Chapter 21

Wave Exercise

Q.1 In the equation representing wave function $y = A\sin(kx - \omega t + \emptyset_0)$ the term phase is defined as:
(A) ϕ_0 **(B)** $\phi_0 - \omega t$ **(C)** $kx + \phi_0$ **(D)** $kx - \omega t + \phi_0$

Q.2 Assertion: Transverse mechanical wave does not travel in air.
Reason: Air has only bulk modulus of elasticity.
(A) Both assertion and reason are correct and reason is the correct explanation of assertion.
(B) Both assertion and reason are correct but reason is not a correct explanation of assertion.
(C) Assertion is correct but reason is incorrect.
(D) Assertion is incorrect but reason is correct

Q.3 Assertion: Longitudinal waves are called pressure waves.
Reason: Propagation of longitudinal waves through a medium involves changes in pressure in the medium.
(A) Both assertion and reason are correct and reason is the correct explanation of assertion.
(B) Both assertion and reason are correct but reason is not a correct explanation of assertion.
(C) Assertion is correct but reason is incorrect.
(D) Assertion is incorrect but reason is correct

Q.4 Which of the following statements are true for wave motion?
(A) Mechanical transverse waves can propagate through all mediums
(B) Longitudinal waves can propagate through solids only
(C) Mechanical transverse waves can propagate through solids only
(D) Longitudinal waves can propagate through vacuum

Q.5 The equation of a progressive wave is $y = 0.03\sin 2\pi\left[\frac{t}{0.01} - \frac{x}{0.30}\right]$ here x and y are in meters and t is in seconds. The velocity of propagation of the wave is
(A) 300 m/s **(B)** 30 m/s **(C)** 400 m/s **(D)** 40 m/s

Q.6 The amplitude of wave disturbance propagating in positive x direction is given by $y = \frac{1}{1+x^2}$ at $t = 0$ and $y = \frac{1}{1+(x-1)^2}$ at $t = 2s$. the wave speed is.
(A) 1.5 m/s **(B)** 2 m/s **(C)** 1 m/s **(D)** 0.5 m/s

Q.7 Equation for a wave on a string is given by $y = 0.03\sin(7.86x - 2t)$ where y and x are in meters and t is in second at $t = 0$, find the value of displacement (approximately) for a particle on string at $x = 0.1$ m.
(A) 2.1 cm **(B)** 4 cm **(C)** 3 cm **(D)** 7.86 cm

Q.8 For a plane progressive wave represented by, $y = 5\sin(100\pi t - 0.4\pi x)$ what is the wave velocity (in m/s)?
(A) 350 **(B)** 250 **(C)** 200 **(D)** 180

Q.9 A wave travelling along the x -axis is described by the equation $y(x,t) = 0.008\cos(\alpha x - \beta t)$. If the wavelength and time period of the wave are 0.16 m and 6.0 s respectively, then α and β in appropriate units are.
(A) $\alpha = 25.00\pi, \beta = \pi$ **(B)** $\alpha = 12.50\pi, \beta = \frac{\pi}{2}$

(C) $\alpha = 12.50\pi, \beta = \frac{\pi}{3}$ **(D)** $\alpha = \frac{0.08}{\pi}, \beta = \frac{2}{\pi}$

Q.10 For the equation $y = A\sin 2\pi(ax + bt + \pi/4)$,
Match the following columns.

Column I	Column II
(a) Frequency of wave (Hz)	(p) a
(b) Wavelength of wave (m)	(q) b
(c) Phase difference between two points $\frac{1}{4a}$ m distance apart	(r) π
(d) Phase difference of a particle after a time interval of $\frac{1}{8b}$ s	(s) $\frac{\pi}{2}$
	(t) None of above

(A)	a	b	c	d
	q	t	s	t

(B)	a	b	c	d
	t	q	r	s

(C)	a	b	c	d
	p	q	r	s

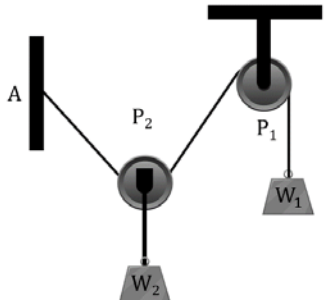
(D)	a	b	c	d
	t	s	p	r

WORK SHEET

Q.1 The trajectory of a projectile in a vertical plane is:$y = ax - bx^2$, where a and b are constants and x and y are respectively the horizontal and vertical distances of the projectile from the point of projection. The maximum height attained is.

(A) $\frac{a^2}{4b}$ **(B)** $\frac{a^2}{8b}$ **(C)** $\frac{a^2}{2b}$ **(D)** $\frac{a^2}{2gb}$

Q.2 In the following figure, the pulley P_1 is fixed and the pulley P_2 is movable. If $W_1 = W_1 = 100N$, what is the value of $\angle AP_2P_1$? The pulleys are light and frictionless.

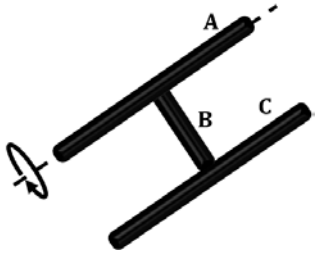


(A) 30° **(B)** 60° **(C)** 90° **(D)** 120°

Q.3 A massless platform is kept on a light elastic spring, as shown in the figure. When a particle of mass 0.1 kg is dropped on the pan from a height of 0.24 m, the spring gets compressed by 0.01 m. From what height should the same particle be dropped to cause a compression of 0.04 m in the spring? Neglect the effect of collision.

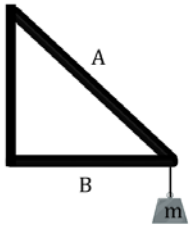
(A) 0.96 m **(B)** 2.96 m **(C)** 3.96 m **(D)** 0.48 m

Q.4 A rigid body is made up of three identical thin rods, A, B and C, each of length L fastened together in the form of letter H. The body is free to rotate about a horizontal axis that runs along the length of one of the legs (A) of the body H. The body is allowed to fall from rest from a position in which the pane of H is horizontal. What is the angular speed of the body when the plane of H becomes vertical?



(A) $\sqrt{\frac{g}{L}}$ **(B)** $\frac{1}{2}\sqrt{\frac{g}{L}}$ **(C)** $\frac{3}{2}\sqrt{\frac{g}{L}}$ **(D)** $2\sqrt{\frac{g}{L}}$

Q.5 Two thin and light rods A and B are attached to a block of mass m with the help of a massless string as shown in the figure. Then identify the correct statement, if the angle between the rods is acute.



(A) Both *A* and *B* experience compression.
(B) Both *A* and *B* experience extension.
(C) *A* experience extension and *B* experiences compression.
(D) *B* experiences extension and *A* experiences compression.

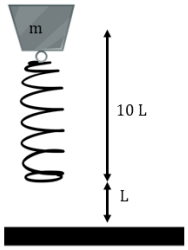
Q.6 A water droplet splits into 27 identical small droplets. The pressure difference between the inner and outer surface of the big droplet will be

(A) Same as that of smaller droplet
(B) 1/3rd of the pressure difference for smaller droplet
(C) 1/4th of the pressure difference for smaller droplet
(D) None of these

Q.7 In an adiabatic process, pressure is increased by $\frac{2}{3}\%$. If $\frac{CP}{CV} = \frac{3}{2}$, then the volume decreases by about

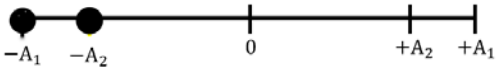
(A) $\frac{4}{9}\%$ **(B)** $\frac{2}{3}\%$ **(C)** 4% **(D)** $\frac{9}{4}\%$

Q.8 A small block of mass m is fixed at upper end of a massless vertical spring of spring constant $k = 4mg/L$ and natural length $'10L'$.The lower end of spring is free and is at a height L from the fixed horizontal floor as shown in figure. The spring is initially un stretched and the spring-block system is released from rest in the shown position. At the instant speed of block is maximum, the magnitude of force exerted by spring on the block is



(A) $\frac{mg}{2}$ **(B)** mg **(C)** 0 **(D)** 2

Q.9 Two particles P_1 and P_2 are performing SHM along the same line about the same mean position. Initially they are at their positive extreme position. If the time period of each particle is 12 second and the difference of their amplitude is 12 cm, then find the minimum time in seconds after which the separation between the particles become 6 cm



(A) 5 s **(B)** 4 s **(C)** 2 s **(D)** 8 s

Q.10 A spring block system is put into SHM in two experiments. In the first experiment, the block is pulled from the equilibrium position through a distance d_1 and then released. In the second experiment, it is pulled from the equilibrium position through a greater distance d_2 and then released. For the given scenario choose the incorrect statement.

(A) Time period is same for both SHM
(B) Frequency is same for both SHM
(C) Maximum kinetic energy is same for both SHM
(D) Angular frequency is same For both SHM

Q.11 The displacement, y of a particle on a straight line is given by $y = f(x,t)$, as a function of time. Which of the following functions does not represent wave motion?

(A) $y = A\sin(kx - \omega t)$ **(B)** $y = A\sin^2(kx - \omega t)$
(C) $y = A\sin(k^2x^2 - \omega^2t^2)$ **(D)** $y = A\sin(kx + \omega t + \frac{\pi}{10})$

Q.12 Assertion: In the equation, $y = A\sin(kx - \omega t)$ particle at $x = 0$ starts from its mean position and moves towards negative y - axis. Reason: The wave corresponding to given equation is travelling towards positive x- direction.

(A) Both assertion and reason are correct and reason is the correct explanation of assertion
(B) Both assertion and reason are correct but reason is not a correct explanation of assertion.
(C) Assertion is correct but reason is incorrect.
(D) Assertion is incorrect but reason is correct.

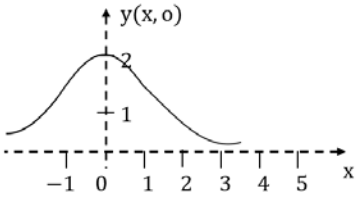
Q.13 The equation of a transverse wave on a stretched string is given by $y = 0.05\sin 2\pi\left(\frac{t}{0.002} - \frac{x}{0.1}\right)$ where x and y are expressed in metre and t in second. The speed of the wave is

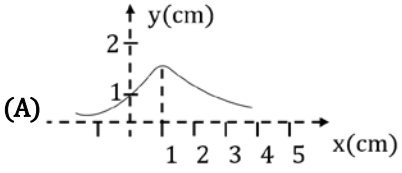
(A) $100\ ms^{-1}$ **(B)** $50\ ms^{-1}$ **(C)** $200\ ms^{-1}$ **(D)** $400\ ms^{-1}$

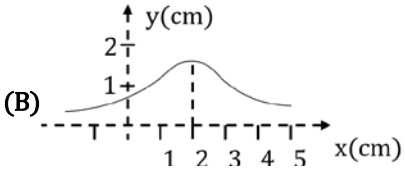
Q.14 The displacement of a particle of a string carrying a travelling wave is given by $y = 3\sin[6.28(0.50x - 50t)]$ ($x \rightarrow$ in cm, $y \rightarrow$ cm, $t \rightarrow$ in second).What would be the speed of the wave?

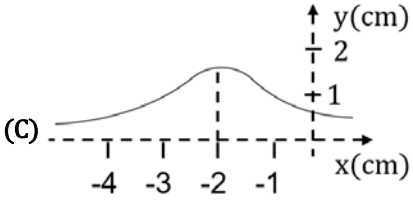
(A) $200\ cm\ s^{-1}$ **(B)** $150\ cm\ s^{-1}$ **(C)** $100\ cm\ s^{-1}$ **(D)** $50\ cm\ s^{-1}$

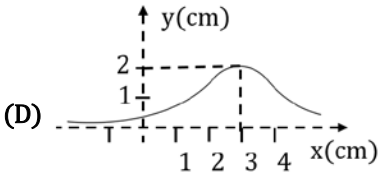
Q.15 A pulse moving along $x-$ axis is represented by the wave function $y\ (x, t) = \frac{2}{(x-2t)2+1}$ Where x and y measured in centimeters and t is measured in seconds. The shape of pulse $y(x, o) = \frac{2}{x2+1}$ is shown in the figure below. Which of the following correctly represents the shape of pulse at $t = 1$ s.



(A)


(B)


(C)


(D)


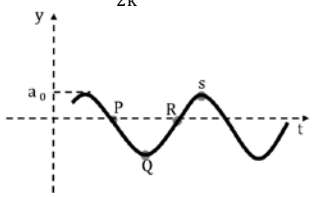
Q.16 A wave travelling along the positive x - direction having maximum displacement along y - direction as 1 m, wavelength 2π m and frequency of $1/\pi$ Hz is represented by:

(A) $y = \sin(x - 2t)$ **(B)** $y = \sin(2\pi x - 2\pi t)$
(C) $y = \sin(10\pi x - 20\pi t)$ **(D)** $y = \sin(2\pi x + 2\pi t)$

Q.17 For a travelling wave represented by equation, $y = 0.1\sin\pi\left(x - 330t + \frac{2}{3}\right)$ $(SI\ units)$ the phase difference between particles at $x_1 = 3$ m and $x_2 = 3.5$ m is

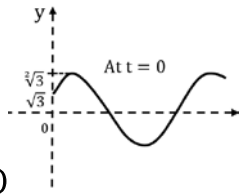
(A) $\frac{\pi}{2}$ **(B)** π **(C)** $\frac{3\pi}{2}$ **(D)** 2π

Q.18 A wave motion has the function $y = a_o \sin(\omega t - kx)$.The graph in figure shows how the displacement y at a fixed point varies with time t. Which one of the labelled points represents the same displacement as will be at the position $x = \frac{\pi}{2k}$ at time $t = 0$?

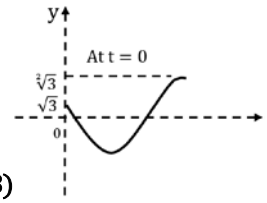


(A)P **(B)**Q **(C)**R **(D)**S

Q.19 Identify the option that correctly represents given wave function. $y = 2\sqrt{3}\sin\pi\left(x - 2t + \frac{1}{6}\right)$



(A)



(B)

(C) Both of the above graphs are possible **(D)**None of the two graphs are possible

ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(D)	(A)	(A)	(C)	(B)	(D)	(A)	(B)	(C)	(A)
WORK SHEET										
Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(A)	(D)	(C)	(C)	(C)	(B)	(A)	(B)	(C)	(C)
Q.	11	12	13	14	15	16	17	18	19	
Sol.	(C)	(B)	(B)	(C)	(B)	(A)	(A)	(B)	(A)	