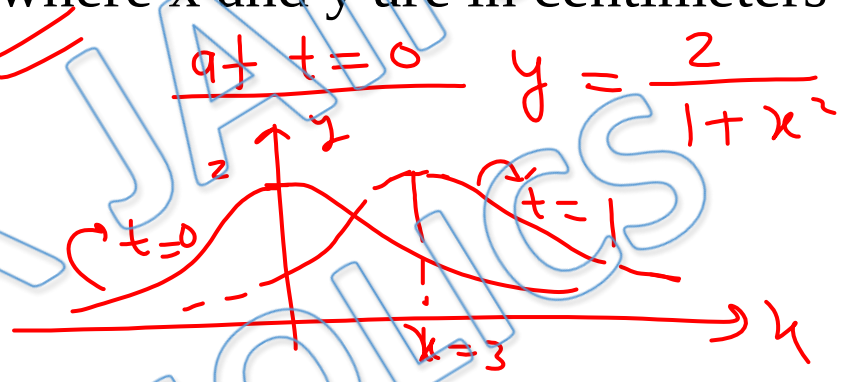
at $t=0$

$y = \frac{.8}{5+16x}$

Q8) A wave pulse moving in the positive x-direction along the x-axis is represented by the wavefunction y (x, t) = $\frac{2.0}{(x-3.0t)^2+1}$, where x and y are in centimeters and t is in seconds. Then

$y = \frac{2}{1+(x-3t)^2}$

$v = 3$



(a) The speed of particle at time t = 1 sec. and x = 3cm is zero. → $\Delta x = vt = 3$

(b) The speed of particle at time t = 1 sec. and x = 3cm is 2 cm/s.

(c) The speed of the pulse is 3.0 cm/s

(d) The speed of the pulse is 0.33 cm/s

$v_p = \frac{\partial y}{\partial t} = -2\left[(x-3t)^2+1\right]^{-2} 2(x-3t)3$

$= \frac{-12(x-3t)}{\left[1+(x-3t)^2\right]^2}$

$v_p = 0$ at $x = 3, t = 1$

Q9) The equation of a practical travelling wave is /are

$y = f(\omega t \mp kx)$

y should not be ∞ for any value of x & t

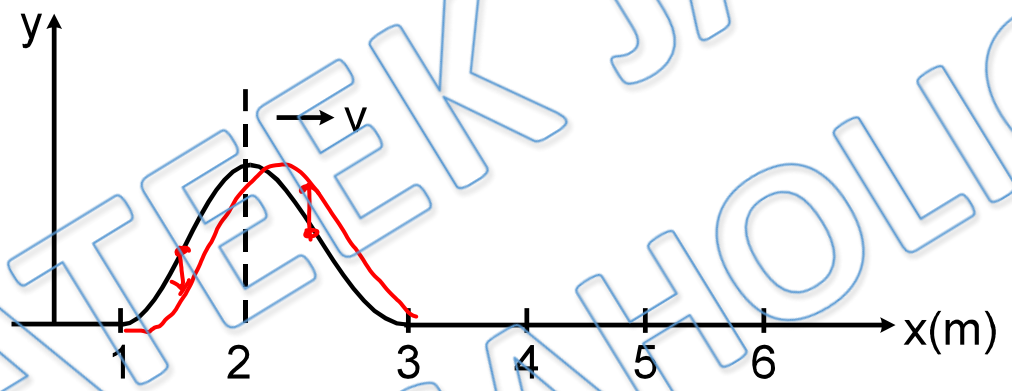
(a) A tan (wt - kx)

(b) A $\sin^2$ (wt - kx)

(c) A sin(wt - kx) cos(wt - kx)

(d) none

Q10) Wave pulse on a string shown in figure is moving to the right without changing shape. Consider two particles at positions x_1 = 1.5 m and x_2 = 2.5 m. Their transverse velocities at the moment shown in figure are along directions:



(a) positive y–axis and positive y–axis respectively

(b) negative y–axis and positive y–axis respectively

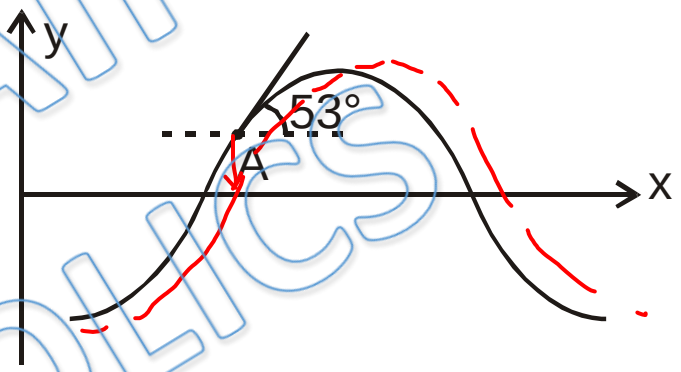
(c) positive y–axis and negative y–axis respectively

(d) negative y–axis and negative y–axis respectively

Q11) y-x curve at an instant for a wave travelling along x axis on a string is shown. Slope at the point A on the curve, as shown, is 53° .

$$\left|\frac{\partial y}{\partial x}\right| = \frac{\left|\partial y/\partial t\right|}{v}$$

$$|v_p| = v\,|\text{slope}| = \frac{4}{3}v$$



(a) Transverse velocity of the particle at point A is positive if the wave is travelling along positive x axis.

(b) Transverse velocity of the particle at point A is positive if the wave is travelling along negative x axis of the particle at point A

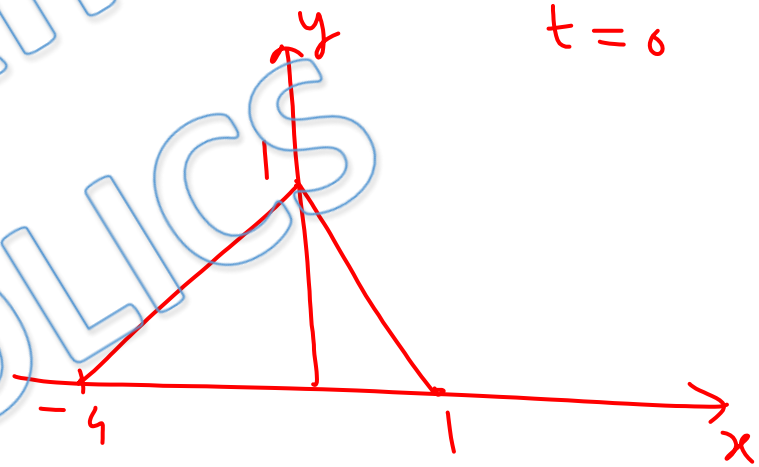
(c) Magnitude of transverse velocity of the particle at point A is greater than wave speed.

(d) Magnitude of transverse velocity of the particle at point A is lesser than wave speed.

COMPREHENSION

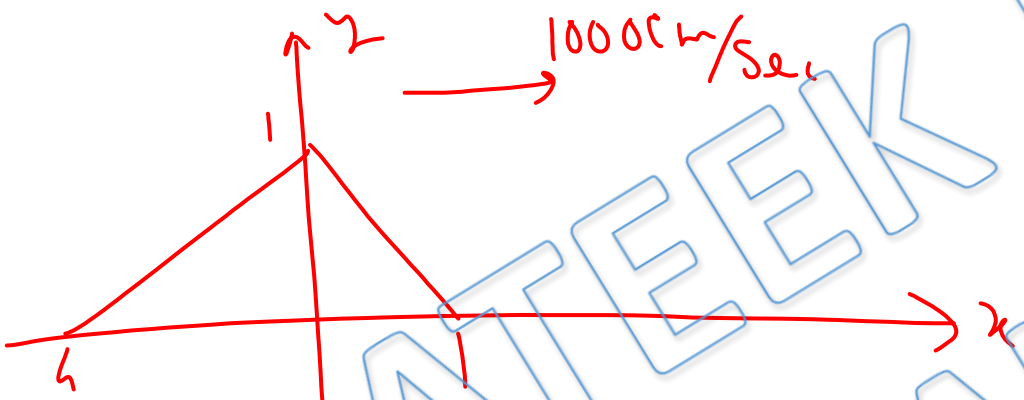
A pulse is started at a time t = 0 along the +x direction with speed 10 m/sec on a long, taut string. The shape of the pulse at t = 0 is given by function f(x) with

$$f(x) = \begin{cases} \frac{x}{4} + 1 & \text{for} \quad -4 < x \le 0 \\ -x + 1 & \text{for} \quad 0 < x < 1 \\ 0 & \text{otherwise} \end{cases}$$



here f and x are in centimeter.

Q12) The shape of the string is drawn at t = 0 and the area of the pulse enclosed by the string and the x-axis is measured. It will be equal to



(a) 2 cm^2 (b) 2.5 cm^2 (c) 4 cm^2 (d) 5 cm^2

$\Delta = \frac{1}{2} \times 5 \times 1$

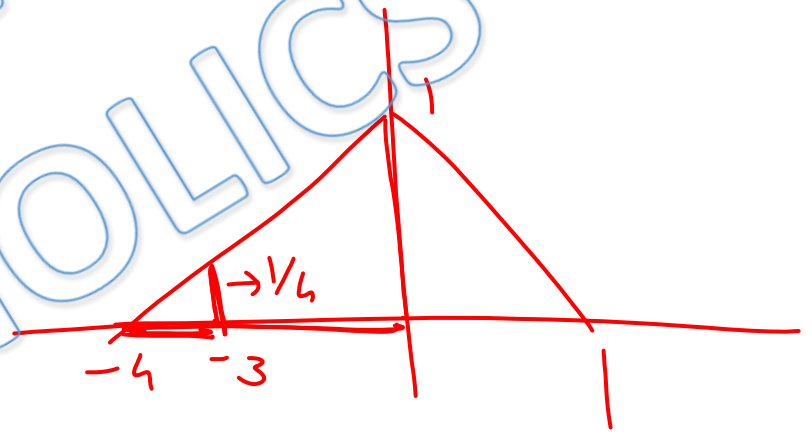
$= 2.5\ cm^2$

Q13) The vertical displacement of the particle of the string at x = 7 cm and t = 0.01 s will be

$t = .01 \Rightarrow \Delta x = Vt = 1000 \times .01 = 10\,cm$

Displacement of $x = 7$ at $t = .01$

$=$ " " " $x = -3cm$ at $t = 0$



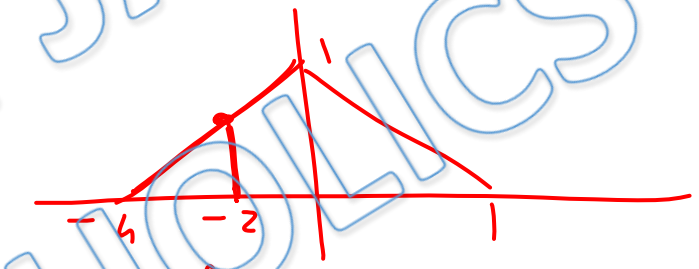
(a) 0.75 cm (b) 0.5 cm (c) 0.25 cm (d) zero

Q14) The transverse velocity of the particle at x = 13 cm and t = 0.015 s will be

$t = .015 \Rightarrow \Delta x = 1000 \times .015 = 15\,cm$

phase of $x = 13$ at $t = .015$

$=$ " " $x = -2$ " $t = 0$



Velocity of $x = 13\,cm$ at $t = .015$ = velocity of $x = -2$ at $t = 0$

(a) –250 cm/s

(b) –500 cm/s

(c) 500 cm/s

(d) –1000 cm/s

$v = -V(\text{Slope})$

$= -1000 \times 1/4 = -250\,cm/sec$

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/APC3Mcm8SF0

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

SUBSCRIBE

@Physicsaholics

@Physicsaholics_prateek

@NEET_Physics
@IITJEE_Physics

physicsaholics.com

Unacademy

CLICK

Chalo Niklo