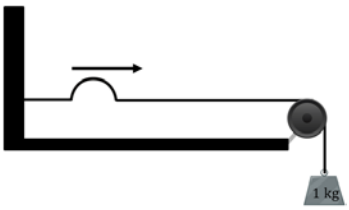
Q.1 A heavy rope is suspended from a rigid support. A wave pulse is set up at the lowest end, then:
(A) The pulse will travel with uniform speed **(B)**The pulse will travel with increasing speed
(C) The pulse will travel with decreasing speed **(D)**The pulse cannot travel through the rope

Q.2 A string of length 7 m has a mass of 0.035 kg. If the tension in the string is 60.5 N, then speed of a wave on the string is:
(A)77 m/s **(B)**102 m/s **(C)**110 m/s **(D)**165 m/s

Q.3 Figure shows a string of linear mass density 1.0 g/cm on which a wave pulse is travelling. Find the time taken by the pulse in travelling through a distance of 50 cm on the string. Take g $= 10\ m/s^2$



(A)0.04 s **(B)**0.03 s **(C)**0.05 s **(D)**0.08 s

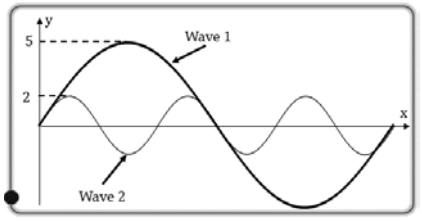
Q.4 The speed of a transverse wave travelling through a wire having a length 50 cm and mass 5.0 gis 80 m/s. The area of cross-section of the wire is $1.0mm^2$ and its Young's modulus is $16 \times 10^{11}\ N/m^2$. Find the extension in the wire with respect to its natural length.
(A)0.01 mm **(B)**0.3 mm **(C)**0.02 mm **(D)**0.04 mm

Q.5 A transverse wave is propagating through a medium. The potential energy associated with vibrating particle is maximum when the displacement of the particle from the mean position is
(A) Zero **(B)**Half of the amplitude
(C) Equal to the amplitude **(D)**None of the above

Q.6 Average total energy density for a transverse wave is 16 J/m.the average kinetic energy density for the corresponding wave will be
(A)4 J/m **(B)**2 J/m **(C)**8 J/m **(D)**16 J/m

Q.7 If the amplitude of a transverse wave is doubled then average rate of transmission of potential energy becomes
(A) One fourth of initial value **(B)**Twice of its initial value
(C) Four times of its initial value **(D)**None of the above

Q.8 Two transverse waves in a given medium are represented by the curve as shown in the figure. Find the ratio of their intensities. All the measurements are in S.I units.



(A)$\frac{10}{11}$ **(B)**$\frac{24}{5}$ **(C)**$\frac{25}{36}$ **(D)**$\frac{25}{18}$

Q.9 A wave is propagating on a long-stretched string. If the cross-sectional area of string is doubled then average power associated with wave becomes
(A) Twice of its initial value **(B)**Half of its initial value
(C) Four times of its initial value **(D)**None of these

Q.10 If potential energy density is twice the average rate of transmission of potential energy. The speed of transverse wave is

(A)0.5 m/s **(B)**2 m/s **(C)**5 m/s **(D)**1 m/s

WORK SHEET

Q.1 The unit vector which, is perpendicular to the vectors $\vec{A} = \hat{\imath} - 2\hat{\jmath} + \hat{k}$ and $\vec{B} = 3\hat{\imath} - 2\hat{\jmath} - \hat{k}$ is

(A)$\frac{1}{\sqrt{3}}(\hat{\imath} - \hat{\jmath} + \hat{k})$ **(B)**$\frac{1}{\sqrt{3}}(\hat{\imath} + \hat{\jmath} + \hat{k})$ **(C)**$\frac{1}{\sqrt{3}}(\hat{\imath} + \hat{\jmath} - \hat{k})$ **(D)**$\frac{1}{\sqrt{3}}(\hat{\imath} - \hat{\jmath} - \hat{k})$

Q.2 Suppose two particle, 1 and 2 are projected in vertical plane simultaneously. Their angles of projected are 30°and θ, respectively, with the horizontal. If they collide after time t in air, then which of the following is incorrect?

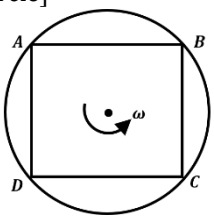
(A)$\theta = 53°$and they will have same speeds just before the collision.

(B)$\theta = 53°$and they will have different speeds just before the collision.

(C)$x < (1280\sqrt{3} - 960)$m

(D) It is possible that the particles collide when both of them are at their highest point.

Q.3 Particles each of mass 'm' are tied by means of strings of equal length as shown in figure. If the system is rotated with constant angular velocity 'ω' in horizontal plane, find the tension in the string.[Given 'r' is the radius of the circle]



(A)$\frac{mr\omega^2}{\sqrt{2}}$ **(B)**$\frac{mr\omega^2}{\sqrt{5}}$ **(C)**$\frac{mr\omega^2}{2}$ **(D)**$\frac{mr\omega^2}{2\sqrt{2}}$

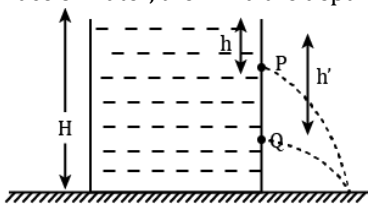
Q.4 A force acts on a 10 g particle in such a way that the position of particle as a function of time is given by $x = 3 + 4t^2$, where x is in m and t is in seconds. The work done during first 7 seconds is

(A)156.8 J **(B)**15.68 J **(C)**78.4 J **(D)**7.84 J

Q.5 A man of mas 50 kg is standing on a platform of mass 200 kg kept on a smooth horizontal surface. The man starts moving on the platform with a velocity 20 km/hr relative to the platform. Find the recoil speed of the platform.

(A)4 km/hr **(B)**2 km/hr **(C)**3 km/hr **(D)**1 km/hr

Q.6 As shown in the figure, water squirts horizontally out of two small holes in the side of cylinder and the two streams strike the ground at the same point. If the level of water stands at height $H = 4.25$ m and hole P is at depth of 0.25 m below the surface of water, then find the depth of hole Q from the surface of water.



(A)3 m **(B)**2 m **(C)**0.5 m **(D)**4

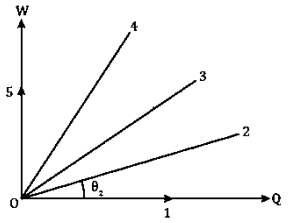
Q.7 Two drops of equal radii coalesce to form a bigger drop. What is ratio of surface energy of bigger drop to smaller one?

(A)$2^{1/3}:2$ **(B)**$2^{1/2}:2$ **(C)**$2^{1/2}:1$ **(D)**$2:1$

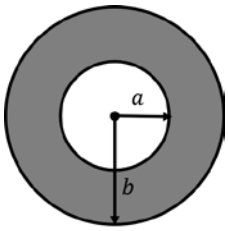
Q.8 The given figure shows an isochoric process, an isothermal process, an adiabatic process and two isobaric processes (one for monoatomic gas and other for diatomic) on a work done (W) versus heat supplied (Q) curve. The initial states of both gases are the same and the scales for the two axes are same.

Which of the following statements is incorrect?

(A) Straight line 1 corresponds to an isochoric process.
(B) Straight line 2 corresponds to an isobaric process for diatomic gas.
(C) Straight line 4 corresponds to an isothermal process.
(D) Straight line 1 corresponds to an isothermal process.

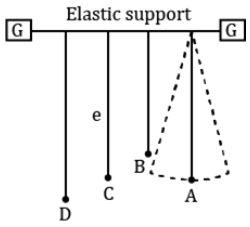


Q.9 A spherical body of radius $b = \frac{4}{\pi}$ m has a concentric cavity of radius $a = \frac{2}{\pi}$ m as shown in the figure. Thermal conductivity of the material is 100 W/m°C. If temperature of inner surface is kept at 70°C and of the outer surface at 30°C, then find the rate of heat flow (in kW)



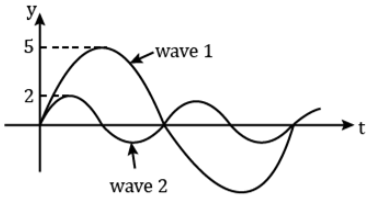
(A)16 **(B)**32 **(C)**64 **(D)**40

Q.10 Four pendulums A, B, C and D are suspended from the same elastic support as shown in figure. A and C are of the same length, while B is smaller than A and D is larger than A. If A is given a transverse displacement, [Assume there is no loss of energy]



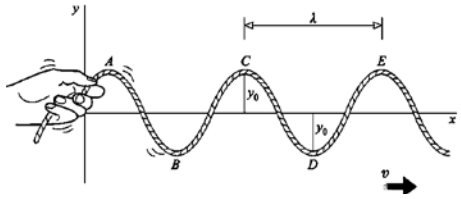
(A)D will vibrate with maximum amplitude **(B)**C will vibrate with maximum amplitude
(C)B will vibrate with maximum amplitude **(D)**All the four will oscillate with equal amplitude

Q.11 Two waves in the same medium are represented by y − t curves in the figure. Find the ratio of their average intensities.



(A)$\frac{25}{16}$ **(B)**$\frac{16}{25}$ **(C)**$\frac{4}{5}$ **(D)**$\frac{5}{4}$

Q.12 A sinusoidal wave of amplitude 5 cm is to be transmitted along a string having a linear mass density of 4×10^{-2} kg/m. If the source can be deliver an average power of 90 watts and string is under a tension of 100 N, then the frequency at which the source operates is [Take $\pi^2 = 10$]



(A)43.3 Hz **(B)**50 Hz **(C)**30 Hz **(D)**62.3 Hz

Q.13 Statement (A): In a small segment of string carrying a sinusoidal wave, the total energy is conserved.
Statement (B): Every small part of the string performs SHM and in SHM, the total energy is conserved.
(A) Both (A) and (B) are correct **(B)**(B) Is correct only
(C) (A) Is correct only **(D)**None of these

Q.14 A taut string for which $\mu = 15 \times 10^{-2}$ kg/m is under a tension of 240 N. How much power must be supplied to the string to generate sinusoidal waves at a frequency of 18.0 Hz and an amplitude of 18 cm?
(A)1280 W **(B)**1300 W **(C)**1240 W **(D)**1220 W

Q.15 A 400 Hz wave with amplitude 2 mm travels on a long string of linear mass density 5 g/m kept under a tension of 50 N. Find the average power and total energy associated with the wave in a 2 m long portion of the string.
(A)6 W, 1 J **(B)**1W, 6J **(C)**6.32W, 0.13 J **(D)**None of the above

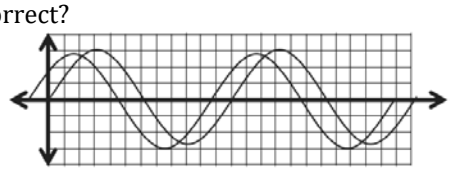
Q.16 A sinusoidal wave on a string is described by the wave function $y = 0.3\sin(1.6x - 100t)$ Where x and y are in metre and t is in second the mass per unit length of this string is 10 g/m. Determine the power transmitted to the wave.
(A)260 J **(B)**360 J **(C)**281 J **(D)**320 J

Q.17 Two transverse waves passing through a region are represented by $y_1 = (2\text{ cm})\sin[(2\pi\text{ cm}^{-1})x - (100\pi\text{ s}^{-1})t]$and $y_2 = (3\text{ cm})\sin[(\pi\text{ cm}^{-1})x - (200\pi\text{ s}^{-1})t]$.
Find the net displacement of the particle at x = 4.5 cm and time t = 5 ms.[Assume, ↑ for positive y −direction and ↓ for negative y −direction]
(A)5 cm ↑ **(B)**5 cm ↓ **(C)**1 cm ↑ **(D)**1 cm ↓

Q.18 A wave is represented by $y_1 = 10\cos(5x + 25t)$, where x and y are measured in centimeters and t in seconds. A second wave for which $y_2 = 20\cos(5x + 25t + \pi/3)$ interferes with the first wave. Find the amplitude and phase of the resultant wave.
(A)26.46 cm, 0.71rad **(B)**28.50 cm, 1rad
(C)30 cm, 0.71rad **(D)**30.46 cm, 0.6rad

Q.19 Sources separated by 20 m vibrate according to the equation $y_1 = 0.06\sin\pi$tand $y_2 = 0.02\sin\pi t$. They send out waves along a rod with speed 3 m/s. What is the equation of motion of a particle 12 m from the first source and 8 m from the second? Given y_1, y_2 are in metres.
(A)$0.0173\sin\pi t - 0.05\cos\pi t$ **(B)**$0.0173\sin\pi t - 0.017\cos\pi t$
(C)$0.05\sin\pi t - 0.0173\cos\pi t$ **(D)**$0.05\sin\pi t - 0.5\cos\pi t$

Q.20 Two travelling sinusoidal waves are described by the wave functions $y_1 = 10\sin[\pi(8x - 1400t)]$ and $y_2 = 10\sin[\pi(8x - 1400t - 0.5)]$ where x, y_1, and y_2 are in metres and t is in seconds. Which of the following options is/are correct?



(A) Amplitude of the resultant wave is $10\sqrt{2}$ m **(B)** Frequency of the resultant wave is 700 Hz
(C) Time period of the resultant wave is 0.1 s **(D)** None of these

Q.21 Two waves are passing through a region in the same direction at the same time. If the equation of these waves are $y_1 = \alpha \sin\frac{2\pi}{\lambda}(vt - x)$ and $y_2 = \beta \sin\frac{2\pi}{\lambda}[(vt - x) + \phi]$, then the amplitude of the resultant wave at $\phi = \frac{\lambda}{2}$ is

(A) $|\alpha - \beta|$ **(B)** $\alpha + \beta$
(C) $\sqrt{\alpha^2 + \beta^2}$ **(D)** $\sqrt{\alpha^2 + \beta^2 + 2\alpha\beta\cos x}$

ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(B)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(A)	(A)
WORK SHEET										
Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(B)	(A)	(A)	(B)	(A)	(D)	(C)	(D)	(C)	(B)
Q.	11	12	13	14	15	16	17	18	19	20
Sol.	(A)	(C)	(C)	(C)	(C)	(C)	(D)	(A)	(C)	(A,B)
Q.	21									
Sol.	(A)									