GGSRDN
Educational Services Private Limited
NEET, JEE(Main/Advanced)
अभ्यास ही सबसे बड़ा गुरू है।

GGSRDN

Educational Services Private Limited

9th, 10th, NEET, JEE(Main/Advanced)

अभ्यास ही सबसे बड़ा गुरू है।

CLASS : XI (PHYSICS)

DPP

DAILY PRACTICE PROBLEM

DPP-71 TO 92

a String , Rigid Body Dynamics

DPP 86 : Simple Harmonic Motion, Sound Waves, Center of Mass, Circular motion, Kinetic Theory of Gases & Heat

DPP 87 : String, Simple Harmonic Motion, Wave on a String, Rigid Body Dynamics, Sound Waves

DPP 88 : Sound Waves, Sound , Work, Power and Energy, Center of Mass

DPP 89 : Elasticity and Plasticity

DPP 90 : Variation of Strain with Stress

DPP 91 : Viscosity

DPP 92 : Stokes' Law

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 71

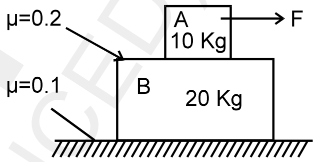
Total Marks : 27

Max. Time : 29 min.

Topics : Friction, Rigid Body Dynamics, Work, Power and Energy, Simple Harmonic Motion

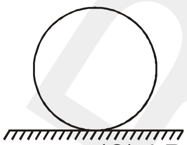
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Multiple choice objective ('–1' negative marking) Q.6	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.7 to Q.8	(4 marks, 5 min.)	[8, 10]

1. In given diagram what is the minimum value of a horizontal external force F on Block 'A' so that block 'B' will slide on ground is:



(A) 30 N
(B) 20 N
(C) 10 N
(D) Not possible

2. A ring of radius R rolls without slipping on a rough horizontal surface with a constant velocity. The radius of curvature of the path followed by any particle of the ring at the highest point of its path will be :



(A) 3R
(B) 2 R
(C) 4 R
(D) none of these

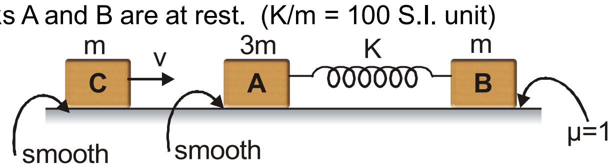
3. A particle is moving along x – axis has potential energy U = (2 – 20x + 5 x^2) Joules.
The particle is released at x = – 3. The maximum value of 'x' will be:
[x is in meters and U is in joules]
(A) 5 m
(B) 3 m
(C) 7 m
(D) 8 m

4. The potential energy of a particle executing SHM changes from maximum to minimum in 5 s. Then the time period of SHM is :
(A) 5 s
(B) 10 s
(C) 15 s
(D) 20 s

5. A particle performs S.H.M. of amplitude A along a straight line. When it is at a distance $\frac{\sqrt{3}}{2}$ A from mean position, its kinetic energy gets increased by an amount 1/2 m $\omega^2 A^2$ due to an impulsive force. Then its new amplitude becomes:
(A) $\frac{\sqrt{5}}{2}$ A
(B) $\frac{\sqrt{3}}{2}$ A
(C) $\sqrt{2}$ A
(D) $\sqrt{5}$ A

6. The amplitude of a particle executing SHM about O is 10 cm. Then:
(A) when the K.E. is 0.64 of its maximum K.E. its displacement is 6 cm from O.
(B) when the displacement is 5 cm from O its K.E. is 0.75 times its maximum K.E.
(C) Its total energy of SHM at any point is equal to its maximum K.E.
(D) Its speed is half the maximum speed when its displacement is half the maximum displacement.

7. A block of mass m collides with another block of mass 3m completely inelastically as shown in figure. What is the maximum value of v (in m/s) for which the block B does not move. Assume that initially spring is in natural length and blocks A and B are at rest. (K/m = 100 S.I. unit)



8. A particle performs SHM of time period T, along a straight line. Find the minimum time interval to go from position A to position B. At A both potential energy and kinetic energy are same and at B the speed is half of the maximum speed.

PHYSICS DPP
DAILY PRACTICE PROBLEMS

DPP No. 72

Total Marks : 23

Max. Time : 23 min.

Topics : Center of Mass, Work, Power and Energy, Rigid Body Dynamic, Rotation, Simple Harmonic Motion

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3 to Q.4	(4 marks, 4 min.)	[8, 8]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]

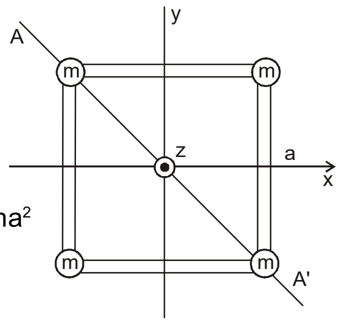
1. A continuous stream of particles of mass m and velocity *v*, is emitted from a source at a rate of *n* per second. The particles travel along a straight line, collide with a body of mass M and are buried in this body. If the mass M was originally at rest, its velocity when it has received N particles will be:

(A) $\frac{mvn}{Nm+n}$ (B) $\frac{mvN}{Nm+M}$ (C) $\frac{mv}{Nm+M}$ (D) $\frac{Nm+M}{mv}$

2. A particle is moving along x – axis has potential energy U = $(2 - 20x + 5x^2)$ Joules.
The particle is released at x = – 3. The maximum value of ' x ' will be: [x is in meters and U is in joules]

(A) 5 m (B) 3 m (C) 7 m (D) 8 m

3. Four point mass, each of mass m are connected at a corner of a square of side 'a' , by massless rods as shown in the figure. x and y axis are in the plane of the system and z axis is perpendicular to the plane and passing through the centre of the square.

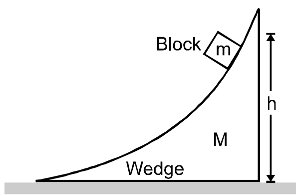


(A) Moment of inertia of the system about x axis is $I_x = ma^2$
(B) Moment of inertia of the system about y axis is $I_y = ma^2$
(C) Moment of inertia of the system about the diagonal axis AA' is $I_{AA'} = ma^2$
(D) Moment of inertia of the system about z axis is $I_z = ma^2$

4. The amplitude of a particle executing SHM about O is 10 cm. Then:
(A) when the K.E. is 0.64 of its maximum K.E. its displacement is 6 cm from O.
(B) when the displacement is 5 cm from O its K.E. is 0.75 times its maximum K.E.
(C) Its total energy of SHM at any point is equal to its maximum K.E.
(D) Its speed is half the maximum speed when its displacement is half the maximum displacement.

COMPREHENSION

A block of mass m slides down a wedge of mass M as shown. The whole system is at rest, when the height of the block is h above the ground. The wedge surface is smooth and gradually flattens. There is no friction between wedge and ground.



5. As the block slides down, which of the following quantities associated with the system remains conserved?
(A) Total linear momentum of the system of wedge and block
(B) Total mechanical energy of the complete system
(C) Total kinetic energy of the system
(D) Both linear momentum as well as mechanical energy of the system

6. If there would have been friction between wedge and block, which of the following quantities would still remain conserved ?
(A) Linear momentum of the system along horizontal direction
(B) Linear momentum of the system along vertical direction
(C) Linear momentum of the system along a tangent to the curved surface of the wedge
(D) Mechanical energy of the system

7. If there is no friction any where, the speed of the wedge, as the block leaves the wedge is :

(A) $m\sqrt{\frac{2gh}{(M+m)M}}$ (B) $M\sqrt{\frac{2gh}{(M+m)m}}$ (C) $(\sqrt{2gh})\frac{m}{M+m}$ (D) $(\sqrt{2gh})\frac{M}{M+m}$

PHYSICS

DPP
DAILY PRACTICE PROBLEMS

DPP No. 73

Total Marks : 22

Max. Time : 24 min.

Topics : Simple Harmonic Motion, Work, Power and Energy, Center of Mass, Circular Motion

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1	(3 marks, 3 min.)	[3, 3]
True or False (no negative marking) Q.2	(2 marks, 2 min.)	[2, 2]
Subjective Questions ('–1' negative marking) Q.3 to Q.4	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]

1. A particle performs S.H.M. of amplitude A along a straight line. When it is at a distance $\frac{\sqrt{3}}{2}$ A from mean position, its kinetic energy gets increased by an amount $\frac{1}{2}$ m ω^2 A^2 due to an impulsive force. Then its new amplitude becomes:

(A) $\frac{\sqrt{5}}{2}$ A (B) $\frac{\sqrt{3}}{2}$ A (C) $\sqrt{2}$ A (D) $\sqrt{5}$ A

2. **S_1 :** If the internal forces within a system are conservative, then the work done by the external forces on the system is equal to the change in mechanical energy of the system.

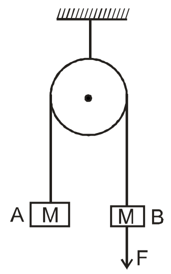
S_2 : The potential energy of a particle moving along x-axis in a conservative force field is U = $2x^2 - 5x + 1$ in S.I. units. No other forces are acting on it. It has a stable equilibrium position at one point on x-axis.

S_3 : Internal forces can perform net work on a rigid body.

S_4 : Internal forces can perform net work on a non–rigid body.

(A) T T F T (B) T F F T (C) F F T T (D) F T F T

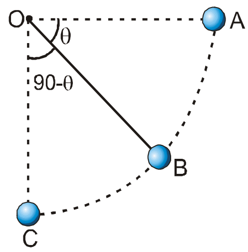
3. Two particles A and B having equal mass are interconnected by a light inextensible string that passes over a smooth pulley. One of the masses is pulled downward by a constant force 'F' as shown in diagram, then find the acceleration of the centre of mass of the system (A + B).



4. A particle performs SHM of time period T, along a straight line. Find the minimum time interval to go from position A to position B. At A both potential energy and kinetic energy are same and at B the speed is half of the maximum speed.

COMPREHENSION

One end of a light string of length L is connected to a ball and the other end is connected to a fixed point O. The ball is released from rest at t = 0 with string horizontal and just taut. The ball then moves in vertical circular path as shown. The time taken by ball to go from position A to B is t_1 and from B to lowest position C is t_2. Let the velocity of ball at B is $\vec{v}_B$ and at C is $\vec{v}_C$ respectively.



5. If $|\vec{v}_C| = 2|\vec{v}_B|$ then the value of θ as shown is

(A) $\cos^{-1}\frac{1}{4}$ (B) $\sin^{-1}\frac{1}{4}$ (C) $\cos^{-1}\frac{1}{2}$ (D) $\sin^{-1}\frac{1}{2}$

6. If $|\vec{v}_C| = 2|\vec{v}_B|$ then :

(A) $t_1 > t_2$ (B) $t_1 < t_2$ (C) $t_1 = t_2$ (D) Information insufficient

7. If $|\vec{v}_C - \vec{v}_B| = |\vec{v}_B|$, then the value of θ as shown is :

(A) $\cos^{-1}\left(\frac{1}{4}\right)^{1/3}$ (B) $\sin^{-1}\left(\frac{1}{4}\right)^{1/3}$ (C) $\cos^{-1}\left(\frac{1}{2}\right)^{1/3}$ (D) $\sin^{-1}\left(\frac{1}{2}\right)^{1/3}$

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 74

Total Marks : 26

Max. Time : 29 min.

Topics : Newton's law of Motion, Simple Harmonic Motion, Rigid Body Dynamics, Work Power and Energy, Projectile Motion

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3 to Q.4	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.5 to Q.7	(4 marks, 5 min.)	[12, 15]

1. A man stands on a weighing machine kept inside a lift. Initially the lift is ascending with the acceleration 'a' due to which the reading is W. Now the lift decends with the same accleration and reading is 10 % of initial. Find the acceleration of lift ?

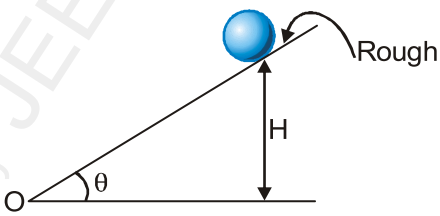
(A) $\frac{g}{19}$ m/sec^2 (B) $\frac{9g}{11}$ m/sec^2

(C) 0 m/sec^2 (D) g m/sec^2

2. A horizontal spring–block system of mass 2kg executes S.H.M. When the block is passing through its equilibrium position, an object of mass 1kg is put gently on it and the two move together. The new amplitude of vibration is (A being its initial amplitude):

(A) $\sqrt{\frac{2}{3}}A$ (B) $\sqrt{\frac{3}{2}}A$ (C) $\sqrt{2}\,A$ (D) $\frac{A}{\sqrt{2}}$

3. A solid ball of mass 'm' is released on a rough fixed inclined plane from height H. The ball will perform pure rolling on the inclined plane. Then



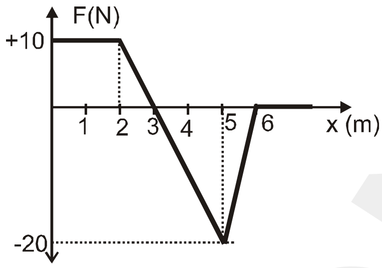
(A) Kinetic energy of the ball at O will be less than mgH.

(B) Translational kinetic energy of the ball at O will be $\frac{5mgH}{7}$

(C) Rotational kinetic energy of the ball at O will be $\frac{2mgH}{7}$

(D) Angular momentum of the ball will be conserved about a point on the inclined plane.

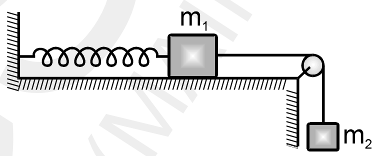
4. A particle of mass 1 kg moves from rest along a straight line due to action of a force F which varies with the displacement x as shown in graph - (Use $\frac{1}{\sqrt{2}}$ = 0.7 if needed)



(A) maximum K.E. of particle is 25 J
(B) Total work done by force on particle up to x = 6m is – 5J
(C) There will be no power delivered by the particle at x = 3, 5.3 and 6 m
(D) None of these

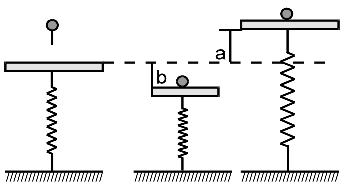
5. A particle is projected from ground with an initial velocity 20 m/sec making an angle 60° with horizontal. If R_1 and R_2 are radius of curvatures of the particle at point of projection and highest point respectively, then find the value of $\frac{R_1}{R_2}$

6. A block of mass m_1 = 1 kg is attached to a spring of force constant k = 24 N/cm at one end and attached to a string tensioned by mass m_2 = 5 kg. Deduce the frequency of oscillations of the system. If m_2 is initially supported in hand and then suddenly released, find



(a) instantaneous tension just after m_2 is released.
(b) the maximum displacement of m_1.
(c) the maximum and minimum tensions in the string during oscillations.

7. A mass M is in static equilibrium on a massless vertical spring as shown in the figure. A ball of mass m dropped from certain height sticks to the mass m after colliding with it. The oscillations they perform reach to height 'a' above the original level of spring & depth 'b' below it.



(a) Find the force constant of the spring.
(b) Find the oscillation frequency.
(c) What is the height above the initial level from which the mass m was dropped ?

PHYSICS
DPP
DAILY PRACTICE PROBLEMS

DPP No. 75

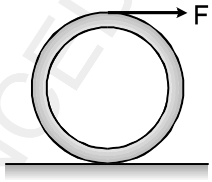
Total Marks : 24

Max. Time : 24 min.

Topic : Circular Motion, Center Of Mass, Rotation, Simple Harmonic Motion

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

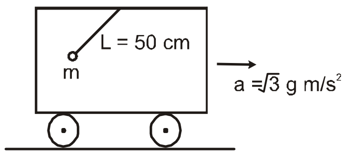
1. A ring of mass m and radius R rolls on a horizontal rough surface without slipping due to an applied force 'F'. The friction force acting on ring is : –



(A) $\frac{F}{3}$ (B) $\frac{2F}{3}$

(C) $\frac{F}{4}$ (D) Zero

2. A simple pendulum 50 cm long is suspended from the roof of a cart accelerating in the horizontal direction with constant acceleration $\sqrt{3}$ g m/s^2. The period of small oscillations of the pendulum about its equilibrium position is(g = π^2 m/s^2) :



(A) 1.0 sec (B) $\sqrt{2}$ sec

(C) 1.53 sec (D) 1.68 sec

3. If the length of a simple pendulum is doubled then the % change in the time period is :

(A) 50 (B) 41.4 (C) 25 (D) 100

4. A disc is hinged such that it can freely rotate in a vertical plane about a point on its radius. If radius of disc is 'R', then what will be minimum time period of its simple harmonic motion?

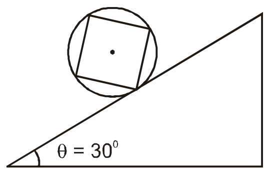
(A) $2\pi\sqrt{\frac{R}{g}}$ (B) $2\pi\sqrt{\frac{3R}{2g}}$ (C) $2\pi\sqrt{\frac{\sqrt{2}R}{g}}$ (D) $2\pi\sqrt{\frac{R}{2g}}$

5. A 25 kg uniform solid sphere with a 20 cm radius is suspended by a vertical wire such that the point of suspension is vertically above the centre of the sphere. A torque of 0.10 N-m is required to rotate the sphere through an angle of 1.0 rad and then maintain the orientation. If the sphere is then released, its time period of the oscillation will be :

(A) π second (B) $\sqrt{2}\pi$ second (C) 2π second (D) 4π second

COMPREHENSION

Four identical uniform rods of mass M = 6kg each are welded at their ends to form square and then welded to a uniform ring having mass m = 4kg & radius R = 1 m. The system is allowed to roll down the incline of inclination $\theta = 30^0$.



6. The moment of inertia of system about the axis of ring will be -

(A) 20 kg m^2 (B) 40 kg m^2 (C) 10 kg m^2 (D) 60 kg m^2.

7. The acceleration of centre of mass of system is -

(A) $\frac{g}{2}$ (B) $\frac{g}{4}$ (C) $\frac{7g}{24}$ (D) $\frac{g}{8}$

8. The minimum value of coefficient of friction to prevent slipping is -

(A) $\frac{5}{7}$ (B) $\frac{5}{12\sqrt{3}}$ (C) $\frac{5\sqrt{3}}{7}$ (D) $\frac{7}{5\sqrt{3}}$

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 76

Total Marks : 28

Max. Time : 29 min.

Topics : Simple Harmonic Motion, Newton's Law of Motion, Work, Power and Energy

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1	(3 marks, 3 min.)	[3, 3]
Multiple choice objective ('–1' negative marking) Q.2 to Q.4	(4 marks, 4 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.5	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

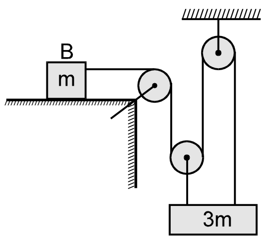
1. The resultant amplitude due to super position of $x_1 = \sin \omega t$, $x_2 = 5 \sin (\omega t + 37°)$ and $x_3 = -15 \cos \omega t$ is:
(A) 17 (B) 21 (C) 13 (D) none of these

2. A 20 gm particle is subjected to two simple harmonic motions
$x_1 = 2 \sin 10 t$,
$x_2 = 4 \sin (10 t + \frac{\pi}{3})$. where x_1 & x_2 are in metre & t is in sec.
(A) The displacement of the particle at t = 0 will be $2\sqrt{3}$ m.
(B) Maximum speed of the particle will be $20\sqrt{7}$ m/s.
(C) Magnitude of maximum acceleration of the particle will be $200\sqrt{7}$ m/s^2.
(D) Energy of the resultant motion will be 28 J.

3. A particle moves in xy plane according to the law x = a sinwt and y = a(1-coswt) where a and w are constants. The particle traces
(A) a parabola (B) a straight line equally inclined to x and y axes
(C) a circle (D) a distance proportional to time.

4. Out of the statements given, which is/are correct ?
(A) The amplitude of a resultant simple harmonic motion obtained by superposition of two simple harmonic motions along the same direction can be less than lesser of the amplitudes of the participating SHMs.
(B) When two simple harmonic motions which are in phase and in perpendicular directions superpose then resulting motion will be SHM with same phase.
(C) When two simple harmonic motions (with amplitudes A_1 and A_2) which are out of phase (that means phase difference π) and in perpendicular directions, superpose then resulting motion will be SHM with amplitude $\sqrt{A_1^2 + A_2^2}$.
(D) The combination of two simple harmonic motions of equal amplitude in perpendicular directions differing in phase by $\pi/2$ rad is a circular motion.

5. If the acceleration of the block B in the following system is a (in m/s^2) then find out value of 2a/5 (g = 10 m/s^2) :



COMPREHENSION

The velocity of a block of mass 2 kg moving along x-axis at any time t is given by v = 20 – 10t (m/s) where t is in seconds and v is in m/s. At time t = 0, the block is moving in positive x-direction.

6. The work done by net force on the block starting from t = 0 till it covers a distance of 25 meter will be:
(A) +200 J (B) – 200J (C) + 300J (D) – 300J

7. The power due to net force on block at t = 3 sec. is :
(A) 100 watts (B) 200 watts (C) 300 watts (D) 400 watts

8. The Kinetic energy of block at t = 3 sec. is :
(A) 50 J (B) 100 J (C) 200 J (D) 300 J

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 77

Total Marks : 29

Max. Time : 33 min.

Topics : Wave on a String, Circular Motion, Rigid Body Dynamics, Friction, Center of Mass

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.5 to Q.8	(4 marks, 5 min.)	[16, 20]

1. A sine wave of wavelength λ is travelling in a medium. The minimum distance between the two particles, always having same speed, is -
(A) $\lambda/4$ (B) $\lambda/3$ (C) $\lambda/2$ (D) λ

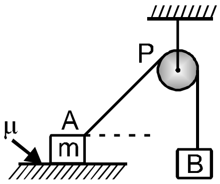
2. When a harmonic wave is propagating through a medium, the displacement 'y' of a particle of the medium is represented by $y = 10 \sin\frac{2\pi}{5}(1800\,t - x)$. The time period will be
(A) $\frac{1}{360}$ s (B) $\frac{1}{36}$ s (C) 36 s (D) 360 s

3. A transverse wave described by equation y = 0.02sin (x + 30t) (where x and t are in metres and sec.respectively) is travelling along a wire of area of cross–section $1mm^2$ and density $8000 kg/m^3$. What is the tension in the string ?
(A) 20 N (B) 7.2 N (C) 30 N (D) 14.4 N

4. A ball tied to the end of the string swings in a vertical circle under the influence of gravity.
(A) When the string makes an angle 90° with the vertical, the tangential acceleration is zero and radial acceleration is somewhere between minimum and maximum
(B) When the string makes an angle 90° with the vertical, the tangential acceleration is maximum and radial acceleration is somewhere between maximum and minimum
(C) At no place in circular motion, tangential acceleration is equal to radial acceleration (in magnitude)
(D) When radial acceleration has its maximum value, the tangential acceleration is zero

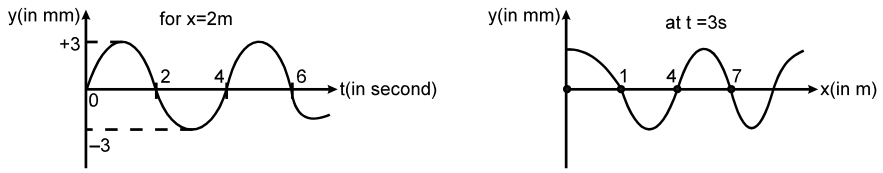
5. A uniform rod of length 75 cm is hinged at one of its ends and is free to rotate in vertical plane. It is released from rest when rod is horizontal. When the rod becomes vertical, it is breaks at mid–point and lower part now moves freely. The distance of centre of lower part from hinge, when it again becomes vertical for the first time is r. Find the approximate value of 2r.

6. In figure shown minimum mass of block B (at a particular angle between horizontal and string AP) to just slide the block A on rough horizontal surface is $\frac{m}{2}$ as shown in figure. If μ is the coefficient of friction between block A and ground then $\frac{1}{\mu^2}$ will be :



7. Body 1 experiences a perfectly elastic collision with a stationary Body 2. Determine the mass ratio $\left(\frac{m_2}{m_1}\right)$, if after a head-on collision the particles fly apart in the opposite directions with equal speeds.

8. A sinusoidal wave propagates along a string. In figure (a) and (b) 'y' represents displacement of particle from the mean position. 'x' & 't' have usual meanings. Find:



(a) wavelength, frequency and speed of the wave.
(b) maximum velocity and maximum acceleration of the particles
(c) the magnitude of slope of the string at x = 2 at t = 4 sec.

PHYSICS
DPP
DAILY PRACTICE PROBLEMS

DPP No. 78

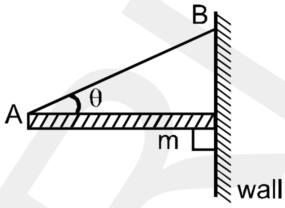
Total Marks : 27

Max. Time : 30 min.

Topics : Rigid Body Dynamics, Circular Motion, Friction, Projectile Motion, Work, Power and Energy

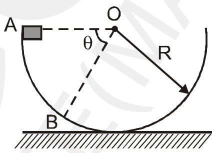
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.3	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.4 to Q.6	(3 marks, 3 min.)	[9, 9]
Match the Following (no negative marking) (2 × 4)Q.7	(8 marks, 10 min.)	[8, 10]

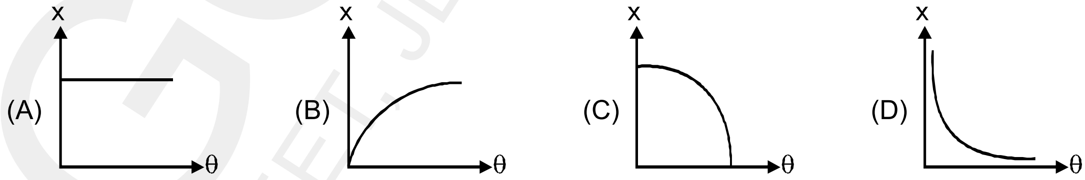
1. A rod of mass m is supported by string AB and friction due to wall. Then friction force on rod due to wall is : (g = acceleration due to gravity).



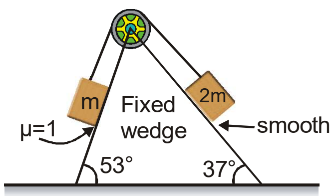
(A) mg upward (B) mg downward (C) $\frac{mg}{2}$ upward (D) Data insufficient

2. A small block of mass m is released from rest from point A inside a smooth hemisphere bowl of radius R, which is fixed on ground such that OA is horizontal. The ratio (x) of magnitude of centripetal force and normal reaction on the block at any point B varies with θ as :





3. Two blocks of mass m and 2m are arranged on a wedge that is fixed on a horizontal surface. Friction coefficient between the block and wedge are shown in figure. Find the magnitude of acceleration of two blocks.



COMPREHENSION

A projectile is fired with speed v_0 at t = 0 on a planet named 'Increasing Gravity'. This planet is strange one, in the sense that the acceleration due to gravity increases linearly with time t as g(t) = bt, where b is a positive constant. 'Increasing Gravity'

4. If angle of projection with horizontal is θ then the time of flight is :

(A) $\sqrt{\frac{6v_0 \sin\theta}{b}}$ (B) $\sqrt{\frac{2v_0 \sin\theta}{b}}$ (C) $\sqrt{\frac{3v_0 \sin\theta}{b}}$ (D) $\sqrt{\frac{2v_0}{b}}$

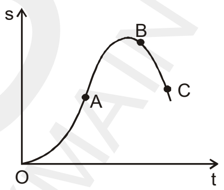
5. If angle of projection with horizontal is θ, then the maximum height attained is

(A) $\frac{1}{3}\frac{(v_0 \sin\theta)^{3/2}}{\sqrt{b}}$ (B) $\frac{4}{3}\frac{(v_0 \sin\theta)^{3/2}}{\sqrt{b}}$ (C) $\frac{(2v_0 \sin\theta)^{3/2}}{3\sqrt{b}}$ (D) None of these

6. At what angle with horizontal should the projectile be fired so that it travels the maximum horizontal distance:

(A) $\theta = \tan^{-1}\frac{1}{2}$ (B) $\theta = \tan^{-1}\frac{1}{\sqrt{2}}$ (C) $\theta = \tan^{-1}\sqrt{2}$ (D) $\theta = \tan^{-1}2$

7. The displacement-time graph of a body acted upon by some forces is shown in the figure. For this situation match the entries of column I with the entries of column II.



Column I	**Column II**
(A) For OA, the total work done by all forces together	(p) always positive
(B) For OA, the work done by few of the acting forces	(q) always negative
(C) For AB, the work done by few of the acting forces	(r) can be positive
(D) For BC, the work done by few of the acting forces.	(s) can be zero
	(t) can be negative

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 79

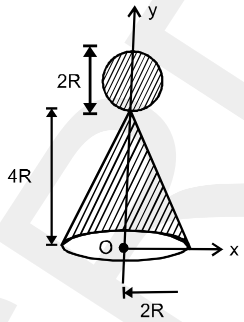
Total Marks : 22

Max. Time : 23 min.

Topics : Center of Mass, Relative Motion, Wave on a String, Friction

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.3	**(3 marks, 3 min.)**	**[9, 9]**
Subjective Questions ('–1' negative marking) Q.4	**(4 marks, 5 min.)**	**[4, 5]**
Comprehension ('–1' negative marking) Q.5 to Q.7	**(3 marks, 3 min.)**	**[9, 9]**

1. A carpenter has constructed a toy as shown in figure. If the density of the material of the sphere is 12 tirnes that of cone, the y-coordinate of COM of toy from point O



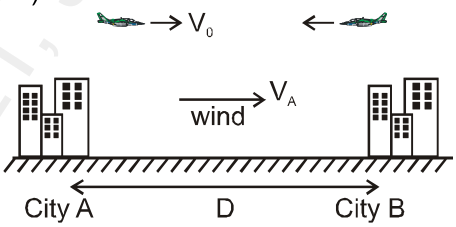
(A) 3R

(B) $\frac{9R}{2}$

(C) $\frac{7R}{2}$

(D) 4R

2. An airplane flies between two cities separated by a distance D. Assume the wind blows directly from one city to the other at a speed V_A (as shown) and the speed of the airplane is V_o relative to the air. Find the time taken by the airplane to make a round trip between the two cities (that is, to fly from city A to city B and then back to City A) ?



(A) $\frac{2DV_o}{V_0^2 - V_A^2}$

(B) $\frac{DV_o}{V_0^2 - V_A^2}$

(C) $\frac{2DV_o}{V_0^2 + V_A^2}$

(D) $\frac{DV_o}{V_0^2 + V_A^2}$

3. A travelling wave $y = A \sin (kx - \omega t + \theta)$ passes from a heavier string to a lighter string. The reflected wave has amplitude 0.5 A. The junction of the strings is at x = 0. The equation of the reflected wave is:

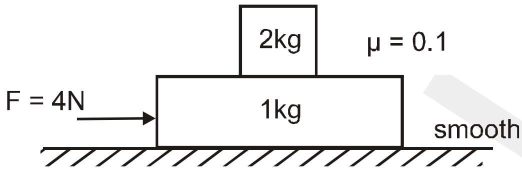
(A) $y' = 0.5 A \sin (kx + \omega t + \theta)$

(B) $y' = -0.5 A \sin (kx + \omega t + \theta)$

(C) $y' = -0.5 A \sin (\omega t - kx - \theta)$

(D) $y' = 0.5 A \sin (kx + \omega t - \theta)$

4. 2 kg block is kept on 1 kg block as shown. The friction between 1 kg block and fixed surface is absent and the coefficient of friction between 2 kg block and 1 kg block is $\mu = 0.1$. A constant horizontal force F = 4 N is applied on 1 kg block. If the work done by the friction on 1 kg block in 2 s is – X J, then find X. Take $g = 10\ m/s^2$.



COMPREHENSION

A sinusoidal wave travels along a taut string of linear mass density 0.1 g/cm. The particles oscillate along y-direction and wave moves in the positive x-direction. The amplitude and frequency of oscillation are 2mm and 50 Hz respectively. The minimum distance between two particles oscillating in the same phase is 4m.

5. The tension in the string is (in newton)

(A) 4000 (B) 400 (C) 25 (D) 250

6. The amount of energy transferred (in Joules) through any point of the string in 5 seconds is

(A) $\frac{\pi^2}{10}$

(B) $\frac{\pi^2}{50}$

(C) $\frac{\pi^2}{5}$

(D) Cannot be calculated because area of cross-section of string is not given.

7. If at x = 2m and t = 2s, the particle is at y = 1mm and its velocity is in positive y-direction, then the equation of this travelling wave is : (y is in mm, t is in seconds and x is in metres)

(A) $y = 2\sin\left(\frac{\pi x}{2} - 100\pi t + 30°\right)$ (B) $y = 2\sin\left(\frac{\pi x}{2} - 100\pi t + 120°\right)$

(C) $y = 2\sin\left(\frac{\pi x}{2} - 100\pi t + 150°\right)$ (D) None of these

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 80

Total Marks : 22

Max. Time : 23 min.

Topics :Circular Motion, Center of Mass, Rigid Body Dynamics, Work, Power and Energy, String Waves

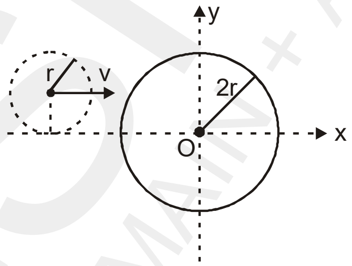
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]

1. A boy of mass 30 kg starts running from rest along a circular path of radius 6 m with constant tangential acceleration of magnitude 2 m/s^2. After 2 sec from start he feels that his shoes started slipping on ground. The friction coefficient between his shoes and ground is : (Take g = 10 m/s^2)

(A) $\frac{1}{2}$ (B) $\frac{1}{3}$

(C) $\frac{1}{4}$ (D) $\frac{1}{5}$

2. A small smooth disc of mass m and radius r moving with an initial velocity 'v' along the positive x-axis collided with a big disc of mass 2m and radius 2r which was initially at rest with its centre at origin as shown in figure.

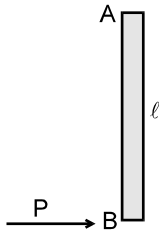


If the coefficient of restitution is 0 then velocity of larger disc after collision is

(A) $\frac{8v}{27}\hat{i} - \frac{2\sqrt{2}}{27}v\hat{j}$ (B) $\frac{8v}{27}\hat{i} + \frac{2\sqrt{2}}{27}v\hat{j}$

(C) $\frac{v}{3}\hat{i}$ (D) $\frac{2\sqrt{2}}{27}v\hat{i} - \frac{8v}{27}\hat{j}$

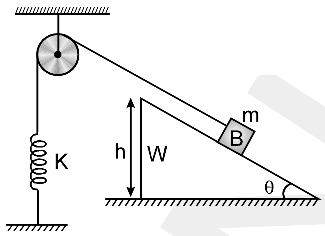
3. A uniform rod AB of mass m and length l at rest on a smooth horizontal surface. An impulse P is applied to the end B. The time taken by the rod to turn through a right angle is:



(A) $\frac{2\pi ml}{P}$ (B) $\frac{\pi ml}{3P}$

(C) $\frac{\pi ml}{12P}$ (D) $\frac{2\pi ml}{3P}$

4. In the figure shown the pulley is smooth. The spring and the string are light. The block 'B' slides down from the top along the fixed rough wedge of inclination θ. Assuming that the block reaches the end of the wedge. Find the speed of the block at the end. Take the coefficient of friction between the block and the wedge to be μ and the spring was relaxed when the block was released from the top of the wedge.



COMPREHENSION

A sinusoidal wave travels along a taut string of linear mass density 0.1 g/cm. The particles oscillate along y-direction and wave moves in the positive x-direction. The amplitude and frequency of oscillation are 2mm and 50 Hz respectively. The minimum distance between two particles oscillating in the same phase is 4m.

5. The tension in the string is (in newton)
(A) 4000 (B) 400 (C) 25 (D) 250

6. The amount of energy transferred (in Joules) through any point of the string in 5 seconds is

(A) $\frac{\pi^2}{10}$

(B) $\frac{\pi^2}{50}$

(C) $\frac{\pi^2}{5}$

(D) Cannot be calculated because area of cross-section of string is not given.

7. If at x = 2m and t = 2s, the particle is at y = 1mm and its velocity is in positive y-direction, then the equation of this travelling wave is : (y is in mm, t is in seconds and x is in metres)

(A) $y = 2\sin\left(\frac{\pi x}{2} - 100\pi t + 30°\right)$ (B) $y = 2\sin\left(\frac{\pi x}{2} - 100\pi t + 120°\right)$

(C) $y = 2\sin\left(\frac{\pi x}{2} - 100\pi t + 150°\right)$ (D) None of these

PHYSICS

DPP
DAILY PRACTICE PROBLEMS

DPP No. 81

Total Marks : 22

Max. Time : 22 min.

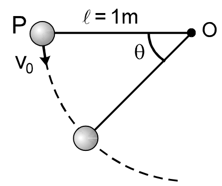
Topics : Wave on a String , Circular Motion, Relative Motion

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4	(4 marks, 4 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]

1. Three waves producing displacement in the same direction of same frequency and of amplitudes 10μ m, 4μm and 7μ m arrive at a point with successive phase difference of $\pi / 2$. The amplitude of the resultant wave is
(A) 2μm (B) 7μm (C) 5μm (D) 1

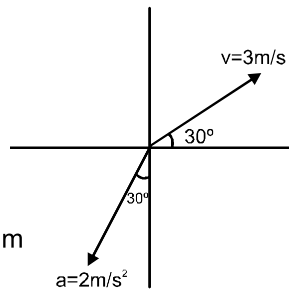
2. A string fixed at both ends has consecutive standing wave modes for which the distances between adjacent nodes are 18 cm and 16 cm respectively. The length of the string is -
(A) 144 cm (B) 152 cm (C) 176 cm (D) 200 cm

3. The sphere at P is given a downward velocity v_0 and swings in a vertical plane at the end of a rope of ℓ = 1m attached to a support at O. The rope breaks at angle 30° from horizontal, knowing that it can withstand a maximum tension equal to three times the weight of the sphere. Then the value of v_0 will be :
($g = \pi^2$ m/s^2)



(A) $\frac{g}{2}$ m/s (B) $\frac{2g}{3}$ m/s
(C) $\sqrt{\frac{3g}{2}}$ m/s (D) $\frac{g}{3}$ m/s

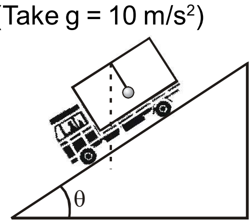
4. Initial velocity and acceleration of a particle are as shown in the figure. Acceleration vector of particle remain constant. Then radius of curvature of path of particle :



(A) is 9m initially (B) is $\frac{9}{\sqrt{3}}$ m initially
(C) will have minimum value of $\frac{9}{8}$ m (D) will have minimum value $\frac{3}{8}$ m

COMPREHENSION

A van accelerates uniformly down an inclined hill going from rest to 30 m/s in 6 s. During the acceleration, a toy of mass m = 0.1 kg hangs by a light string from the van's ceiling. The acceleration is such that string remains perpendicular to the ceiling. (Take g = 10 m/s^2)



5. The angle θ of the incline is :
(A) 30° (B) 60° (C) 90° (D) 45°

6. The tension in the string is
(A) 1.0 N (B) 0.5 N (C) $\frac{\sqrt{3}}{2}$ N (D) $\sqrt{3}$ N

7. The friction force on the van is
(A) Zero (B) mg cosθ (C) mg sinθ (D) mg tanθ

PHYSICS DPP
DAILY PRACTICE PROBLEMS

DPP No. 82

Total Marks : 23

Max. Time : 25 min.

Topics : Wave on a String , Circular Motion

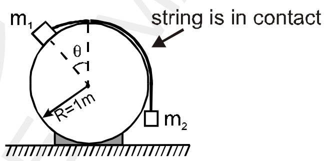
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.3 to Q.4	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]

1. The particle displacement (in cm) in a stationary wave is given by $y(x, t) = 2 \sin(0.1\pi x) \cos(100\,\pi t)$. The distance between a node and the next antinode is :
(A) 2.5 cm (B) 7.5 cm (C) 5 cm (D) 10 cm

2. A string of length 1.5 m with its two ends clamped is vibrating in fundamental mode. Amplitude at the centre of the string is 4 mm. Minimum distance between the two points having amplitude 2 mm is:
(A) 1 m (B) 75 cm (C) 60 cm (D) 50 cm

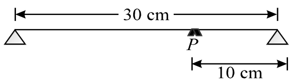
3. A string is fixed at both ends. The tension in the string and density of the string are accurately known but the length and the radius of cross section of the string are known with some error. If maximum errors made in the measurement of length and radius are 1% and 0.5% respectively then what is the maximum possible percentage error in the calculation of fundamental frequency of that string.

4. A mass m_1 lies on fixed, smooth cylinder. An ideal cord attached to m_1 passes over the cylinder and is connected to mass m_2 as shown in the figure.
(a) Find the value of θ (shown in diagram) for which the system is in equilibrium
(b) Given m_1 = 5 kg, m_2 = 4kg . The system is released from rest when θ = 30º. Find the magnitude of acceleration of mass m_1 just after the system is released.



COMPREHENSION

Figure shows a clamped metal string of length 30 cm and linear mass density 0.1 kg/m. which is taut at a tension of 40 N. A small rider (piece of paper) is placed on string at point *P* as shown. An external vibrating tuning fork is brought near this string and oscillations of rider are carefully observed.



5. At which of the following frequencies of turning fork, rider will not vibrate at all :
(A) $\frac{100}{3}$ Hz (B) 50 Hz (C) 200 Hz (D) None of these

6. At which of the following frequencies the point *P* on string will have maximum oscillation amplitude among all points on string :
(A) $\frac{200}{3}$ Hz (B) 100 Hz (C) 200 Hz (D) None of these

7. Now if the tension in the string is made 160 N, at which of the following frequencies of turning fork, rider will not vibrate at all
(A) $\frac{100}{3}$ Hz (B) 50 Hz (C) 200 Hz (D) None of these

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 83

Total Marks : 29

Max. Time : 32 min.

Topics : Center of Mass, Wave on a String ,Friction

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4 to Q.5	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.6	(4 marks, 5 min.)	[4, 5]
Match the Following (no negative marking) (2 × 4)	(8 marks, 10 min.)	[8, 10]

1. A loaded spring gun, initially at rest on a horizontal frictionless surface fires a marble of mass m at an angle of elevation θ. The mass of the gun is M, that of the marble is m and the muzzle velocity of the marble is v_0, then velocity of the gun just after the firing is :

(A) $\frac{mv_0}{M}$ (B) $\frac{mv_0\cos\theta}{M}$ (C) $\frac{mv_0\cos\theta}{M+m}$ (D) $\frac{mv_0\cos2\theta}{M+m}$

2. Equation of a standing wave is generally expressed as $y = 2A \sin\omega t \cos kx$. In the equation, quantity ω/k represents

(A) the transverse speed of the particles of the string.

(B) the speed of either of the component waves.

(C) the speed of the standing wave.

(D) a quantity that is independent of the properties of the string.

3. A string 1m long fixed at one end is made to oscillate by a 300Hz vibrator attached to its other end. The string vibrates in 3 loops. The speed of transverse waves in the string is equal to

(A) 100 m/s (B) 200 m/s (C) 300 m/s (D) 400 m/s

4. Which of the following combinations can give standing wave.

(A) $y_1 = A\sin^2(\omega t - kx)$; $y_2 = -A\sin^2(\omega t + kx)$

(B) $y_1 = A\sin(kx - \omega t)$; $y_2 = A\cos(\omega t + kx)$

(C) $y_1 = 2A\cos^2(\omega t - kx + \pi)$; $y_2 = A[\sin 2(\omega t + kx) - 1]$

(D) $y_1 = A\sin(kx - \omega t + 30^\circ)$; $y_2 = A\cos(\omega t + kx - 60^\circ)$.

5. The vibrations of a string of length 600 cm fixed at both ends are represented by the equation

$$y = 4\sin\left(\pi\frac{x}{15}\right)\cos(96\pi t)$$

where x and y are in cm and t in seconds.

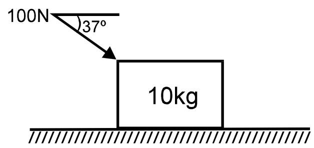
(A) The maximum displacement of a particle at x = 5 cm is $2\sqrt{3}$ cm .

(B) The nodes located along the string are 15n where integer n varies from 0 to 40.

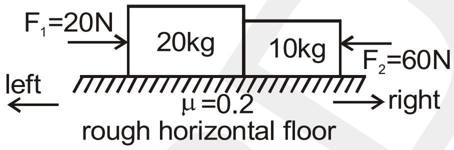
(C) The velocity of the particle at x = 7.5 cm at t = 0.25 sec is zero

(D) The equations of the component waves whose superposition gives the above wave are $2\sin 2\pi\left(\frac{x}{30}+48t\right)$, $2\sin 2\pi\left(\frac{x}{30}-48t\right)$.

6. In the figure shown calculate the angle of friction. The block does not slide. Take g = 10 m/s^2.



7. Two blocks of masses 20 kg and 10 kg are kept or a rough horizontal floor. The coefficient of friction between both blocks and floor is μ = 0.2. The surface of contact of both blocks are smooth. Horizontal forces of magnitude 20 N and 60 N are applied on both the blocks as shown in figure. Match the statement in column-I with the statements in column-II.



Column-I	Column-II
(A) Frictional force acting on block of mass 10 kg	(p) has magnitude 20 N
(B) Frictional force acting on block of mass 20 kg	(q) has magnitude 40 N
(C) Normal reaction exerted by 20 kg block on 10 kg block	(r) is zero
(D) Net force on system consisting of 10 kg block and 20 kg block	(s) is towards right (in horizontal direction).

DPP No. 84

Total Marks : 25

Max. Time : 25 min.

Topics : Work, Power and Energy, Wave on a String, Center of Mass, Projectile Motion

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.5	(4 marks, 5 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]

1. What is the minimum stopping distance for a vehicle of mass m moving with speed v along a level road. If the coefficient of friction between the tyres and the road is μ.

(A) $\frac{v^2}{2\mu g}$ (B) $\frac{2v^2}{\mu g}$ (C) $\frac{v^2}{\mu g}$ (D) none of these

2. The (x, y) coordinates of the corners of a square plate are (0, 0) (L, 0) (L, L) and (0, L). The edges of the plate are clamped & transverse standing waves are set up in it. If u (x, y) denotes the displacement of the plate at the point (x, y) at some instant of time, the possible expression for 'u' is : [a = positive constant]

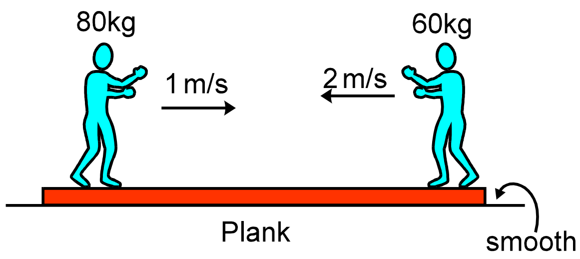
(A) $a\cos\left(\frac{\pi x}{2L}\right)\cos\left(\frac{\pi y}{2L}\right)$ (B) $a\sin\left(\frac{\pi x}{L}\right)\sin\left(\frac{\pi y}{2L}\right)$

(C) $a\sin\left(\frac{\pi x}{L}\right)\sin\left(\frac{2\pi y}{L}\right)$ (D) $a\cos\left(\frac{2\pi x}{L}\right)\sin\left(\frac{\pi y}{L}\right)$

3. A chord attached about an end to a vibrating fork divides it into 6 loops, when its tension is 36 N. The tension at which it will vibrate in 4 loops is:
(A) 24 N (B) 36 N (C) 64 N (D) 81 N

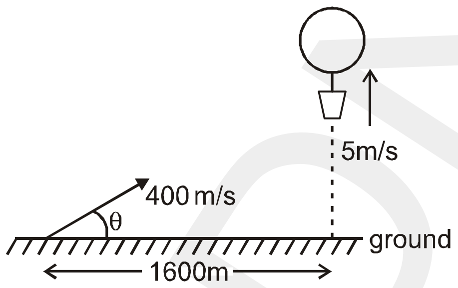
4. A wire having a linear mass density 5.0×10^{-3} kg/m is stretched between two rigid supports with a tension of 450 N. The wire resonates at a frequency of 420 Hz. The next higher frequency at which the same wire resonates is 480 Hz. The length of the wire is
(A) 2.0 m (B) 2.1 m (C) 2.5 m (D) 3 m

5. Two men of masses 80 kg and 60 kg are standing on a wood plank of mass 100 kg, that has been placed over a smooth surface. If both the men start moving toward each other with speeds 1 m/s and 2 m/s respectively then find the velocity of the plank by which it starts moving.



COMPREHENSION

An observer having a gun observes a remotely controlled balloon. When he first noticed the balloon, it was at an altitude of 800 m and moving vertically upward at a constant velocity of 5m/s. The horizontal displacement of balloon from the observer is 1600 m . Shells fired from the gun have an initial velocity of 400 m/s at a fixed angle θ (sin θ = 3/5 and cos θ = 4/5). The observer having gun waits (for some time after observing the balloon) and fires so as to destroy the balloon. Assume $g = 10 m/s^2$. Neglect air resistance.



6. The flight time of the shell before it strikes the balloon is
(A) 2sec (B) 5sec. (C) 10 sec (D) 15 sec

7. The altitude of the collision above ground level is
(A) 1250m (B) 1325m (C) 1075m (D) 1200m

8. After noticing the balloon, the time for which observer having gun waits before firing the shell is
(A) 50 sec. (B) 55 sec. (C) 60 sec. (D) 45 sec.

PHYSICS DPP
DAILY PRACTICE PROBLEMS

DPP No. 85

Total Marks : 25

Max. Time : 26 min.

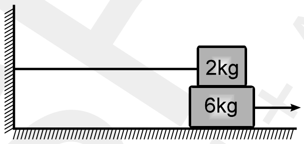
Topics : Work, Power and Energy, Friction, Wave on a String , Rigid Body Dynamics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.5	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

1. A block of mass 1kg is pushed on a movable wedge of mass 2kg and height h = 30 cm with a velocity u = 6m/sec. Before striking the wedge it travels 2 m on a rough horizontal portion. Velocity is just sufficient for the block to reach the top of the wedge. Assuming all surfaces are smooth except the given horizontal part and collision of block and wedge is jerkless, the friction coefficient of the rough horizontal part is :

(A) 0.125 (B) 0.377 (C) 0.675 (D) 0.45

2. With reference to the figure shown, if the coefficient of friction at the surfaces is 0.42, then the force required to pull out the 6.0 kg block with an acceleration of 1.50 m/s^2 will be:



(A) 36 N (B) 24 N (C) 84 N (D) 51 N

3. A string of length 'ℓ' is fixed at both ends. It is vibrating in its 3rd overtone with maximum amplitude 'a'. The amplitude at a distance $\frac{\ell}{3}$ from one end is :

(A) a (B) 0 (C) $\frac{\sqrt{3}\,a}{2}$ (D) $\frac{a}{2}$

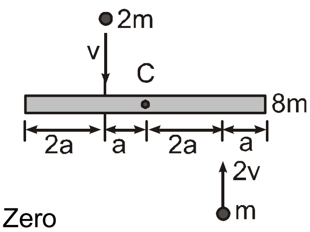
4. What is the percentage change in the tension necessary in a sonometer of fixed length to produce a note one octave lower (half of original frequency) than before

(A) 25% (B) 50% (C) 67% (D) 75%

5. A rope, under tension of 200 N and fixed at both ends, oscillates in a second harmonic standing wave pattern. The displacement of the rope is given by $y = (0.10\text{ m})\sin\left(\frac{\pi x}{3}\right)\sin(12\pi t)$, where x = 0 at one end of the rope, x is in meters and t is in seconds. Find the length of the rope in meters.

COMPREHENSION

A uniform bar of length 6 a & mass 8 m lies on a smooth horizontal table. Two point masses m & 2 m moving in the same horizontal plane with speeds 2 v and v respectively strike the bar as shown & stick to the bar after collision.



6. Velocity of the centre of mass of the system is

(A) $\frac{v}{2}$ (B) v (C) $\frac{2v}{3}$ (D) Zero

7. Angular velocity of the rod about centre of mass of the system is

(A) $\frac{v}{5a}$ (B) $\frac{v}{15a}$ (C) $\frac{v}{3a}$ (D) $\frac{v}{10a}$

8. Total kinetic energy of the system, just after the collision is

(A) $\frac{3}{5}mv^2$ (B) $\frac{3}{25}mv^2$ (C) $\frac{3}{15}mv^2$ (D) $3\,mv^2$

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 86

Total Marks : 27

Max. Time : 30 min.

Topics : Simple Harmonic Motion, Sound Waves, Center of Mass, Circular motion, Kinetic Theory of Gases & Heat

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.5	**(3 marks, 3 min.)**	**[15,15]**
Subjective Questions ('–1' negative marking) Q.6	**(4 marks, 5 min.)**	**[4, 5]**
Match the Following (no negative marking) (2 × 4)	**(8 marks, 10 min.)**	**[8, 10]**

1. Two pendulums differ in lengths by 22 cm. They oscillate at the same place so that one of them makes 30 oscillations and the other makes 36 oscillations during the same time.The lengths (in cm) of the pendulum are :

(A) 72 and 50 (B) 60 and 38 (C) 50 and 28 (D) 80 and 58

2. Three waves of the same amplitude have frequencies (n – 1), n and (n + 1)Hz. They superpose on one another to produce beats. The number of beats produced per second is :

(A) n (B) 2 (C) 1 (D) 3n

3. A spherical ball of mass m_1 collides head on with another ball of mass m_2 at rest. The collision is elastic. The fraction of kinetic energy lost by m_1 is :

(A) $\frac{4m_1m_2}{(m_1+m_2)^2}$ (B) $\frac{m_1}{m_1+m_2}$ (C) $\frac{m_2}{m_1+m_2}$ (D) $\frac{m_1m_2}{(m_1+m_2)^2}$

4. Two equal masses are connected by a spring satisfying Hooke's law and are placed on a frictionless table. The spring is elongated a little and allowed to go. Let the angular frequency of oscillations be ω. Now one of the masses is stopped. The square of the new angular frequency is :

(A) ω^2 (B) $\frac{\omega^2}{2}$ (C) $\frac{\omega^2}{3}$ (D) $2\omega^2$

5. When a compressible wave is sent towards bottom of sea from a stationary ship it is observed that its echo is heard after 2s. If bulk modulus of elasticity of water is 2×10^9 N/m^2 , mean temperature of water is 4° and mean density of water is 1000 kg/m^3, then depth of sea will be

(A) 1014 m (B) 1414 m (C) 2828 m (D) 3000 m

6. The speed of sound in a mixture of n_1 = 2 moles of He, n_2 = 2 moles of H_2 at temperature T = $\frac{972}{5}$ K is $\eta \times 10$ m/s. Find η. (Take R = $\frac{25}{3}$ J/mole-K)

7. Match the statements in column-I with the statements in column-II.

Column-I	**Column-II**
(A) A tight string is fixed at both ends and sustaining standing wave	(p) At the middle, antinode is formed in odd harmonic
(B) A tight string is fixed at one end and free at the other end	(q) At the middle, node is formed in even harmonic
(C) Standing wave is formed in an open organ pipe. End correction is not negligible.	(r) At the middle, neither node nor antinode is formed
(D) Standing wave is formed in a closed organ pipe. End correction is not negligible.	(s) Phase difference between SHMs of any two particles will be either π or zero.

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 87

Total Marks : 28

Max. Time : 31 min.

Topics : String, Simple Harmonic Motion, Wave on a String, Rigid Body Dynamics, Sound Waves

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[12,12]
Multiple choice objective ('–1' negative marking) Q.5	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.6	(4 marks, 5 min.)	[4, 5]
Match the Following (no negative marking) (2 × 4)	(8 marks, 10 min.)	[8, 10]

1. When a particle oscillates in simple harmonic motion, both in potential energy and kinetic energy vary sinusoidally with time. If ν be the frequency of the motion of the particle, the frequency associated with the kinetic energy is :

(A) 4ν (B) 2ν (C) ν (D) $\frac{\nu}{2}$

2. Two elastic waves move along the same direction in the same medium. The pressure amplitudes of both the waves are equal, but the wavelength of the first wave is three times that of the second. If the average power transmitted through unit area by the first wave is W_1 and that by the second is W_2, then.

(A) $W_1 = W_2$ (B) $W_1 = 3W_2$ (C) $W_2 = 3W_1$ (D) $W_1 = 9W_2$

3. A spring of certain length and having spring constant k is cut into two pieces of lengths in a ratio 1 : 2. The spring constants of the two pieces are in a ratio :

(A) 1 : 1 (B) 1 : 4 (C) 1 : 2 (D) 2 : 1

4. Which of the following options is not correct :

(A) Intensity of the wave produced by a point source at any point is inversely proportional to square of the distance from point source

(B) Power of the wave, produced by a point source, varies as inverse square of the distance from point source

(C) Intensity of the wave produced by line source at any point varies as inverse of the distance from line source

(D) Amplitude of the wave produced by a point source at any point varies as inverse of the distance from point source

5. The rate of change of angular momentum of a system of particles about the centre of mass is equal to the sum of external torques about the centre of mass when the centre of mass is :

(A) Fixed with respect to an inertial frame.

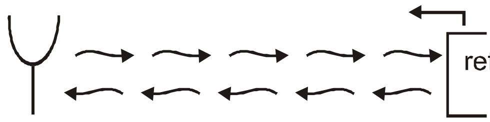
(B) in linear acceleration

(C) in rotational motion.

(D) is in a translational motion.

6. A man standing in front of a mountain beats a drum at regular intervals. The druming rate is gradually increased and he finds that the echo is not heard distinctly when the rate becomes 40 per minute.He then moves towards mountain by 90 m and finds that echo is again not heard when drumming rate becomes 60 per minute. Find the ratio of distance between the mountain and the initial position of the man and the distance by which he moved.

7. **Match the column:**

	Column–I	Column–II
(A)	 Sinusoidal sound waves are continuously sent from one end by a tuning fork and they are reflected from a moving wall. Due to the superposition of the incident waves and the reflected waves.	(p) Travelling wave is formed
(B)	Equation of vibrating particles is $y = A\sin^2(\omega t - kx) + B\cos^2(kx - \omega t) + C\cos(kx + \omega t)\sin(\omega t + kx)$ (where A,B,C are constants and can have any value) it is possible that	(q) Standing wave is formed
(C)	 A metal rod is fixed at one end and free at the other end. The free end is hit once by a hammer as shown. Then :	(r) Beats are formed
(D)	Equation of vibrating particles is $y = (1\text{mm})\ \sin 100\left(t - \frac{x}{330}\right)\cos\left(\frac{x}{330} - t\right)$	(s) Particles perform simple harmonic motion

PHYSICS DPP
DAILY PRACTICE PROBLEMS

DPP No. 88

Total Marks : 23

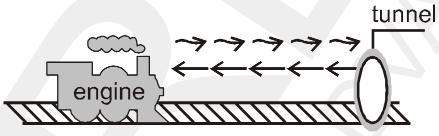
Max. Time : 24 min.

Topics : Sound Waves, Sound , Work, Power and Energy, Center of Mass

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Multiple choice objective ('–1' negative marking) Q.6	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.7	(4 marks, 5 min.)	[4, 5]

1. The frequency of a man's voice is 300 Hz and its wavelength is 1 meter. If the wavelength of a child's voice is 1.5 m, then the frequency of the child's voice is:
(A) 200 Hz (B) 150 Hz (C) 400 Hz (D) 350 Hz.

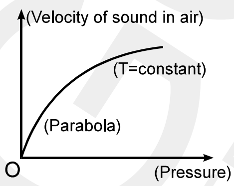
2. An engine is moving towards a tunnel with a constant speed.

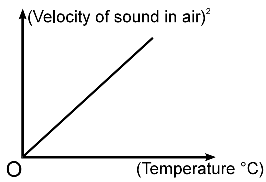


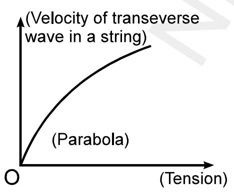
To check its own velocity, the driver sends whistles twice at an intervel of 2 minutes. The sound moves forward, gets reflected from the tunnel and again reaches to the driver. He listens two echoes of the sound, at an interval of 1 minute. If speed of sound is 300 m/sec, speed of the engine should be :
(A) 50 m/sec (B) 75 m/sec (C) 100 m/sec (D) 125 m/sec

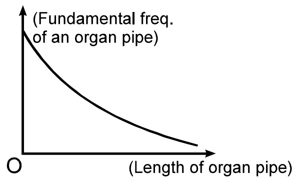
3. The equation of displacement due to a sound wave is $s = s_0 \sin^2(\omega t - kx)$. If the bulk modulus of the medium is B, then the equation of pressure variation due to that sound is
(A) $B k s_0 \sin(2\omega t - 2kx)$ (B) $-B k s_0 \sin(2\omega t - 2kx)$
(C) $B k s_0 \cos^2(\omega t - kx)$ (D) $-B k s_0 \cos^2(\omega t - kx)$

4. Which of the following is/ are correct.

(A) 

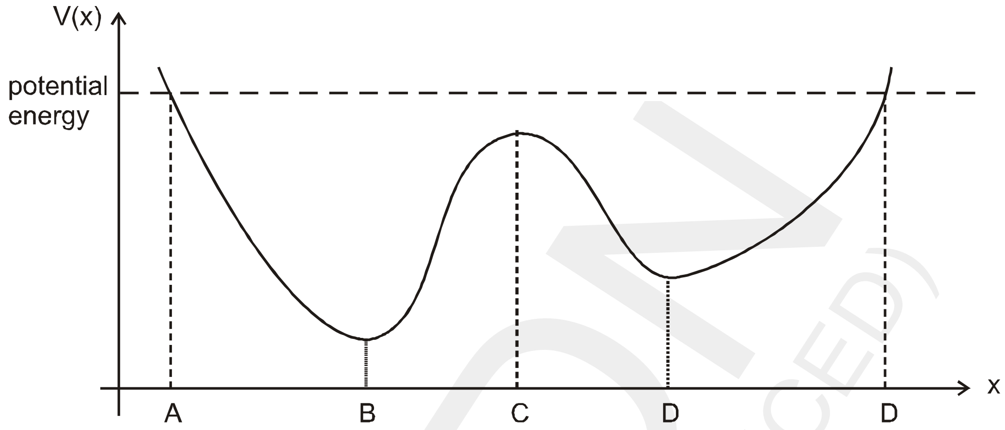
(B) 

(C) 

(D) 

5. Propagation of a sound wave in a gas is quite close to :
(A) an isothermal process
(B) an adiabatic process
(C) an isobaric process
(D) a process that does not exhibit properties close to any of the three given in (A),(B),(C)

6. A particle moves in one dimension in a conservation force field. The potential energy is depicted in the graph below.



If the particle starts to move from rest from the point A, then
(A) the speed is zero at the point A and E.
(B) the acceleration vanished at the points A, B, C, D, E
(C) the acceleration vanished at the points B, C, D.
(D) the speed is maximum at the point D.

7. A railway carriage of mass M_c filled with sand of mass M_s moves along the rails. The carriage is given an impulse and it starts with a velocity v_0. At the same time it is observed that the sand starts leaking through a hole at the bottom of the carriage at a constant mass rate λ. Find the distance at which the carriage becomes empty and the velocity attained by the carriage at that time. (Neglect the friction along the rails.)

PHYSICS DPP
DAILY PRACTICE PRODUCTS

DPP No. 89

Total Marks : 27

Max. Time : 30 min.

Topics : Elasticity and Plasticity

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15,15]
Subjective Questions ('–1' negative marking) Q.6	(4 marks, 5 min.)	[4, 5]
Match the Following (no negative marking) (2 × 4)	(8 marks, 10 min.)	[8, 10]

COMPREHENSION

ELASTICITY AND PLASTICITY

The property of a material body by virtue of which it regains its original configuration (i.e. shape and size) when the external deforming force is removed is called elasticity. The property of the material body by virtue of which it does not regain its original configuration when the external force is removed is called plasticity.

Deforming force : An external force applied to a body which changes its size or shape or both is called deforming force.

Perfectly Elastic body : A body is said to be perfectly elastic if it completely regains its original form when the deforming force is removed. Since no material can regain completely its original form so the concept of perfectly elastic body is only an ideal concept. A quartz fiber is the nearest approach to the perfectly elastic body.

Perfectly Plastic body : A body is said to be perfectly plastic if it does not regain its original form even slightly when the deforming force is removed. Since every material partially regain its original form on the removal of deforming force, so the concept of perfectly plastic body is only an ideal concept. Paraffin wax, wet clay are the nearest approach to a perfectly plastic bodies.

Cause of Elasticity : In a solid, atoms and molecules are arranged in such a way that each molecule is acted upon by the forces due to the neighbouring molecules. These forces are known as intermolecular forces. When no deforming force is applied on the body, each molecule of the solid (i.e. body) is in its equilibrium position and the inter molecular forces between the molecules of the solid are maximum.

On applying the deforming force on the body, the molecules either come closer or go far apart from each other. As a result of this, the molecules are displaced from their equilibrium position. In other words, intermolecular forces get changed and restoring forces are developed on the molecules. When the deforming force is removed, these restoring forces bring the molecules of the solid to their respective equilibrium positions and hence the solid (or the body) regains its original form.

STRESS

When deforming force is applied on the body then the equal restoring force in opposite direction is developed inside the body. The restoring forces per unit area of the body is called stress.

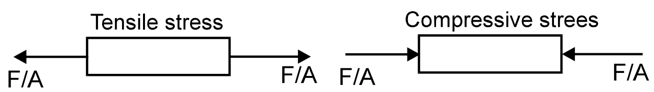
$$\text{stress} = \frac{\text{restoring force}}{\text{Area of the body}} = \frac{F}{A}$$

The unit of stress is N/m^2 or Nm^{-2}. There are three types of stress

1. Longitudinal or Normal stress

When object is one dimensional then force acting per unit area is called longitudinal stress.

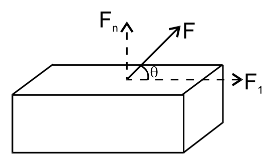
It is of two types : (a) compressive stress (b) tensile stress



Examples :

(i) Consider a block of solid as shown in figure. Let a force F be applied to the face which has area A. Resolve $\vec{F}$ into two components :

$F_n = F \sin\theta$ called normal force and $F_t = F \cos\theta$ called tangential force.



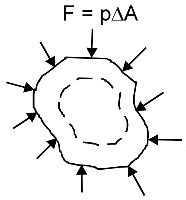
$\therefore$ Normal (tensile) stress $= \frac{F_n}{A} = \frac{F\sin\theta}{A}$

2. Tangential or shear stress

It is defined as the restoring force acting per unit area tangential to the surface of the body. Refer to shown in figure above

Tangential (shear) stress = $\frac{F_t}{A} = \frac{F\cos\theta}{A}$

The effect of stress is to produce distortion or a change in size, volume and shape (i.e. configuration of the body).



STRAIN

The ratio of the change in configuration (i.e. shape, length or volume) to the original configuration of the body is called strain

i.e. Strain, $\in = \frac{\text{change in configuration}}{\text{original configuration}}$

It has no unit

(i) Longitudinal strain : This type of strain is produced when the deforming force causes a change in length of the body. It is defined as the ratio of the change in length to the original length of the body.

Consider a wire of length L : When the wire is stretched by a force F, then let the change in length of the wire is ΔL shown in the figure.

$\therefore$ Longitudinal strain , $\in_\ell = \frac{\text{change in length}}{\text{original length}}$ or Longitudinal strain = $\frac{\Delta L}{L}$

HOOKE'S LAW AND MODULUS OF ELASTICITY

According to this law, within the elastic limit, stress is proportional to the strain.

i.e. stress $\propto$ strain

or stress = constant × strain or $\frac{\text{stress}}{\text{strain}}$ = Modulus of Elasticity.

This constant is called modulus of elasticity.

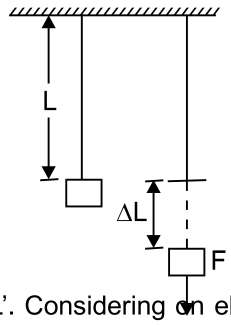
Thus, modulus of elasticity is defined as the ratio of the stress to the strain.

Modulus of elasticity depends on the nature of the material of the body and is independent of its dimensions (i.e. length, volume etc.).

Unit : The SI unit of modulus of elasticity is Nm^{-2} or Pascal (Pa).

1. Young's modulus of elasticity

It is defined as the ratio of the normal stress to the longitudinal strain.



i.e. Young's modulus (Y) = $\frac{\text{Longitudinal stress}}{\text{Longitudinal strain}}$

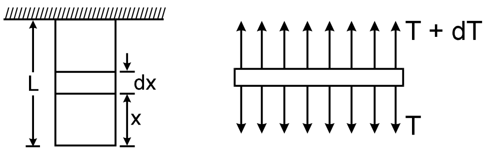
Normal stress = F/A,

Longitudinal strain = ΔL/L

$Y = \frac{F/A}{\Delta L/L} = \frac{FL}{A\Delta L}$ $\quad \therefore \Delta\ell = \frac{F\ell}{AY}$

ELONGATION OF ROD UNDER IT'S SELF WEIGHT

Let rod is having self weight 'W', area of cross-section 'A" and length 'L'. Considering on element at a distance 'x' from bottom.



then $T = \frac{W}{L}x$

elongation in 'dx' element = $\frac{T.dx}{Ay}$

Total elongation $s = \int_0^L \frac{T dx}{Ay} = \int_0^L \frac{W x dy}{LAy} = \frac{WL}{2Ay}$

Note : One can do directly by considering total weight at C.M. and using effective length $\ell/2$.

Illus. 1. One end of a wire 2 m long and 0.2 m^2 in cross-section is fixed in a ceiling and a load of 4.8 kg is attached to the free end. Find the extension of the wire. Young's modulus of steel = 2.0×10^{11} N/m^2. Take g = 10 m/s^2.

Sol. We have

$$Y = \frac{\text{stress}}{\text{strain}} = \frac{T/A}{\ell/L}$$

with symbols having their usual meanings. The extension is

$$l = \frac{TL}{AY}$$

As the load is in equilibrium after the extension, the tension in the wire is equal to the weight of the load

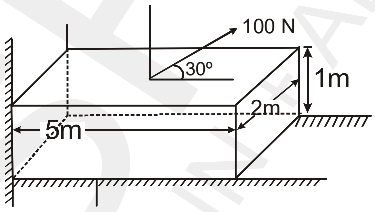
= 4.8 kg × 10 m/s^2 = 48 N.

Thus, $l = \frac{(48 \text{ N})(2\text{m})}{(0.2 \times 10^{-4} \text{m}^2) \times (2.0 \times 10^{11} \text{N/m}^2)}$

= 2.4×10^{-5} m.

Illus. 2.

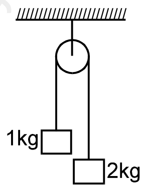
Find out longitudinal stress and tangential stress on a fixed block shown in figure when a tangential force of 100 N magnitude is applied on the block.



Sol. Longitudinal or normal stress $\Rightarrow$ $\sigma_l = \frac{100 \sin 30^\circ}{5 \times 2}$ = 5 N/m^2

Tangential stress $\Rightarrow$ $\sigma_t = \frac{100 \cos 30^\circ}{5 \times 2} = 5\sqrt{3} \text{N/m}^2$

Illus. 3. Two blocks of masses 1 kg and 2 kg are connected by a metal wire going over a smooth pulley as shown in figure. The breaking stress of the metal is 2×10^9 N/m^2. What should be the minimum radius of the wire used if it is not to break? Take g = 10 m/s^2



Sol. The stress in the wire = $\frac{\text{Tension}}{\text{Area of cross-section}}$. To avoid breaking, this stress should not exceed the breaking stress.

Let the tension in the wire be T. The equations of motion of the two blocks are,

T – 10 N = (1 kg) a

and 20 N – T = (2 kg) a.

Eliminating a from these equations,

T = (40/3) N.

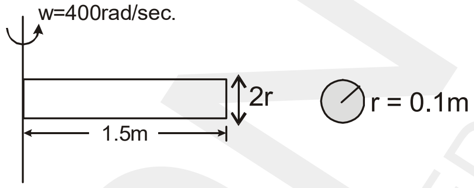
The stress = $\frac{(40/3)\text{N}}{\pi r^2}$.

If the minimum radius needed to avoid breaking is r,

$$2 \times 10^9 \ \frac{N}{m^2} = \frac{(40/3)\,N}{\pi r^2}.$$

Solving this, $r = 4.6 \times 10^{-5}$ m.

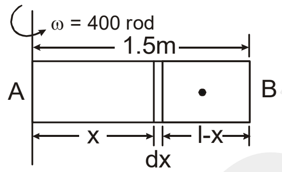
Illus. 4. A rod of 1.5 m length and uniform density 10^4 kg/m^3 is rotating at an angular velocity 400 rad/sec. about its one end in a horizontal plane. Find out elongation in rod.
Given $y = 2 \times 10^{11}$ N/m^2

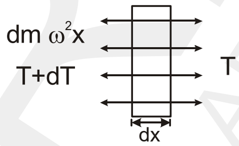


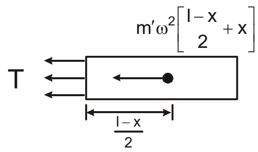
Sol. mass of shaded portion

$$m' = \frac{m}{\ell}(\ell - x) \qquad \text{[where m = total mass = } \rho A l \text{]}$$

$$T = m'\omega^2\left[\frac{\ell - x}{2} + x\right] \quad \Rightarrow T = \frac{m}{\ell}(\ell - x)\,\omega^2\left(\frac{\ell + x}{2}\right) \quad T = \frac{m\omega^2}{2\ell}(\ell^2 - x^2)$$







this tension will be maximum at A $\left(\frac{m\omega^2\ell}{2}\right)$ and minimum at 'B' (zero), elongation in element of width 'dx' $= \frac{Tdx}{Ay}$

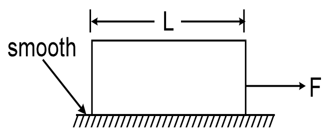
Total elengation

$$\delta = \int \frac{Tdx}{Ay} = \int_0^{\ell} \frac{m\omega^2(\ell^2 - x^2)}{2\ell\, Ay}\,dx$$

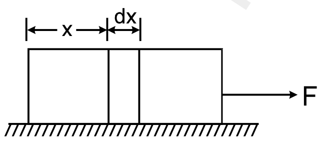
$$\delta = \frac{m\omega^2}{2\ell Ay}\left[\ell^2 x - \frac{x^3}{3}\right]_0^{\ell} = \frac{m\omega^2 \times 2\ell^3}{2\ell Ay \times 3} = \frac{m\omega^2\ell^2}{3Ay} = \frac{\rho A\ell\omega^2\ell^2}{3Ay}$$

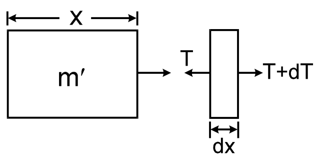
$$\delta = \frac{\rho\omega^2\ell^3}{3y} = \frac{10^4 \times (400) \times (1.5)^3}{3 \times 2 \times 10^{11}} = 9 \times 10^{-3}\text{ m} = 9\text{mm}$$

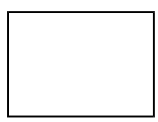
Illus. 5. Find out the elongation in block. If mass, area of cross-section and young modulus of block are m, A and y respectively.



Sol.







Acceleration, $a = \frac{F}{m}$ then $T = m'a$ where $\Rightarrow$ $m' = \frac{m}{\ell}x$

$$T = \frac{m}{\ell}x\,\frac{F}{m} = \frac{Fx}{\ell}$$

Elongation in element 'dx' $= \frac{Tdx}{Ay}$

total elongation, $\delta = \int_0^{\ell} \frac{Tdx}{Ay}$ d = $\int_0^{\ell} \frac{Fxdx}{A\ell y} = \frac{F\ell}{2Ay}$

Note : -

In this problem, if friction is given between block and surface (μ = friction coefficient), and

Case : (I) $F < \mu mg$

(II) $F > \mu mg$

Then in both cases answer will be total elongation $\delta = \frac{F\ell}{2Ay}$

Now answer the follwing :

1. A wire alongates by 1.0 mm when a load W is hanged from it. If this wire goes over a pulley and two weights W each are hung at the two ends, the elongation of the wire will be

(A) 0.5 m (B) 1.0 mm (C) 2.0 mm (D) 4.0 mm

2. The length of a metal wire is ℓ_1 when the tension in it is T_1 and is ℓ_2 when the tension is T_2. The natural length of the wire is

(A) $\frac{\ell_1 + \ell_2}{2}$ (B) $\sqrt{\ell_1 \ell_2}$ (C) $\frac{\ell_1 T_2 - \ell_2 T_1}{T_2 - T_1}$ (D) $\frac{\ell_1 T_2 + \ell_2 T_1}{T_2 + T_1}$

3. A heavy mass is attached to a thin wire and is whirled in a vertical circle. The wire is most likely to break

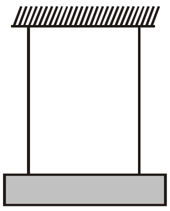
(A) when the mass is at the highest point

(B) when the mass is at the lowest point

(C) when the wire is horizontal

(D) at an angle of $\cos^{-1}(1/3)$ from the upward vertical

4. Two wires of equal length and cross-section area suspended as shown in figure. Thier Young's modulus are Y_1 and Y_2 respectively. The equivalent Young's modulus will be

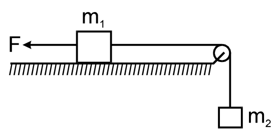


(A) $Y_1 + Y_2$ (B) $\frac{Y_1 + Y_2}{2}$ (C) $\frac{Y_1 Y_2}{Y_1 + Y_2}$ (D) $\sqrt{Y_1 Y_2}$

5. A steel wire and a copper wire of equal length and equal cross-sectional area are joined end to end and the combination is subjected to a tension. Find the ratio of (a) the stresses developed in the two wires and (b) the strains developed. Y of steel = 2×10^{11} N/m^2. Y of copper = 1.3×10^{11} N/m^2.

6. A steel rod of cross-sectional area 4 cm^2 and length 2 m shrinks by 0.1 cm as the temperature decreases in night. If the rod is clamped at both ends during the day hours, find the tension developed in it during night hours. Young's modulus of steel = 1.9×10^{11} N/m^2.

7. Consider the situation shown in figure. The force F is equal to the $m_2 g/2$. If the area of cross-section of the string is A and its Young's modulus Y, find the strain developed in it. The string is light and there is no friction anywhere.



PHYSICS DPP
DAILY PRACTICE PROBLEMS

DPP No. 90

Total Marks : 28

Max. Time : 31 min.

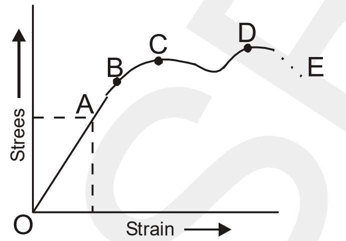
Topic : Variation of Strain with Stress

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[12,12]
Multiple choice objective ('–1' negative marking) Q.5	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.6	(4 marks, 5 min.)	[4, 5]
Match the Following (no negative marking) (2 × 4) Q. 7	(8 marks, 10 min.)	[8, 10]

COMPREHENSION

VARIATION OF STRAIN WITH STRESS

When a wire is stretched by a load, it is seen that for small value of load, the extension produced in the wire is proportional to the load. On removing the load, the wire returns to its original length. The wire regains its original dimensions only when load applied is less or equal to a certain limit. This limit is called elastic limit. Thus, elastic limit is the maximum stress on whose removal, the bodies regain their original dimensions. In shown figure, this type of behavior is represented by OB portion of the graph. Till A the stress is proportional to strain and from A to B if deforming forces are removed then the wire comes to its original length but here stress is not proportional to strain.



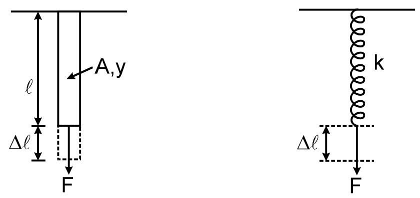
OA → Limit of Proportionality
OB → Elastic limit
C → Yield Point
CD → Plastic behaviour
D → Ultimate point
DE → Fracture

As we go beyond the point B, then even for a very small increase in stress, the strain produced is very large. This type of behaviour is observed around point C and at this stage the wire begins to flow like a viscous fluid. The point C is called yield point. If the stress is further increased, then the wire breaks off at a point D called the breaking point. The stress corresponding to this point is called breaking stress or tensile strength of the material of the wire. A material for which the plastic range CD is relatively high is called ductile material. These materials get permanently deformed before breaking. The materials for which plastic range is relatively small are called brittle materials. These materials break as soon as elastic limit is crossed.

Analogy of Rod as a spring

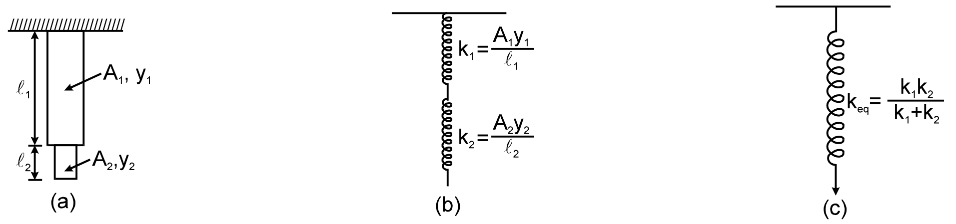
$y = \dfrac{\text{stress}}{\text{strain}} \Rightarrow y = \dfrac{F\ell}{A\Delta\ell}$

or $F = \dfrac{Ay}{\ell}\Delta\ell$



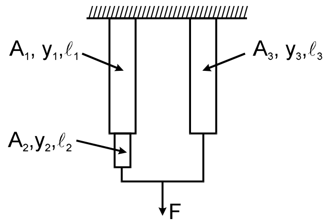
$\dfrac{Ay}{\ell}$ = constant, depends on type of material and geometry of rod. $F = k\Delta\ell$

where $k = \dfrac{Ay}{\ell}$ = equivalent spring constant.

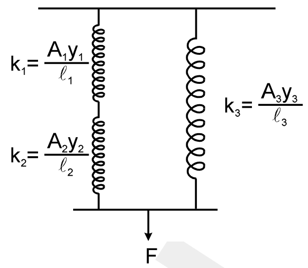


for the system of rods shown in figure (a), the replaced spring system is shown in figure (b) two spring in series]. Figure (c) represents equivalent spring system.

Figure (d) represents another combination of rods and their replaced spring system.

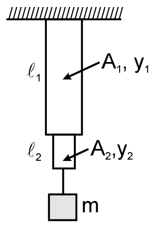


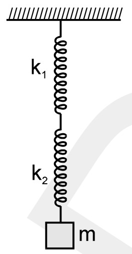
(d)



Illus. 1.

A mass 'm' is attached with rods as shown in figure. This mass is slightly stretched and released whether the motion of mass is S.H.M., if yes then find out the time period.





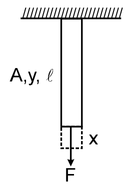
Sol. $k_{eq} = \dfrac{k_1k_2}{k_1+k_2}$ $\qquad T = 2\pi\sqrt{\dfrac{m}{k_{eq}}} = 2\pi\sqrt{\dfrac{m(k_1+k_2)}{k_1k_2}}$

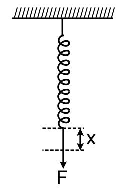
where $k_1 = \dfrac{A_1y_1}{\ell_1}$ and $k_2 = \dfrac{A_2y_2}{\ell_2}$

ELASTIC POTENTIAL ENERGY STORED IN A STRETCHED WIRE OR IN A ROD

Strain energy stored in equivalent spring

$$U = \frac{1}{2}kx^2$$





where $x = \dfrac{F\ell}{Ay}$, $\quad k = \dfrac{Ay}{\ell}$ $\quad U = \dfrac{1}{2}\dfrac{Ay}{\ell}\dfrac{F^2\ell^2}{A^2y^2} = \dfrac{1}{2}\dfrac{F^2\ell}{Ay}$.

equation can be re-arranged

$$U = \frac{1}{2}\frac{F^2}{A^2}\times\frac{\ell A}{y}$$ [ℓA = volume of rod, F/A = stress]

$$U = \frac{1}{2}\frac{(\text{stress})^2}{y}\times \text{volume}$$

again, $U = \dfrac{1}{2}\dfrac{F}{A}\times\dfrac{F}{Ay}\times A\,\ell$ $\qquad$ [Strain $= \dfrac{F}{Ay}$]

$$U = \frac{1}{2}\text{ stress} \times \text{strain} \times \text{volume}$$

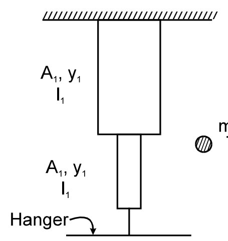
again, $U = \dfrac{1}{2}\dfrac{F^2}{A^2y^2}A\ell y$

$$U = \frac{1}{2}y\,(\text{strain})^2 \times \text{volume}$$

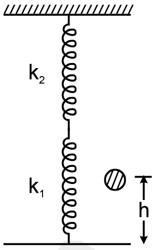
strain energy density $= \dfrac{\text{strain energy}}{\text{volume}} = \dfrac{1}{2}\dfrac{(\text{stress})^2}{y} = \dfrac{1}{2}y(\text{strain})^2 = \dfrac{1}{2}\text{ stress} \times \text{strain}$

Illus. 2.

A ball of mass 'm' drops from a height 'h', which sticks to hanger after striking. Neglect over turning, find out the maximum extension in rod. Asumme rod and hanger is massless.



Sol. Applying energy conservation



$$mg(h+x) = \frac{1}{2}\frac{k_1k_2}{k_1+k_2}x^2$$

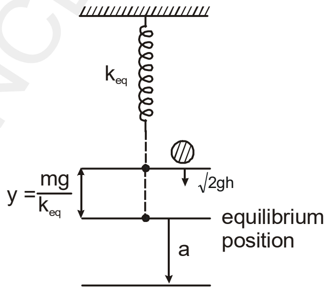
where $k_1 = \frac{A_1y_1}{\ell_1}$ $\quad k_2 = \frac{A_2y_2}{\ell_2}$

& $K_{eq} = \frac{A_1A_2y_1y_2}{A_1y_1\ell_2 + A_2y_2\ell_1}$

$k_{eq}x^2 - 2mgx - 2mgh = 0$

$$x = \frac{2mg \pm \sqrt{4m^2g^2 + 8mghk_{eq}}}{2k_{eq}} \qquad x_{max} = \frac{mg}{k_{eq}} + \sqrt{\frac{m^2g^2}{k_{eq}^2} + \frac{2mgh}{k_{eq}}}$$

BY S.H.M.



$$w = \sqrt{\frac{k_{eq}}{m}} \qquad v = \omega\sqrt{a^2 - y^2}$$

$$\sqrt{2gh} = \sqrt{\frac{keq}{m}}\sqrt{a^2-y^2} \Rightarrow \sqrt{\frac{2mgh}{k_{eq}} + \frac{m^2g^2}{k_{eq}^2}} = a$$

max^m extension $= a + y = \frac{mg}{k_{eq}} + \sqrt{\frac{m^2g^2}{k_{eq}} + \frac{2mgh}{k_{eq}}}$

1. If x longitudinal strain is produced in a wire of Young's modulus y, then energy stored in the material of the wire per unit volume is :
(A) yx^2 (B) $2\ yx^2$ (C) $\frac{1}{2}\ y^2x$ (D) $\frac{1}{2}\ yx^2$

2*. A metal wire of length L is suspended vertically from a rigid support. When a bob of mass M is attached to the lower end of wire, the elongation of the wire is ℓ :
(A) The loss in gravitational potential energy of mass M is $Mg\ell$
(B) The elastic potential energy stored in the wire is $Mg\ell$
(C) The elastic potential energy stored in the wire is $\frac{1}{2}Mg\ell$
(D) Heat produced is loss of mechanical energy of system is $\frac{1}{2}Mg\ell$

3*. A metal wire of length L area of cross-section A and Young's modulus Y is stretched by a variable force F such that F is always slightly greater than the elastic force of resistance in the wire. When the elongation of the wire is ℓ :
(A) the work done by F is $\frac{YA^2}{L}$
(B) the work done by F is $\frac{YA\ell^2}{2L}$
(C) the elastic potential energy stored in the wire is $\frac{YA\ell^2}{2L}$
(D) heat is produced during the elongation

4. Two wires of the same material and length but diameter in the ratio 1 : 2 are stretched by the same force. The ratio of potential energy per unit volume for the two wires when stretched will be :
(A) 1 : 1 (B) 2 : 1 (C) 4 : 1 (D) 16 : 1

5. The workdone in increasing the length of a one metre long wire of cross-sectional area 1 mm^2 through 1 mm will be ($Y = 2 \times 10^{11}\ Nm^{-2}$) :

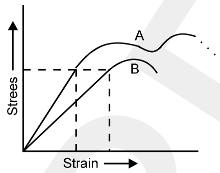
(A) 0.1 J (B) 5 J (C) 10 J (D) 250 J

6. One end of a long metallic wire of length L is tied to the ceiling. The other end is tied to a massless spring of spring constant k. A mass m hangs freely from the free end of the spring. The area of cross-section and the Young modulus of the wire are A and Y respectively. If the mass is slightly pulled down and released, it will oscillate with a time period T equal to :

(A) $2\pi\sqrt{\frac{m}{k}}$ (B) $2\pi\sqrt{\frac{m(YA+kL)}{YAk}}$

(C) $2\pi\sqrt{\frac{mYA}{kL}}$ (D) $2\pi\sqrt{\frac{mL}{YA}}$

7. In the figure shown the strain versus stress graph for two values of young's modulus?



(i) which material is more ductile ? Explain.
(ii) Which material is more brittle? Explain.
(iii) Which material is stronger? Explain.

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 91

Total Marks : 9

Max. Time : 9 min.

Topic : Viscosity

Type of Questions — **M.M., Min.**

Comprehension ('–1' negative marking) Q.1 to Q.3 — **(3 marks, 3 min.)** — **[9, 9]**

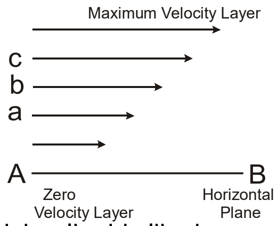
COMPREHENSION

VISCOSITY

When a solid body slides over another solid body, a frictional-force begins to act between them. This force opposes the relative motion of the bodies. Similarly, when a layer of a liquid slides over another layer of the same liquid, a frictional-force acts between them which opposes the relative motion between the layers. This force is called 'internal frictional-force'.

Suppose a liquid is flowing in streamlined motion on a fixed horizontal surface AB (Fig.). The layer of the liquid which is in contact with the surface is at rest due to adhesive forces between the liquid and the surface, while the velocity of other layers increases with distance from the fixed surface. In the Fig., the lengths of the arrows represent the increasing velocity of the layers. Thus there is a relative motion between adjacent layers of the liquid. Let us consider three parallel layers a, b and c. Their velocities are in the increasing order. The layer a tends to retard the layer b, while b tends to retard c.

Thus each layer tends to decrease the velocity of the layer above it. Similarly, each layer tends to increase the velocity of the layer below it. This means that in between any two layers of the liquid, internal tangential forces act which try to destroy the relative motion between the layers. These forces are called 'viscous forces'. If the flow of the liquid is to be maintained, an external force must be applied to overcome the dragging viscous forces. In the absence of the external force, the viscous forces would soon bring the liquid to rest. **The property of the liquid by virtue of which it opposes the relative motion between its adjacent layers is known as 'viscosity'.**



The property of viscosity is seen in the following examples :

(i) A stirred liquid, when left, comes to rest on account of viscosity. Thicker liquids like honey, coaltar, glycerine, etc. have a larger viscosity than thinner ones like water. If we pour coaltar and water on a table, the coaltar will stop soon while the water will flow upto quite a large distance.

(ii) If we pour water and honey in separate funnels, water comes out readily from the hole in the funnel while honey takes enough time to do so. This is because honey is much more viscous than water. As honey tends to flow down under gravity, the relative motion between its layers is opposed strongly.

(iii) We can walk fast in air, but not in water. The reason is again viscosity which is very small for air but comparatively much larger for water.

Viscosity comes into play only when there is a relative motion between the layers of the same material. This is why it does not act in solids.

VELOCITY GRADIENT AND COEFFICIENT OF VISCOSITY

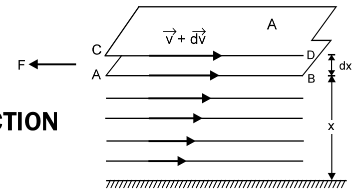
The property of a liquid by virtue of which an opposing force (internal friction) comes into play whenever there is a relative motion between the different layers of the liquid is called viscosity. Consider a flow of a liquid over the horizontal solid surface as shown in fig. Let us consider two layers AB and CD moving with velocities $\vec{v}$ and $\vec{v} + d\vec{v}$ at a distance x and (x + dx) respectively from the fixed solid surface.

According to Newton, the viscous drag or back ward force (F) between these layers depends.

(i) directly proportional to the area (A) of the layer and (ii) directly proportional to the velocity gradient $\left(\frac{dv}{dx}\right)$ between the layers.

i.e. $F \propto A\frac{dv}{dx}$ or $\boxed{F = -\eta A\frac{dv}{dx}}$ ...(1)

η **is called Coefficient of viscosity**. Negative sign shows that the direction of viscous drag (F) is just opposite to the direction of the motion of the liquid.



SIMILARITIES AND DIFFERENCES BETWEEN VISCOSITY AND SOLID FRICTION

Similarities

Viscosity and solid friction are similar as

1. Both oppose relative motion. Whereas viscosity opposes the relative motion between two adjacent liquid layers, solid friction opposes the relative motion between two solid layers.

2. Both come into play, whenever there is relative motion between layers of liquid or solid surfaces as the case may be.

3. Both are due to molecular attractions.

Differences between them →

	Viscosity		Solid Friction
(i)	Viscosity (or viscous drag) between layers of liquid is directly proportional to the area of the liquid layers.	(i)	Friction between two solids is independent of the area of solid surfaces in contact.
(ii)	Viscous drag is proportional to the relative velocity between two layers of liquid.	(ii)	Friction is independent of the relative velocity between two surfaces.
(iii)	Viscous drag is independent of normal reaction between two layers of liquid.	(iii)	Friction is directly proportional to the normal reaction between two surfaces in contact.

EFFECT OF TEMPERATURE ON THE VISCOSITY

The viscosity of liquids decrease with increase in temperature and increase with the decrease in temperature.

That is, $\eta \propto \frac{1}{\sqrt{T}}$. On the other hand, the value of viscosity of gases increases with the increase in temperature and vice-versa. That is, $\eta \propto \sqrt{T}$ (This takes into account the diffusion of the gases).

SOME APPLICATIONS OF VISCOSITY

Knowledge of viscosity of various liquids and gases have been put to use in daily life. Some applications of its knowledge are discussed as under →

1. As the viscosity of liquids vary with temperature, proper choice of lubricant is made depending upon season. Coaltar used for making of roads is heated to reduce its viscosity so that it can be easily laid on the road.

2. Liquids of high viscosity are used in shock absorbers and buffers at railway stations.

3. The phenomenon of viscosity of air and liquid is used to damp the motion of some instruments like galvanometer

UNITS OF COEFFICIENT OF VISCOSITY

From the above formula, we have $\eta = \dfrac{F}{A(\Delta v_x / \Delta z)}$

$$\therefore \quad \text{dimensions of} \quad \eta = \frac{[MLT^{-2}]}{[L^2][LT^{-1}/L]} = \frac{[MLT^{-2}]}{[L^2T^{-1}]} = [ML^{-1}T^{-1}]$$

Its unit is kg/(meter-second)

In C.G.S. system, the unit of coefficient of viscosity is dyne s cm^{-2} and is called poise. In SI the unit of coefficient of viscosity is N sm^{-2} and is called decapoise.

1 decapoise = 1 N sm^{-2} = (10^5 dyne) × s × (10^2 cm)$^{-2}$ = 10 dyne s cm^{-2} = 10 poise

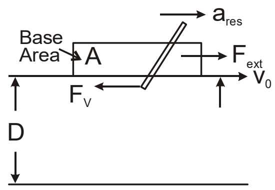
Illus. 1.

A man is rowing a boat of mass m with a constant velocity 'v_0' in a river the contact area of boat is 'A' and coefficient of viscosity is η. The depth of river is 'D'. Find the force required to row the boat. Assume that velocity gradient is constant.

Sol. $F_{ext} - F_V = m\, a_{res}$

As boat moves with constant velocity $a_{res} = 0$

$F_{ext} = F_V$

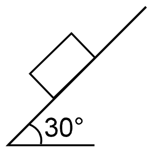


But $\quad F_V = \eta A \dfrac{dv}{dz}$, but $\dfrac{dv}{dz} = \dfrac{v_0 - 0}{D} = \dfrac{v_0}{D}$

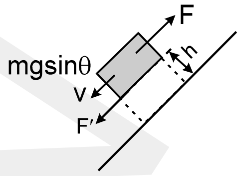
then $F_{ext} = F_V = \dfrac{\eta A v_0}{D}$

Illus. 2.

A cubical block (of side 2m) of mass20 kg slides on inclined plane lubricated with the oil of viscosity $\eta = 10^{-1}$ poise with constant velocity of 10 m/sec. (g = 10 m/sec^2)
find out the thickness of layer of liquid. (10^{-1} poise = 10^{-2} Nsm^2)



Sol. $F = F' = \eta A \dfrac{dv}{dz} = mg \sin\theta \qquad \dfrac{dv}{dz} = \dfrac{v}{h}$



$20 \times 10 \times \sin 30° = \eta \times 4 \times \dfrac{10}{h}$

$h = \dfrac{40 \times 10^{-2}}{100}$ – [$\eta = 10^{-1}$ poise = 10^{-2} N-sec-m^{-2}]

$= 4 \times 10^{-3}$ m = 4 mm

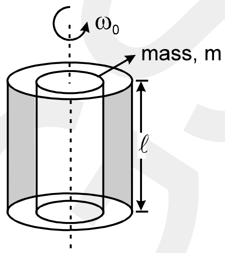
Now Answer the questions below :

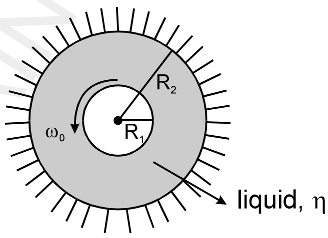
1. A metal square plate of 10 cm side rests on a 2 mm thick caster oil layer. Calculate the horizontal force needed to move the plate with speed 3 cm s^{-1} : (Coefficient of viscosity of caster oil is 15 poise.)

(A) 2.25×10^{-2} N (B*) 2.25×10^{-1} N (C) 2.25×10^{-3} N (D) 2.25×10^{-4} N

2. A man starts rowing his stationary cuboidal boat of base area A = 10m^2. The driving force on the boat due to rowing is 100 N in the direction of motion. Find the maximum velocity that the boat can achieve. Also find the time in which he will attain half of this maximum velocity. [Take coefficient of viscosity of water = 15 poise] The depth of the lake is 10 m and the combined mass of man and the boat to be 150 kg. (u = 0, velocity gradient uniform)

3. As per the shown figure the central solid cylinder starts with initial angular velocity ω_0. Find out the time after which the angular velocity becomes half. (Velocity gradient uniform)





PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 92

Total Marks : 9

Max. Time : 9 min.

Topic : Stokes' Law

Type of Questions		**M.M., Min.**
Comprehension ('–1' negative marking) Q.1 to Q.3	**(3 marks, 3 min.)**	**[9, 9]**

COMPREHENSION

STOKES' LAW

Stokes proved that the viscous drag (F) on a **<u>spherical body</u>** of radius r moving with relative velocity v in a fluid of viscosity η is given by $F = 6\pi\eta r v$. This force is opposite to relative velocity. This is called Stokes' law. The work done by the force is negative and it dissipates in the form of heat.

TERMINAL VELOCITY

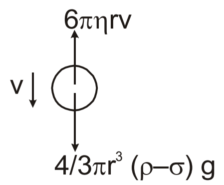
When a body is dropped in a viscous fluid, it first accelerates and then its acceleration becomes zero and it attains a constant velocity called terminal velocity.

Calculation of Terminal Velocity

Let us consider a small ball, whose radius is r and density is ρ, falling freely in a liquid (or gas) whose density is σ and coefficient of viscosity η. When it attains a terminal velocity v. It is subjected to two forces :

(i) effective force acting downward

$= V(\rho-\sigma)\,g = \frac{4}{3}\pi r^3(\rho-\sigma)g,$



(ii) viscous force acting upward $= 6\pi\eta rv$.

Since the ball is moving with a constant velocity v i.e., there is no acceleration in it, the net force acting on it must be zero. That is

$$6\pi\eta rv = \frac{4}{3} p\, r^3(\rho-\sigma)\,g \quad \text{or} \quad v = \frac{2}{9}\frac{r^2(\rho-\sigma)g}{\eta}$$

Thus, terminal velocity of the ball is directly proportional to the square of its radius

Important point

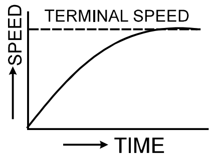
Air bubble in water always goes up. It is because density of air (ρ) is less than the density of water (σ). So the terminal velocity for air bubble is Negative, which implies that the air bubble will go up. Positive terminal velocity means the body will fall down.

Applications of Stokes' Formula

(i) **In determining the Electronic Charge by Millikan's Experiment** : Stokes' formula is used in Millikan's method for determining the electronic charge. In this method the formula is applied for finding out the radii of small oil-drops by measuring their terminal velocity in air.

(ii) **Velocity of Rain Drops** : Rain drops are formed by the condensation of water vapour on dust particles. When they fall under gravity, their motion is opposed by the viscous drag in air. As the velocity of their fall increases, the viscous drag also increases and finally becomes equal to the effective force of gravity. The drops then attain a (constant) terminal velocity which is directly proportional to the square of the radius of the drops. In the beginning the raindrops are very small in size and so they fall with such a small velocity that they appear floating in the sky as cloud. As they grow in size by further condensation, then they reach the earth with appreciable velocity,

(iii) **Parachute** : When a soldier with a parachute jumps from a flying aeroplane, he descends very slowly in air.



In the beginning the soldier falls with gravity acceleration g, but soon the acceleration goes on decreasing rapidly until in parachute is fully opened. Therefore, in the beginning the speed of the falling soldier increases somewhat rapidly but then very slowly. Due to the viscosity of air the acceleration of the soldier becomes ultimately zero and the soldier then falls with a constant terminal speed. In Fig graph is shown between the speed of the falling soldier and time.

Illus. 1. A spherical ball is moving with terminal velocity inside a liquid. Determine the relationship of rate of heat loss with the radius of ball.

Sol. Rate of heat loss = power = F × v = $6\pi\eta r v \times v$ = $6\pi\eta r v^2$ = $6p\eta r\left[\frac{2}{9}\frac{gr^2(\rho_0-\rho_\ell)}{\eta}\right]^2$

Rate of heat loss α r^5

Illus. 2. A drop of water of radius 0.0015 mm is falling in air. If the coefficient of viscosity of air is 1.8×10^{-5} kg /(m-s), what will be the terminal velocity of the drop? (density of water = 1.0×10^3 kg/m^2 and g = 9.8 N/kg.) Density of air can be neglected.

Sol. By Stokes' law , the terminal velocity of a water drop of radius r is given by

$$v = \frac{2}{9}\frac{r^2(\rho-\sigma)g}{\eta}$$

where ρ is the density of water, σ is the density of air and η the coefficient of viscosity of air. Here σ is negligible and r = 0.0015 mm = 1.5×10^{-3} mm = 1.5×10^{-6} m. Substituting the values :

$$v = \frac{2}{9} \times \frac{(1.5\times10^{-6})^2\times(1.0\times10^3)\times9.8}{1.8\times10^{-5}} = \mathbf{2.72 \times 10^{-4}\ m/s}$$

Now answer the follwing :

1. A ball bearing of radius of 3 mm made of iron of density 7.85 g cm^{-3} is allowed to fall through a long column of glycerine of density 1.25 g cm^{-3}. It is found to attain a terminal velocity of 2.20 cm s^{-1}. Determine the viscosity of glycerine in centipoise. (Take g = 10 m/s^2)

2. An air bubble of 1 cm radius is rising at a steady rate of 0.5 cm s^{-1} through a liquid of density 0.81 gcm^{-3}. Calculate the coefficient of viscosity of the liquid. Neglect the density of air. (Take g = 10 m/s^2)

3. A metallic sphere of radius 1.0×10^{-3} m and density 1.0×10^4 kg/m^3 enters a tank of water, after a free fall through a distance of h in the earth's gravitational field. If its velocity remains unchanged after entering water, determine the value of h. Given : coefficient of viscosity of water = 1.0×10^{-3} N-s/m^2, g = 10 m/s^2 and density of water = 1.0×10^3 kg/m^3.

DPP 71 TO 92 (ANSWER KEY)

DPP NO. - 71

1. (D) **2.** (C) **3.** (C) **4.** (D) **5.** (C)
6. (A)(B)(C) **7.** 2 **8.** $\frac{T}{24}$

DPP NO. - 72

1. (B) **2.** (C) **3.** (A) (B) (C) **4.** (A) (B) (C)
5. (B) **6.** (A) **7.** (A)

DPP NO. - 73

1. (C) **2.** (A) **3.** 0 **4.** $\frac{T}{24}$ **5.** (B)
6. (B) **7.** (B)

DPP NO. - 74

1. (B) **2.** (A) **3.** (B) (C) **4.** (A) (B) (C)
5. 8 **6.** (a) $\frac{10}{\pi}$Hz (b) $\frac{25}{6}$cm (c) $\frac{25}{3}$N , 91.7 N.

7. **(a)** $K = \frac{2mg}{b-a}$; **(b)** $\frac{1}{2\pi}\sqrt{\frac{k}{M+m}}$ **(c)** $\left(\frac{M+m}{b-a}\right)\frac{ab}{m}$

DPP NO. - 75

1. (D) **2.** (A) **3.** (B) **4.** (C) **5.** (D)
6. (A) **7.** (C) **8.** (B)

DPP NO. - 76

1. (C) **2.** (A) (B) (C) (D) **3.** (C) (D)
4. (A) (B) (C) (D) **5.** 3 **6.** (D)
7. (B) **8.** (B)

DPP NO. - 77

1. (C) **2.** (A) **3.** (B) **4.** (B)(D) **5.** 5

6. 3 **7.** $\frac{m_2}{m_1} = 3$ **8.** (a) 6m, 0.25 Hz, 1.5m/s

(b) 1.5π mm/s, $0.75\pi^2$ mm/s (c) π

DPP NO. - 78

1. (C) **2.** (A) **3.** Acceleration = 0
4. (A) **5.** (C) **6.** (B)
7. (A) – p ; (B) – r, s, t ; (C) – r, s, t ; (D) – r, s, t

DPP NO. - 79

1. (D) **2.** (A) **3.** (D) **4.** 8 **5.** (B)
6. (C) **7.** (D)

DPP NO. - 80

1. (B) **2.** (A) **3.** (C)

4. $V = \sqrt{\frac{2}{m}\left[mgh - \frac{1}{2}K\left(\frac{h}{\sin\theta}\right)^2 - \mu mgh\cot\theta\right]}$

5. (B) **6.** (C) **7.** (D)

DPP NO. - 81

1. (C) **2.** (A) **3.** (C) **4.** (A) (C)
5. (A) **6.** (C) **7.** (A)

DPP NO. - 82

1. (C) **2.** (A) **3.** 1.5% **4.** $\sin\theta = \frac{m_2}{m_1}$

(b) $\frac{15}{9}$ m/s^2 **5.** (C) **6.** (D) **7.** (C)

DPP NO. - 83

1. (C) **2.** (B) **3.** (B) **4.** (A) (B) (C) (D)

5. (A) (B) (C) (D) **6.** **$\theta = \tan^{-1}$** $\frac{1}{2}$

7. (A) p,s (B) p,s (C) q,s (D) r

DPP NO. - 84

1. (A) **2.** (C) **3.** (D) **4.** (C)

5. $-\frac{1}{6}$ m/sec. **6.** (B) **7.** (C)

8. (A)

DPP NO. - 85

1. (C) **2.** (D) **3.** (C) **4.** (D)
5. 06 m **6.** (D) **7.** (A)

DPP NO. - 86

1. (A) **2.** (C) **3.** (A) **4.** (B) **5.** (B)
6. 90 **7.** (A) p,q,s (B) r,s (C) s (D) r,s

DPP NO. - 87

1. (B) **2.** (A) **3.** (D) **4.** (B)
5. (A) (B) (C) (D) **6.** 3
7. (A) – r ; (B) – p,q,s ; (C) – p ; (D) – r, p

DPP NO. - 88

1. (A) **2.** (C) **3.** (A) **4.** (C) **5.** (B)
6. (A)(C) **7.** $v = v_0$, $S = V_0 \frac{M_s}{\lambda}$

DPP NO. - 89

1. (B) **2.** (C) **3.** (B) **4.** (B)

5. (a) 1 (b) $\frac{\text{strain in copper wire}}{\text{strain in steel wire}} = \frac{20}{13}$

6. 3.8×10^4 N **7.** $\frac{m_2 g(2m_1 + m_2)}{2AY(m_1 + m_2)}$

DPP NO. - 90

1. (D) **2.** (A) (C) (D) **3.**(B) (C)
4. (D) **5.** (A) **6.** (B)
7. (i) A(from comprehension)
(ii) B (from comprehension)
(iii) A (A can bear more stress than B before fracture)

DPP NO. - 91

1. (B) **2.** $\frac{200}{3}$ m/s, $t = 100\ \ell n2$ seconds

3. $t = \frac{m(R_2 - R_1)\ell n2}{4\pi\eta\ell R_1}$

DPP NO. - 92

1. 6000 **2.** 360 poise **3.** 20 m

GGSRDN

Educational Services Private Limited

9th, 10th, NEET, JEE(Main/Advanced)

अभ्यास ही सबसे बड़ा गुरू है।

CLASS : XI (PHYSICS)

DPP

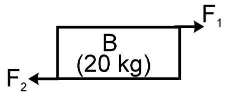
DAILY PRACTICE PROBLEM

Solutions

DPP-71 TO 92

DPP NO. - 71

1.



$F_{1(max)} = 0.2 \times 10 \times 10 = 20$ N

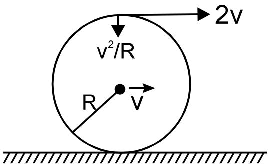
$F_{2(max)} = 0.1 \times 30 \times 10 = 30$ N

$F_{1(max)} < F_{2(max)}$

$\Rightarrow$ 'B' can never move.

2. Radius of Curvature $= \dfrac{(\text{velocity})^2}{\text{Normal Acceleration}}$

$= \dfrac{(2v)^2}{v^2/R} = 4R$



3. $U = 2 - 20x + 5x^2$

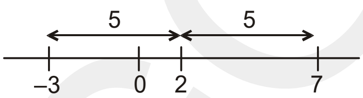
$F = -\dfrac{dU}{dx} = 20 - 10x$

At equilibrium position ; F = 0

$20 - 10x = 0$

$\Rightarrow x = 2$

Since particle is released at x = – 3, therefore amplitude of particle is 5.



It will oscillate about x = 2 with an amplitude of 5.

$\therefore$ maximum value of x will be 7.

4. P.E. is maximum at extreme position and minimum at mean position.

Time to go from extreme position to mean position is,

$t = \dfrac{T}{4}$; where T is time period of SHM $5\text{ s} = \dfrac{T}{4}$

$\Rightarrow T = 20$ s.

5. Due to impulse, the total energy of the particle becomes :

$\dfrac{1}{2}m\omega^2A^2 + \dfrac{1}{2}m\omega^2A^2 = m\omega^2A^2$

Let ; A' be the new amplitude.

$\therefore \dfrac{1}{2}m\omega^2(A')^2 = m\omega^2A^2$

$\Rightarrow A' = \sqrt{2}\,A$. **Ans. mÙkj**

7. Velocity of (A + C),

$V_1 = \dfrac{V}{1+3} = \dfrac{V}{4}$

If B does not move, maximum compression X in the spring is

$\dfrac{1}{2}KX^2 = \dfrac{1}{2} \times 4m\left(\dfrac{v}{4}\right)^2$

$\therefore X = \left(\dfrac{4m}{K}\right) \cdot \dfrac{v}{4}$

$\therefore KX = \mu mg$

$\Rightarrow 100 \cdot \sqrt{\dfrac{4}{100}} \cdot \dfrac{v}{4} = 1 \times 10$

$\Rightarrow v = 2$ m/s

Ans. 2

8. $x_A = \dfrac{A}{\sqrt{2}}$

and for x_B ; $\dfrac{\omega A}{2} = \omega\sqrt{A^2 - x_B^2}$

or $x_B = \dfrac{\sqrt{3}}{2}A$

or $\omega t_A = \dfrac{\pi}{4}$ and $\omega t_B = \dfrac{\pi}{3}$

or $\omega(t_B - t_A) = \dfrac{\pi}{3} - \dfrac{\pi}{4}$

or $\dfrac{\pi}{3} - \dfrac{\pi}{4} = \dfrac{2\pi}{T}t$

or $t = \dfrac{T}{2\pi} \times \dfrac{\pi}{12} = \dfrac{T}{24}$

Ans. $\dfrac{T}{24}$

DPP NO. - 72

1. By momentum conservation (considering 'N particls of mass m + mass M' as system)

$mV \times N = (Nm + M)\, V'$

2. $U = 2 - 20x + 5x^2$

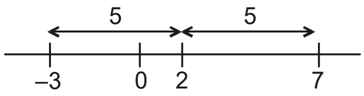
$$F = -\frac{dU}{dx} = 20 - 10x$$

At equilibrium position ; F = 0

$20 - 10x = 0$

$\Rightarrow\ x = 2$

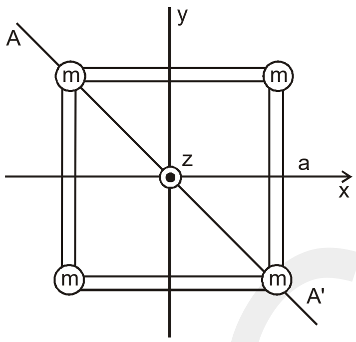
Since particle is released at $x = -3$, therefore amplitude of particle is 5.



It will oscillate about x = 2 with an amplitude of 5.

$\therefore$ maximum value of x will be 7.

3.



$$I_{xx} = m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2$$

$= ma^2$

$$I_{yy} = m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2$$

$= ma^2$

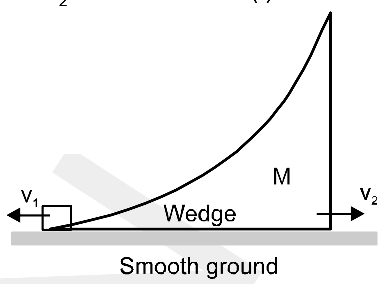
$$I_{AA'} = m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2 + 0 + 0 = ma^2$$

$$I_{zz} = \left(m\left(\frac{a}{2}\right)^2\right) \times 4 = 2ma^2$$

5. to 7 Linear momentum is conserved only in horizontal direction.

6. Net F_{ext} on system is zero in horizontal direction therefore linear momentum is conserved only in horizontal direction.

7. $mv_1 = Mv_2$ ....(i)



$$\frac{1}{2}mv_1^2 + \frac{1}{2}Mv_2^2 = mgh \quad ....(ii)$$

From (i) & (ii), $v_2 = m\sqrt{\dfrac{2gh}{(M+m)M}}$.

DPP NO. - 73

1. Due to impulse, the total energy of the particle becomes :

$$\frac{1}{2}m\omega^2A^2 + \frac{1}{2}m\omega^2A^2 = m\omega^2A^2$$

Let ; A' be the new amplitude.

$$\therefore\ \frac{1}{2}m\omega^2(A')^2 = m\omega^2A^2$$

$\Rightarrow\ A' = \sqrt{2}\,A.$ **Ans. mÙkj**

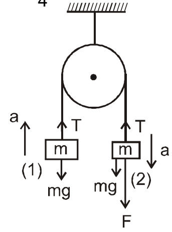
2. S_1 : The statement is true from Work Energy Theorem

$S_2 : F = -\dfrac{dU}{dx} = -4x + 5 \quad \therefore$ SHM

S_3 & S_4 : A rigid body by definition cannot be expanded or compressed, thus it cannot store mechanical potential energy. Hence internal forces can do no work on rigid body, but can do work on non-rigid body. Hence S_3 is false and S_4 is true.

3. $Mg + F - T = Ma$

$T - Mg = Ma$



$F = 2Ma$

$$a = \frac{F}{2M}$$

$$a_{CM} = \frac{m_1a_1 + m_2a_2}{m_1 + m_2} = \frac{Ma + M(-a)}{M + m} = 0$$

4. $x_A = \frac{A}{\sqrt{2}}$

and for x_B ; $\frac{\omega A}{2} = \omega\sqrt{A^2 - x_B^2}$

or $x_B = \frac{\sqrt{3}}{2}A$

or $\omega t_A = \frac{\pi}{4}$ and $\omega t_B = \frac{\pi}{3}$

or $\omega (t_B - t_A) = \frac{\pi}{3} - \frac{\pi}{4}$

or $\frac{\pi}{3} - \frac{\pi}{4} = \frac{2\pi}{T}t$

or $t = \frac{T}{2\pi}\times\frac{\pi}{12} = \frac{T}{24}$

Ans. $\frac{T}{24}$

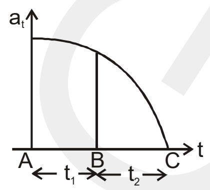
5. to 7 $v_B = \sqrt{2gL\sin\theta}$ and $v_C = \sqrt{2gL}$

If $v_C = 2v_B$

Then $2gL = 4\ (2gL \sin\theta)$

or $\sin\theta = \frac{1}{4}$ or $\theta = \sin^{-1}\frac{1}{4}$

6. Tangential acceleration is $a_t = g \cos\theta$, which decreases with time.
Hence the plot of a_t versus time may be as shown in graph.



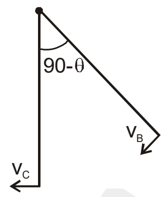
Area under graph in time interval t_1
$= v_B - 0 = v_B$
Area under graph in time interval t_2
$= v_C - v_B = v_B$
Hence area under graph in time t_1 and t_2 is same.
$\therefore t_1 < t_2$

7. $|\vec{v}_B - \vec{v}_C| = \sqrt{v_B^2 + v_C^2 - 2v_Bv_C\sin\theta} = v_B$

$\Rightarrow v_B^2 + v_C^2 - 2v_Bv_C\sin\theta = v_B^2$

$v_C = 2v_B\sin\theta$

$\Rightarrow \sqrt{2g\ell} = 2\sqrt{2g\ell\sin\theta}\sin\theta$



$\therefore \sin^3\theta = \frac{1}{4} \Rightarrow \sin\theta = \left(\frac{1}{4}\right)^{1/3}$

$\theta = \sin^{-1}\left(\frac{1}{4}\right)^{1/3}$

DPP NO. - 74

1. $N = m(g + a)$ $\quad N' = m(g - a)$

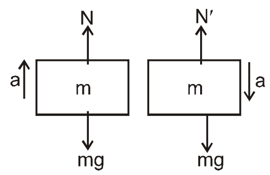
$N' = \frac{10}{100}\times N$

$m(g - a) = \frac{m(g+a)}{10}$

$10g - 10a = g + a$

$9g = 11a$

$\Rightarrow a = \frac{9g}{11}$



2. Conserving momentum : $2V = 3V'$

$\Rightarrow V' = \frac{2}{3}V.$

$E_i = \frac{1}{2}m_1V_1^2 = \frac{1}{2}.2.V^2 = V^2$

$\Rightarrow \frac{1}{2}KA^2 = V^2.$

$E_f = \frac{1}{2}.m_2V_2^2 = \frac{1}{2}.3.\frac{2}{3}.\frac{2}{3}V^2 = \frac{2}{3}V^2$

$\Rightarrow \frac{1}{2}KA'^2 = \frac{2}{3}V^2 = \frac{2}{3}E_i$

($\because E_i = V^2$ from above)

$\Rightarrow \frac{1}{2}KA'^2 = \frac{2}{3}\left(\frac{1}{2}KA^2\right)$

$\Rightarrow A' = \sqrt{\frac{2}{3}}A$ **Ans.**

3. In pure rolling static friction acts so energy remain conserved. So kinetic energy of ball at O = mgh

$mgh = \frac{1}{2}mv^2 + \frac{1}{2}\times\frac{2}{5}mr^2\frac{v^2}{r^2}$

translational kinetic energy $\quad$ Rotational kinetic

$mgh = \frac{1}{2}mv^2 + \frac{1}{5}mv^2$

Translational kinetic energy = $\dfrac{mgh \times \frac{1}{2}}{\frac{1}{2}+\frac{1}{5}}$

$= \dfrac{mgh \times \frac{1}{2}}{\frac{7}{10}} = \dfrac{5mgh}{7}$

Rotational kinetic energy = $\dfrac{2mgh}{7}$

4. (A) Maximum kinetic energy at x = 3m.
(B) KE = work done = area under the curve

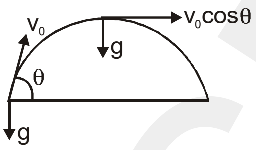
$= 10 \times 2 + \frac{1}{2} \times 1 \times 10 = 25$ J

(C) w_{ret} = area under the curve

$= 25 - \frac{1}{2} \times 3 \times 20 = -5$J

(D) Power $P = \vec{F}.\vec{v}$

5. $R_1 = \dfrac{v_0^2}{g\cos\theta}$



$R_2 = \dfrac{(v_0\cos\theta)^2}{g}$

$\therefore \dfrac{R_1}{R_2} = \dfrac{1}{(\cos\theta)^3} = 8$

Ans. 8

6. $T = 2\pi\sqrt{\dfrac{m_1+m_2}{K}}$

$= 2\pi\sqrt{\dfrac{6}{2400}} = \dfrac{\pi}{10}$

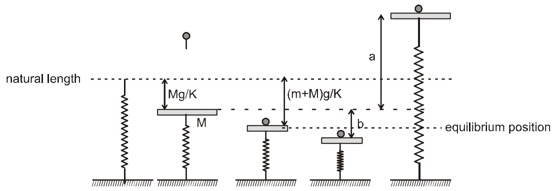
$\Rightarrow f = \dfrac{10}{\pi}$

Instantaneous tension just after m_2 is released will be zero as the spring is unstressed.
Amplitude of $m_1 = m_2g/K = 25/12$ cm, hence maximum dispalcement of m_1 will be 25/6 cm.

7. [Ans: (a) $K = \dfrac{2mg}{b-a}$

(b) $\dfrac{1}{2\pi}\sqrt{\dfrac{k}{M+m}}$

(c) $\left(\dfrac{M+m}{b-a}\right)\dfrac{ab}{m}$



Amplitude = $b - \dfrac{mg}{K} = a + \dfrac{mg}{K}$ (by diagram)

$\Rightarrow K = \dfrac{2mg}{b-a}$

(b) $f = \dfrac{1}{T} = \dfrac{1}{2\pi}\sqrt{\dfrac{K}{M+m}}$.

(c) If the ball was dropped from 'h'.

$\Rightarrow V_{\text{before collision}} = \sqrt{2gh}$

conserving momentum :

$m\sqrt{2gh} = (m+M)V'$ Where V′

$= \omega\sqrt{A^2-x^2} = \sqrt{\dfrac{K}{M+m}}.\sqrt{\left(b-\dfrac{mg}{K}\right)^2-\left(\dfrac{mg}{K}\right)^2}$

Squaring both sides and putting

$K = \dfrac{2mg}{b-a}$, get $h = \left(\dfrac{M+m}{b-a}\right)\dfrac{ab}{m}$.

DPP NO. - 75

1. (D) F + f = ma .... (1)

Also ; $FR - fR = I\dfrac{a}{R}$

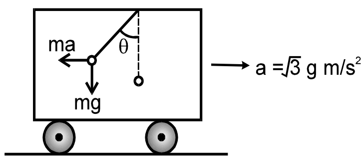
F – f = ma .... (2)

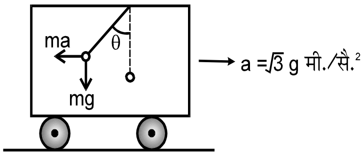
[$I = mR^2$]

From (1) & (2)

f = 0.

2. With respect to the cart, equilibrium position of the pendulum is shown.
If displaced by small angle θ from this position, then it will execute SHM about this equilibrium position, time period of which is given by :





$T = 2\pi\sqrt{\dfrac{L}{g_{eff}}}$; $g_{eff} = \sqrt{g^2 + (\sqrt{3}g)^2}$

$\Rightarrow$ $g_{eff} = 2g$

$\Rightarrow$ T = 1.0 second

3. $\dfrac{\Delta T}{T}\times 100 = \dfrac{1}{2}\dfrac{\Delta \ell}{\ell}\times 100$ is not valid as $\Delta\ell$ is not small.

$\dfrac{\Delta T}{T}\times 100 = \dfrac{1}{2}\dfrac{\Delta \ell}{\ell}\times 100$

$T_1 = 2\pi\sqrt{\dfrac{\ell}{g}}$ $T_2 = 2\pi\sqrt{\dfrac{2\ell}{g}}$ % change

$= \dfrac{T_2 - T_1}{T_1} \times 100 = (\sqrt{2}-1)\times 100 = 41.4$

4. For minimum time period

$x = \dfrac{R}{\sqrt{2}}$

$\Rightarrow T = 2\pi\sqrt{\dfrac{\dfrac{mR^2}{2}+\dfrac{mR^2}{2}}{\dfrac{mgR}{\sqrt{2}}}} = 2\pi\sqrt{\dfrac{\sqrt{2}R}{g}}$

5. (D) $\tau = -k\theta$

0.1 = – k(1.0), where k is torsional constant of the wire.

$k = \dfrac{1}{10}$

$T = 2\pi\sqrt{\dfrac{I}{k}} = 2\pi\sqrt{\dfrac{\dfrac{2}{5}\times 25\times(.2)^2}{1/10}}$

$= 2\pi\sqrt{10\times .2\times .2\times 10}$ $= 4\pi$ second **Ans.**

6. to 8

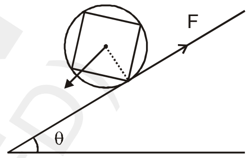
8. (**3 to 5**)

$I = \left[\dfrac{M(R\sqrt{2})^2}{12} + M\left(\dfrac{R}{\sqrt{2}}\right)^2\right]\times 4 + mR^2$

= 20 kgm².

$(4M + m)g\sin\theta - F = (4M + m)a$.

$F.R. = I\left(\dfrac{a}{R}\right)$



Solving

$a = \dfrac{7g}{24}$

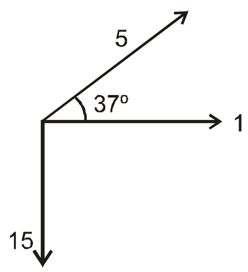
$F = 20a \le \mu\,(4M + m)g\cos 30$

$\mu \ge \dfrac{5}{12\sqrt{3}}$

$\therefore$ $\mu_{min} = \dfrac{5}{12\sqrt{3}}$

DPP NO. - 76

1. $x_1 = \sin\omega t$; $x_2 = 5\sin(\omega t + 37°)$
$x_3 = 15\sin(\omega t - \pi/2)$
By the phasor diagram;



Get the resultant of these 3 vectors as 13.

2. At t = 0
Displacement $x = x_1 + x_2$

$= 4\sin\dfrac{\pi}{3} = 2\sqrt{3}$ m.

Resulting Amplitude A =

$\sqrt{2^2 + 4^2 + 2(2)(4)\cos\pi/3} = \sqrt{4+16+8} = \sqrt{28} =$

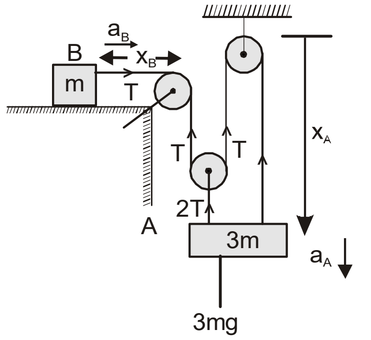
$2\sqrt{7}$ m

Maximum speed = $A\omega = 20\sqrt{7}$ m/s

Maximum acceleration = $A\omega^2 = 200\sqrt{7}$ m/s^2

Energy of the motion = $\frac{1}{2}$ m$\omega^2 A^2$ = **28 J Ans.**

5.



$\ell = x_B + 3x_A$

$\Rightarrow 0 = \frac{d^2x_B}{dt^2} + 3\frac{d^2x_A}{dt^2}$

$\Rightarrow 0 = -a_B + 3a_A$

$\Rightarrow a_B = 3a_A$ .... (1)

For B $T = ma_B$ .... (2)

For A $3mg - 3T = 3ma_A$ .... (3)

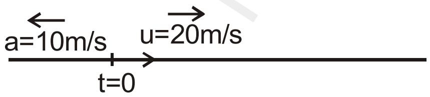
$mg - T = ma_A$

By (1) , (2) & (3)

$\therefore a_B = 15/2$ **Ans.**

6. The velocity of particle is zero when v = (20 – 10 t) = 0.

That is at t = 2 sec. v = 0.



From t = 0 to t = 2 distance traveled is

$S_1 = \frac{(20)^2}{2 \times 10} = 20$ m.

Next 5 meter wil be covered in $5 = \frac{1}{2} \times 10 \times t^2$ or t = 1 s.

$\therefore$ The particle covers 25 metres distance in 3 sec.

K.E. at t = 0 is $K_i = \frac{1}{2} mu^2 = \frac{1}{2} 2 \times (20)^2 = 400$ J

KE at t = 3 is

$K_f = \frac{1}{2} mv^2 = \frac{1}{2} 2 \times (10)^2 = 100$ J

Therefore work done by block from t = 0 to t = 3s is

$\Delta W = K_f - K_i = 100 - 400 = -300$ J

7. At t = 3 sec. force on particle is F = ma = 2 × 10 towards –ve x-direction

At t = 3 sec. the velocity of particles is v = 10 m/s towards – ve x-direction

P = FV = 200 watts **Ans.**

8. From solution of 37 K_f = 100 J **Ans.**

DPP NO. - 77

1. The minimum distance between the two particles having same speed is $\lambda/2$.

3. y = 0.02 sin (x + 30t)

for the given wave :

$v = \frac{dx}{dt} = -30$

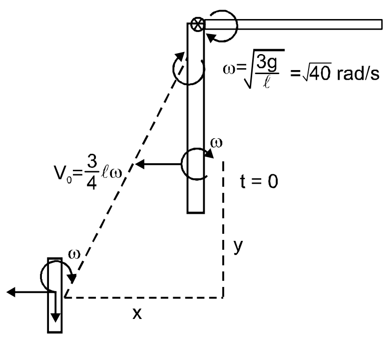
($\because$ x + 30t = constant)

we have : $v = \sqrt{\frac{T}{\mu}} \Rightarrow T = \mu v^2 = A.\rho V^2$

$= (10^{-6}\ m^2)(8 \times 10^3 \frac{kg}{m^3})(30)^2$

$\Rightarrow$ T = 7.2 N **Ans.**

5.



$t = \frac{\pi}{\omega} = \frac{\pi}{\sqrt{40}}$ sec.

$x = v_0 t$

$y = \frac{1}{2}gt^2$

$r = \sqrt{x^2 + \left(y + \frac{3\ell}{4}\right)^2} \simeq 2.5\text{m}$.

6. Minimum for required,

$\Rightarrow \frac{\mu mg}{\sqrt{1+\mu^2}} = \frac{mg}{2}$

$\mu = \frac{1}{\sqrt{3}}$

$\mu^2 = \frac{1}{3}$

$\frac{1}{\mu^2} = 3.$

7. Collision is perfectly elastic collision, particle 2 is at rest

$(u_2 = 0)$

$V_1 = - V_2$ (given)

(A) $\frac{(m_1 - m_2)u_1}{(m_1 + m_2)} = \frac{-2m_1 \; u_1}{(m_1 + m_2)}$

$m_1 - m_2 = -2m_1 = 3m_1 = m_2$

$\frac{m_1}{m_2} = \frac{1}{3}$

8. (a) from y – x graph

wavelength = λ = 6m

from y – t graph

Time period = T = 4 sec

$\Rightarrow$ frequency = f = $\frac{1}{4}$ = 0.25 Hz

wave speed = $f\lambda$ = 0.25 × 6 = 1.50 m/s

(b) maximum velocity = 3mm × $\frac{\pi}{2}$ rad/sec

= 1.5 π mm/sec

maximum accelesation = $w^2A = \frac{\pi^2}{4} \times 3\text{mm}$

= 0.75 p^2 mm/sec^2.

(c) $k = \frac{2\pi}{\lambda} = \frac{\pi}{3}$ m^{-1}

$\Rightarrow w = \frac{2\pi}{T} = \frac{\pi}{2}$ rad/sec

$y = 3 \sin\left(\frac{\pi}{3}x - \frac{\pi}{2}t + \theta_o\right)$

$y(x = 2, t = 0) = 0$

$\Rightarrow \sin\left(\frac{2\pi}{3} + \theta_0\right) = 0$

$\Rightarrow \theta_0 = -\frac{2\pi}{3}$ or $\frac{\pi}{3}$

and $\frac{\partial y}{\partial t}$ (t = 0 , x = 2) > 0

$\Rightarrow \frac{-3\pi}{2} \cos\left(\frac{\pi}{3}x - \frac{\pi t}{2} + \theta_o\right) > 0$

(For x = 2, t = 0)

$\Rightarrow \cos\left(\frac{2\pi}{3} + \theta_o\right) < 0$

$\Rightarrow \theta_o = \frac{\pi}{3}$

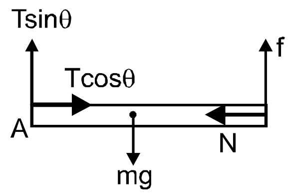
$y = (x,t) = 3 \sin\left(\frac{\pi x}{3} - \frac{\pi t}{2} + \frac{\pi}{3}\right)$

$\frac{\partial y}{\partial x} = \pi \cos\left(\frac{\pi x}{3} - \frac{\pi t}{2} + \frac{\pi}{3}\right)$

$\Rightarrow$ at x = 2 and t = 4 sec ; $\frac{\partial y}{\partial x} = \pi$

DPP NO. - 78

1.

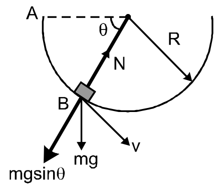


Torque about A

$mg\frac{\ell}{2} - f\ell = 0$

$F = \frac{mg}{2}$.

2. $\frac{mv^2}{R} = N - mg \sin\theta$



$N = \frac{mv^2}{R} + mg\sin\theta$

By energy conservation,

$mgR\sin\theta = \frac{1}{2}mv^2$

$\frac{mv^2}{R} = 2mg\sin\theta$

$N = 3mg\sin\theta$

Ratio $= \frac{mv^2}{RN} = \frac{2}{3}$ (constant)

$x = \frac{2}{3}$.

3. **Ans.** Acceleration = 0

4. $\frac{dV_y}{dt} = -bt$

or $v_y = -\frac{bt^2}{2} + v_0\sin\theta$ .... (1)

$\frac{dy}{dt} = -\frac{bt^2}{2} + v_0\sin\theta$

or $y = -\frac{bt^3}{6} + v_0\sin\theta\, t$ .... (2)

Putting y = 0 in equation (2)

$T = \sqrt{\frac{6v_0\sin\theta}{b}}$ = Time of flight.

5. For maximum height $\frac{dy}{dt} = 0 = -\frac{bt^2}{2} + v_0\sin\theta$

$\therefore$ y is maximum at $t = \sqrt{\frac{2v_0\sin\theta}{b}}$

or $y_{max} = \left(-\frac{bt^2}{6} + v_0\sin\theta\right)t$

$= \left(-\frac{b}{6}\times\frac{2v_0\sin\theta}{b} + v_0\sin\theta\right)\sqrt{\frac{2v_0\sin\theta}{b}}$

$= \frac{2}{3}\frac{v_0\sin\theta}{\sqrt{b}}\sqrt{2v_0\sin\theta} = \frac{(2v_0\sin\theta)^{3/2}}{3\sqrt{b}}$

6. $R = v_0\cos\theta \times \sqrt{\frac{6v_0\sin\theta}{b}}$

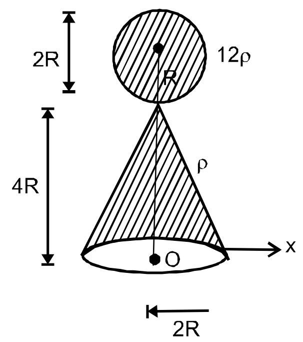
$\therefore \frac{dR}{d\theta} = 0$ at $\tan\theta = \frac{1}{\sqrt{2}}$

or $\theta = \tan^{-1}\frac{1}{\sqrt{2}}$

7. **(A) – p ;**
(B) – r, s, t ;
(C) – r, s, t ;
(D) – r, s, t

DPP NO. - 79

1.



Mass of cone $M_1 = \rho\left(\frac{1}{3}\pi(2R^2)4R\right)$

$c = \frac{\rho}{3}\pi(16R^3)$

mass of sphere M_2

$= 12\rho\left(\frac{4}{3}\pi R^3\right) = \rho 16\pi(R^3)$

$y_1 = y_{com}(\text{Cone}) = \frac{H}{4} = \frac{4R}{4} = R$

$y_2 = y_{com}(\text{sphere}) = 4R + R = 5R$

$y_{com}(toy) = \dfrac{M_1y_1 + M_2y_2}{M_1 + M_2}$

$= \dfrac{16\rho\pi R^3}{3}(R) + 16\rho\pi\,(R^3)\,5R$

$16\,\pi\rho R^3\left[\dfrac{1}{3}+1\right]$

$\Rightarrow \dfrac{16\rho\pi R^3\left[\dfrac{R}{3}+5R\right]}{16\rho\pi R^3\left[\dfrac{1}{3}+1\right]} = 4R$

2. The speed of the plane as it goes from city A to city B is $V_o + V_A$ and the speed of the plane as it goes from city B to city A is $V_o - V_A$. Therefore the time taken by the plane to go once round the trip is

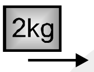
$$t = \frac{D}{V_o - V_A} + \frac{D}{V_o + V_A} = \frac{2DV_o}{V_0^2 - V_A^2}$$

3. As wave has been reflected from a rarer medium, therefore there is no change in phase. Hence equation for the opposite direction can be written as

$y = 0.5A\sin(-kx - \omega t + \theta)$

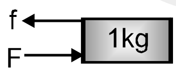
$= -0.5A\sin(kx + \omega t - \theta)$

4. FBD



$f = \mu N = 0.1 \times 2 \times 10N = 2N$

$a_{2kg} = \dfrac{f}{m} = \dfrac{2N}{2kg} = 1\ m/s^2$



$F - f = ma$

$\Rightarrow\ 4 - 2 = 1 \times a_{1kg}$

$\Rightarrow\ a_{1kg} = 2\ m/s^2$

Distance travelled by 1 kg in t = 2 s,

$S = \dfrac{1}{2} \times at^2 = \dfrac{1}{2} \times 2 \times 2^2 = 4\ m$

Velocity of the 1 kg block after t = 2 s,

$v = a = 2 \times 2\ m/s = 4\ m/s$

$\therefore$ work done by F = F.S. = 4 × 4J = 16 J

KE of 1 kg block $= \dfrac{1}{2} \times m \times v^2 = \dfrac{1}{2} \times 1 \times 4^2 =$ 8 J

Using work energy theorem

$W_{net} = \Delta KE$

$W_F + W_{friction} = \Delta KE$

$16 + W_{friction} = 8$

$\Rightarrow\ W_{friction} = -8J$

Ans. 8

5. to 7 $\lambda = 4m$ and $f = 500$ Hz.

$\therefore\ V = f\lambda = 200$ m/s

$\because\ V = \sqrt{\dfrac{T}{\mu}}\ \therefore\ T = \mu v^2 = (0.1) \times (200)^2$

= 400 N

6. Since integral number of waves shall cross a point is 5 seconds, therefore power transmitted in 5 seconds is

$= \langle P\rangle \times 5 = 2\pi^2 f^2 A^2\ \mu v \times 5$

$= 2 \times \pi^2 \times (50)^2 \times (2 \times 10^{-3})^2 \times (0.01) \times 200 \times 5 = \dfrac{\pi^2}{5}$

7. The equation of waves is

$y = A\sin(kx - \omega t + \phi_0)$

$\therefore$ where $K = \dfrac{2\pi}{\lambda} = \dfrac{\pi}{2}$, $\omega = 2\pi f = 100\,\pi$ and A = 2

at x = 2 and t = 2 y = 1 mm

$\therefore\ 1 = 2\sin(\pi - 200\pi + \phi_0)$ solving $\phi_0 = -30°$

$\therefore\ y = 2\sin\left(\dfrac{\pi x}{2} - 100\,\pi t - 30°\right)$

DPP NO. - 80

1. After 2 sec speed of boy will be

$v = 2 \times 2 = 4$ m/s

At this moment centripetal force on boy is

$F_r = \dfrac{mv^2}{R} = \dfrac{30 \times 16}{6} = 80$ Nt.

Tangential force on boy is

$F_t = ma = 30 \times 2 = 60$ Nt.

Total friction acting on boy is

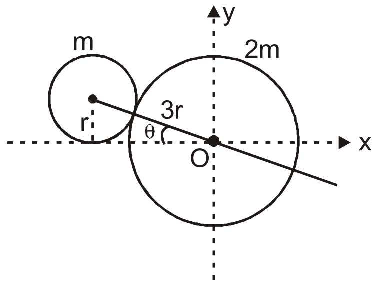
$F = \sqrt{F_r^2 + F_t^2} = 100$ Nt

At the time of slipping

$F = \mu mg$

or $100 = \mu \times 30 \times 10$

$\Rightarrow \mu = \frac{1}{3}.$

2. 

The larger sphere will move along line of impact.
AB e = 0, velocity of larger sphere

$v' = \frac{mv\cos\theta}{m+2m} = \frac{v\cos\theta}{3}$

velocity of larger sphere

$= v'\cos\theta\,\hat{i} - v'\sin\theta\,\hat{j}$

$= \frac{v}{3}\cos^2\theta\,\hat{i} - \frac{v}{3}\sin\theta\cos\theta\,\hat{j}$

$= \frac{8}{27}\hat{i} - \frac{2\sqrt{2}}{27}\hat{j}$

3. **(C)** Impulse = change in momentum

$\therefore P.\frac{\ell}{2} = \frac{m\ell^2}{12}.\omega$

(about centre of AB)

$\Rightarrow \omega = \frac{6P}{m\ell}$

For $\theta = \frac{\pi}{2}$; $\frac{\pi}{2} = \omega t$

$\Rightarrow t = \frac{\pi}{2\omega} = \frac{\pi m\ell}{2\times 6p}$

$\Rightarrow t = \frac{\pi m\ell}{12p}$ **Ans.**

4. By energy conservation :

$mgh = \frac{1}{2}mv^2 + \frac{1}{2}K\left(\frac{h}{\sin\theta}\right)^2 + \mu mg\cos\theta.\frac{h}{\sin\theta}$

$\Rightarrow V$

$= \sqrt{\frac{2}{m}\left[mgh - \frac{1}{2}K\left(\frac{h}{\sin\theta}\right)^2 - \mu mgh\cot\theta\right]}$ **Ans.**

5. to 7 $\lambda = 4m$ and $f = 500$ Hz.

$\therefore V = f\lambda = 200$ m/s

$\because V = \sqrt{\frac{T}{\mu}}$ $\therefore T = \mu v^2 = (0.1)\times(200)^2$

= 400 N

6. Since integral number of waves shall cross a point is 5 seconds, therefore power transmitted in 5 seconds is $= <P> \times 5 = 2\pi^2 f^2 A^2\ \mu v \times 5$

$= 2\times\pi^2\times(50)^2\times(2\times10^{-3})^2\times(0.01)\times 200$ ×

$5 = \frac{\pi^2}{5}$

7. The equation of waves is

$y = A\sin(kx - \omega t + \phi_0)$

$\therefore$ where $K = \frac{2\pi}{\lambda} = \frac{\pi}{2}$, $\omega = 2\pi f = 100\pi$ and A

= 2

at x = 2 and t = 2 y = 1 mm

$\therefore 1 = 2\sin(\pi - 200\pi + \phi_0)$ solving ϕ_0 = –30°

$\therefore y = 2\sin\left(\frac{\pi x}{2} - 100\pi t - 30°\right)$

DPP NO. - 81

2. $L = \frac{m\lambda_1}{2}$ and $L\ (m+1)\ \frac{\lambda_2}{2}$

Where m is no. of harmonic

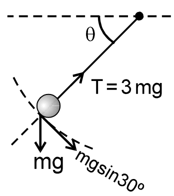
m.36 = (m + 1) 32

$\Rightarrow$ m = 8

L = 8 × 18 = 144 cm

3. $T - mg\sin\theta = \frac{mv^2}{R}$

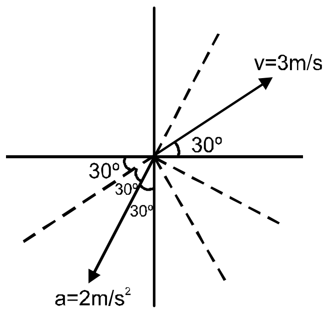
$\Rightarrow$ 3 mg – mg sin30°



$= \frac{m.(u_0^2 + 2g\ell\sin 30°)}{\ell}$

$\therefore u_0 = \sqrt{3g/2}$

4. Initially ROC $= \frac{v^2}{a\sin 30°} = \frac{9}{1}$ m



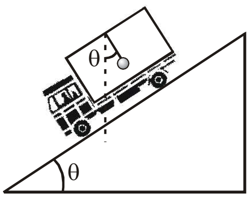
For minimum ROC $= \frac{(v\sin 30^\circ)^2}{a} = \frac{9}{8}$ m.

5. to 7 Acceleration of the van = $\frac{30}{6}$ = 5 m/s²

g sin θ = a

$\Rightarrow$ sin θ = $\frac{1}{2}$

$\Rightarrow$ θ = 30°



6. Tension

$T = mg\cos\theta = \frac{\sqrt{3}}{2}$ N

7. Since accelerationof the van is g sinθ, there is no friction.

DPP NO. - 82

1. y (x, t) = 2 sin (0.1 πx) cos (100 πt)

compare with

y = A sin (Kx) cos ωt

$K = 0.1\,\pi = \frac{2\pi}{\lambda}$

λ = 20 cm

$\frac{\pi}{4} = \frac{20}{4}$ = 5 cm

2. $\lambda = 2\ell = 3$m

Equation of standing wave

y = 2A sin kx cos ωt

y = A as amplitude is 2A.

A = 2A sin kx

$\frac{2\pi}{\lambda}x = \frac{\pi}{6}$

$\Rightarrow x_1 = \frac{1}{4}$ m

and $\frac{2\pi}{\lambda}\cdot x = \frac{5\pi}{6}$

$\Rightarrow x_2 = 1.25$ m

$\Rightarrow x_2 - x_1 = 1$m

3. $f = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}} = \frac{1}{2\ell}\sqrt{\frac{T}{\rho s}} = \frac{1}{2\ell}\sqrt{\frac{T}{\rho\cdot\pi r^2}}$

$= \frac{1}{2\ell r}\sqrt{\frac{T}{\rho\pi}}$

$\therefore \frac{\Delta f}{f} = -\frac{\Delta\ell}{\ell} - \frac{\Delta r}{r}$

$\left(\frac{\Delta f}{f}\right)_{max}$ = 1 + 0.5 = 1.5% **Ans.**

4. (a) The system is in equilibrium when

$m_1 g\sin\theta = m_2 g$

or $\sin\theta = \frac{m_2}{m_1}$

(b) Let the tangential acceleration of m_1 be a.

$\therefore m_2 g - m_1 g\sin\theta = (m_1 + m_2)\,a$

$a = \frac{40-25}{9} = \frac{15}{9}$ m/s²

the normal acceleration of m_1 is zero.

$\because$ speed of m_1 is zero.

$\therefore$ The magnitude of acceleration of $m_1 = \frac{5}{3}$ m/s²

5. to 7. Wave velocity in string is

$v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{40}{0.1}}$ = 20 m/s

Fundamental frequency of string oscillations is

$n_0 = \frac{v}{2e} = \frac{20}{0.6} = \frac{100}{3}$ Hz

Thus string will be in resonance with a turning fork of frequency.

$n_f = \frac{100}{3}$ Hz, $\frac{200}{3}$ Hz, 100 Hz, $\frac{400}{3}$ Hz, ...

Here rider will not oscillate at all only if it is at a node of stationary wave in all other cases of resonance and non-resonance it will vibrate at the frequency of tuning fork. At a distance $\frac{l}{3}$ from one end node will appear at 3rd, 6th, 9th or similar higher Harmonics i.e. at frequencies 100 Hz, 200 Hz, … .

If string is divided in odd no. of segments, these segments can never resonate simultaneously hence at the location of rider, antinode is never obtained at any frequency.

DPP NO. - 83

1. Muzzle velocity = $v_{m/g} = v_0$

Along x-direction ;

$v_{m(x)} - v_{g(x)} = v_0 \cos\theta$

By momentum conservation: (M + m)(0)

= m $(v_0 \cos\theta - v) - Mv$

$\Rightarrow v = \dfrac{mv_0 \cos\theta}{(M+m)}$

2. Equation of the component waves are :

$y = A \sin(\omega t - kx)$ and $y = A \sin(\omega t + kx)$

where; $\omega t - kx$ = constant or $\omega t + kx$ = cosntant

Diffeentaiting w.r.t. 't' ;

$\omega - k\dfrac{dx}{dt} = 0$ and $\omega + k\dfrac{dx}{dt} = 0$

$\Rightarrow v = \dfrac{dx}{dt} = \dfrac{\omega}{k}$ and $v = -\dfrac{\omega}{k}$

i.e.; the speed of component waves is $\left(\dfrac{\omega}{k}\right)$.

Hence (B)

5. $y = 4 \sin\left(\pi\dfrac{x}{15}\right) \cos 96\pi t$

At x = 5 cm, $y = 4 \sin\dfrac{\pi}{3} \cos(96\pi t)$ and y_{max}

$= 2\sqrt{3}$ cm

Positions of nodes is given by equation

$\sin\left(\dfrac{\pi x}{15}\right) = 0$

$\Rightarrow \dfrac{\pi x}{15} = n\pi$

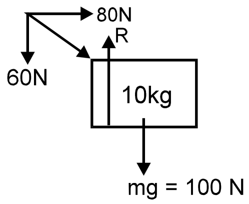
$\Rightarrow x = 15n$

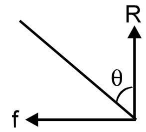
At x = 7.5 cm and t = 0.25 sec.

Velocity of the particle $= \dfrac{\partial y}{\partial t} = -344\,\pi \sin\left(\dfrac{\pi x}{15}\right) \sin(96\pi t) = 0$

$y = 4 \sin\left(\dfrac{\pi x}{15}\right) \cos(96\pi t) = 2 \sin\left(\dfrac{\pi x}{15} + 96\pi t\right) + 2 \sin\left(\dfrac{\pi x}{15} - 96\pi t\right)$

6.





R = mg + 60 = 160 N

f = 80 N ($\because$ No sliding)

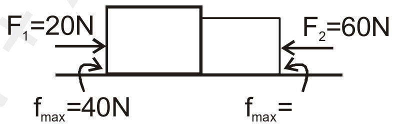
angle of friction $\theta = \tan^{-1}\dfrac{f}{R} = \tan^{-1}\dfrac{80}{160}$ θ

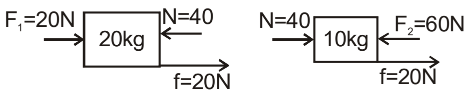
$= \tan^{-1}\dfrac{1}{2}$ Ans.

7. The minimum horizontal force required to push the two block system towards left

= 0.2 × 20 × 10 + 0.2 × 10 × 10 = 60.

Hence the two block system is at rest. The FBD of both of blocks is as shown. The friction force f and normal reaction N for each block is as shown.





FBD of both blocks

Hence magnitude of friction force on both blocks is 20 N and is directed to right for both blocks. Normal reaction exerted by 20 kg block on 10 kg block has magnitude 40 N and is directed towards right. Net force on system of both blocks is zero.

DPP NO. - 84

1. $0^2 = V^2 - 2\mu gs$

$\Rightarrow s = \dfrac{V^2}{2\mu g}$. (A).

2. The possible expression will be one which gives zero displacement at x = 0, X = L, y = 0 and y = L.

3. For waves along a string :

$\upsilon \propto \sqrt{T}$

$\Rightarrow \lambda \propto \sqrt{T}$

Now, for 6 loops : $3\lambda_1 = L$

$\Rightarrow \lambda_1 = L/3$

& for 4 loops : $2\lambda_2 = L$

$\Rightarrow \lambda_2 = L/2$

$$\Rightarrow \frac{\lambda_1}{\lambda_2} = \frac{2}{3}$$

$$\Rightarrow T_2 = \frac{9}{4} x T_1 = \frac{9}{4} \times 36$$

= 81 N. **Ans.**

4. Two consecutive frequencies are 420 Hz & 480 Hz. So the fundamental frequency will be 60 Hz.

$$\therefore 60 = \frac{1}{2 \times \ell} \sqrt{\frac{450}{5 \times 10^{-3}}}$$

$\Rightarrow \ell = 2.1$ m

5. Applying momentum conservation ;

(80) 1 + 60 (– 2) = (80 + 60 + 100) v

$$v = \frac{-40}{240} = -\frac{1}{6} \text{ m/sec.}$$

6. to 8 **(Easy)** The motion in the x-direction is a constant velocity motion. We find the flight time $= \frac{1600\,m}{u_x}$

$$\frac{1600}{400 \cos\theta} = 5 \text{ sec.}$$

Flight time = 5sec.

7. **(Easy)** From the flight time, the initial velocity in the y-direction and the acceleration in the y-direction, we can calculate the altitude of the shell:

$$h = u_y t - \frac{1}{2} g t^2 = \frac{1200}{5} \times 5 - \frac{1}{2} \times 10 \times 25$$

= 1200 – 125 = 1075 m

height = 1075m.

8. **(Easy)** After the waiting time plus the flight time, the balloon should reach the same altitude as the shell. Let t_w be the waiting time.

$$\therefore t_w + 5\text{sec} = \frac{1075 - 800}{5} \quad \text{or } t_w = 50 \text{ sec.}$$

DPP NO. - 85

1. velocity of the block after passing through the rough surface is $v = \sqrt{36 - 2\mu g(2)} = \sqrt{36 - 40\mu}$

Apply work energy theorem

$\mu mg\,(2) + mgh = KE_i - KE_f$ ....(1)

at the highest point

$V_{block} = V_{wedge}$

$$20\mu + 3 = \frac{1}{2} 1(6)^2 - \frac{1}{2} 3v^2$$

$$\mu = \frac{54}{80} = 0.675$$

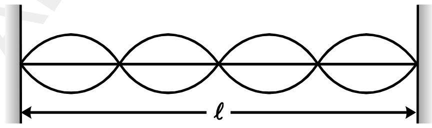
2. F – 8(0.42) (10) – 2(0.42) (10) = 6 (1.5)

F – 42 = 9

F = 51 N

3. For a string vibrating in its n^{th} overtone ($(n + 1)^{th}$ harmonic)

$$y = 2A \sin\left(\frac{(n+1)\pi x}{L}\right) \cos \omega t$$



For $x = \frac{\ell}{3}$, 2A = a and n = 3;

$$y = \left[a \sin\left(\frac{4\pi}{\ell} \cdot \frac{\ell}{3}\right)\right] \cos \omega t$$

$$= a.\ \sin\frac{4\pi}{3} \cos \omega t$$

$$= -a.\left(\frac{\sqrt{3}}{2}\right) \cos \omega t$$

i.e. at $x = \frac{\ell}{3}$; the amplitude is $\frac{\sqrt{3}\,a}{2}$.

4. In Sonometer

$V \alpha \sqrt{T}$

$$\therefore \frac{V_1}{V_2} = 2 = \sqrt{\frac{T_1}{T_2}}$$

$$\Rightarrow T_2 = \frac{T_1}{4}$$

$$\frac{T_1 - T_2}{T_1} \times 100 = \frac{T_1 - \frac{T_1}{4}}{T_1} \times 100 = 75\%$$

5. $y = 0.10 \sin\left(\frac{\pi x}{3}\right) \sin(12\,\pi t)$

[M.Bank_S.W._4.60]

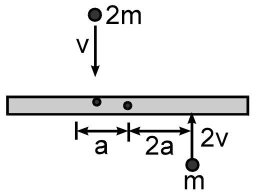
$k = \frac{\pi}{3}$

$\Rightarrow \lambda = 6m$

Length of the rope $= \lambda = 6m$.

6 TO 8.

(i) Cons. linear momentum



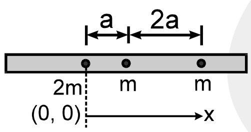
$-2m.v + 2v.m = 0 = MV_{cm}$

$V_{cm} = 0$

(ii) As ball sticks to Rod

Conserving angular momentum about C

$2v.m.\,2a + 2mva = I\omega$



$$= \left(\frac{8m.\,36a^2}{12} + 2m.\,a^2 + m.4a^2\right)$$

$6mv.a = 30\,ma^2.\omega$

$$\Rightarrow \omega = \frac{v}{5a}$$

(iii) $KE = \frac{1}{2} I\omega^2 = \frac{1}{2}.\,30\,ma^2 \times \frac{v^2}{25a^2}$

$$= \frac{3mv^2}{5}.$$

DPP NO. - 86

1. $T_1 = 2\pi\sqrt{\frac{\ell_1}{g}}$

$T_2 = 2\pi\sqrt{\frac{\ell_2}{g}}$

$\frac{t}{T_1} = 30 \qquad \frac{T_2}{T_1} = \frac{5}{6}$

$\frac{t}{T_2} = 36 \qquad 6T_2 = 5T_1$

$$T_1^2 = \frac{88}{100} \times \frac{36}{11} \approx \frac{6 \times \sqrt{2}}{10} = \frac{6\sqrt{2}}{5}$$

$$\frac{6\sqrt{2}}{5} = 2\pi\sqrt{\frac{\ell_1}{g}}$$

$\frac{36 \times 2}{25} = 4 \times 10 \times \frac{\ell_1}{10}$ **Ans. (A)**

2.

	f_1	f_2	f_3	
	1hz	2hz	3hz	
t =	0	0	0	
t =	1 sec.	1/2 sec.	1/3 sec.	T = 1sec.

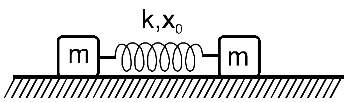
f = 1 hz. **Ans. (C)**

3. $u = v_1 + \frac{m_2}{m_1} v_2$ ....(1)

$v_2 - v_1 = u$ ....(2)

$$\frac{k_{f_1} - k_{i_1}}{k_{i_1}} = 1 - \left(\frac{v_1}{u}\right)^2 = \frac{4m_1m_2}{(m_1 + m_2)^2}$$ **Ans. (A)**

4.



$\sqrt{\frac{k}{\mu}} = \omega \qquad \mu = \frac{m_1m_2}{m_1 + m_2}$

$\omega = \sqrt{\frac{2k}{m}}$

$\omega_2 = \sqrt{\frac{k}{m}}$

$\omega_2^2 = \frac{k}{m} = \frac{\omega^2}{2}$. **Ans. (B)**

5. $\frac{2d}{v_s} = 2$

$\Rightarrow d = v_s$

$\Rightarrow$ d = $\sqrt{\frac{B}{\rho}}$ = $\sqrt{\frac{2\times10^9}{1000}}$ = 1414 m

6. v = $\sqrt{\frac{\gamma RT}{M}}$

M = $\frac{4\times2+2\times2}{4}$ = 3g

$\gamma = 1+\frac{2}{f} = 1+\frac{2\times(2+2)}{2\times3+2\times5} = \frac{3}{2}$

$\therefore$ v = $\sqrt{\frac{3}{2}\times\frac{25}{3}\times\frac{1000}{3}\times\frac{972}{5}}$ = 900 m/s

Ans. 90

7. (A) Number of loops (of length $\lambda/2$) will be even or odd and node or antinode will respectively be formed at the middle.

Phase of difference between two particle in same loop will be zero and that between two particles in adjacent loops will be π.

(B) and (D) Number of loops will not be integral. Hence neither a node nor an antinode will be formed in in the middle.

Phase of difference between two particle in same loop will be zero and that between two particles in adjacent loops will be π.

DPP NO. - 87

1. x = A sin wt

K.E. = $\frac{1}{2}$ $KA^2w^2\cos^2 wt$

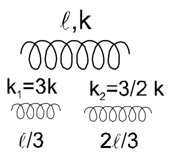
PE = $\frac{1}{2}$ $mA^2w^2\sin^2 wt$

frequancy of kinetic energy is 2V **Ans. (B)**

2. I = $\frac{\text{Power}}{\text{Area}} = \frac{P_0^2}{2\rho v}$

$I = I_1 = I_2$

$w_1 = w_2$ **Ans. (A)**

3.


$\frac{k_1}{k_2} = \frac{3k}{3k/2} = \frac{2}{1}$ **Ans. (D)**

5. $\frac{d\vec{L}_C}{dt} = \vec{\tau}_C$ **Ans. (A,B,C,D)**

6. $\frac{2S}{v} = \frac{60}{40}$ ....(1)

$\frac{2(S-90)}{v} = 1$ ....(2)

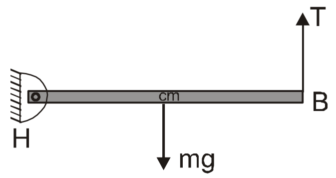
on solving S = 270 m

$\therefore \frac{270}{90} = 3$

7. Ans.
(A) – r ; (B) – q,s ; (C) – p,q,s ; (D) – p ; (E) – r

Ans.
(A) – r ; (B) – q,s ; (C) – p,q,s ; (D) – p ; (E) – r

Sol. (A) Due to reflection from a moving wall, frequency of the sound wave will change. So, the superposition of the incident waves and the reflected waves will produce beats.

(B)


Applying torque balance about the hinge point 'H'

$(mg)\left(\frac{\ell}{2}\right) = (T)(\ell)$

T = $\frac{mg}{2} = \frac{20\times10}{2}$ = 100 m

Natural frequencies of the fixed–free wire are

f = $\frac{1}{4\ell}\sqrt{\frac{T}{\mu}}, \frac{3}{4\ell}\sqrt{\frac{T}{\mu}}, \frac{5}{4\ell}\sqrt{\frac{T}{\mu}}$, ...

f = $\frac{1}{4\times1}\sqrt{\frac{100}{0.01}}$, ...

$\Rightarrow$ f = 25, ***75***, 125,.............

f = 75 Hz matches with the frequency of the source, so resonance will occur and standing waves are generated.

(C) $y = A\sin^2(\omega t - kx) + B\cos^2(kx - \omega t) + C\cos(kx + \omega t)\sin(kx + \omega t)$

Solving we can get,

y = (some constant) $\cos 2(\omega t - kx)$ + (some constant) $\sin 2(kx + \omega t)$

which is superposition of waves moving in opposite direction. So, standing waves can be produced.

But if $A = B$

or $C = 0$, then only travelling waves will be formed.

(D) If the hammer is hit once,a pulse will generated and a moving pulse is a travelling wave. The pulse will more rightward, will be reflected from the wall and then move in opposite direction.

As there is no other wave, so standing waves will not form. As this is just a pulse, so particle will not perform SHM.

(E) This is equation of beats, and in the beats, particle doesn't perform SHM.

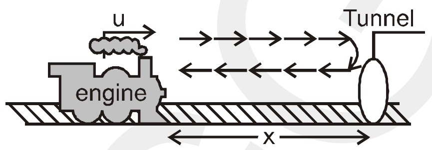
DPP NO. - 88

1. (A) $f_1 \lambda_1 = f_2 \lambda_2$

$(300)(1) = (f_2)(1.5)$

$200 \text{ Hz} = f_2$

2. $\frac{2x}{300} = t_0$ .... (1)



Now in 2 minutes, the engine moves by (u) (120) so time taken by sound to reach the driver again is

$\frac{2(x - 120u)}{300} = t_0 - 120 + 60$ .... (2)

From equation (1) and (2),

$\frac{2 \times 120u}{300} = 60$

$\Rightarrow u = \frac{300}{4} = 75$ m/sec

3. The equation of pressure variation due to sound is

$p = -B\frac{ds}{dx} = -B\frac{d}{dx}[s_0 \sin^2(\omega t - kx)]$

$= B k s_0 \sin(2\omega t - 2kx)$

4. Velocity of sound in air (V) = $\sqrt{\frac{\gamma RT}{M}}$

$\Rightarrow V^2 \alpha T$ (in kelvin)

not $V^2 \alpha T$ (in ^{0}C)

Hence (B) is incorrect.

Velocity of transverse wave in a string :

$V = \sqrt{\frac{T}{\mu}} = V^2 \alpha T$

Hence (C) is a correct graph.

5. Sound waves propagate so fast in a gas that there is no time for the exchange of energy with the medium (gas).

Hence, it is quite close to an adiabatic process.

Hence (B).

6. $V_A + K_A = V_E + K_E$

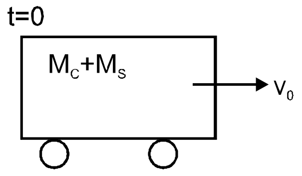
$V_A = V_E$ & $K_A = 0$ $\therefore K_E = 0$

$F = \frac{dV}{dx} = 0,$

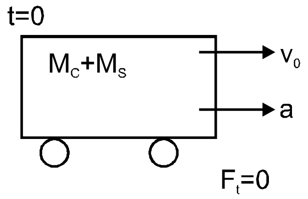
Slope = 0 at points B, C & D

Ans. (AC)

7.



At t,



$F = m\frac{dv}{dt} + (v - v_0)\frac{dm}{dt}$

$0 = m\frac{dv}{dt} + (v - v_0)\frac{dm}{dt}$

$\Rightarrow \frac{dv}{dt} = 0$

$\Rightarrow$ v = constant

$\Rightarrow v = v_0$ **Ans.**

Also $S = v_0 t$

$S = V_0 \frac{M_s}{\lambda}$ **Ans.**

DPP NO. - 89

5. **(a) 1** **(b)** $\frac{\text{strain in copper wire}}{\text{strain in steel wire}} = \frac{20}{13}$

6. **3.8 × 10⁴ N**

7. $\frac{m_2 g(2m_1 + m_2)}{2AY(m_1 + m_2)}$

DPP NO. - 90

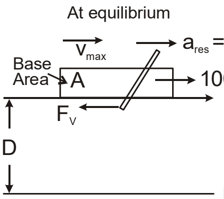
7. (i) A (from comprehension)

(ii) B (from comprehension)

(iii) A (A can bear more stress than B before fracture)

DPP NO. - 91

2.



At equilibrium

$F_{ext} = F_V$

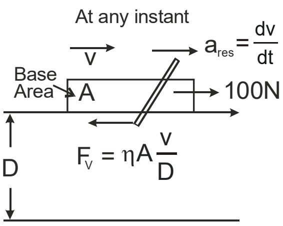
$F_{ext} = 100$ N and $F_V = \eta A \frac{V_{max}}{D} = 1.5 \times 10 \times \frac{V_{max}}{D}$

$\therefore 100 = 1.5 V_{max}$

$\Rightarrow V_{max} = \frac{200}{3}$ m/s

At any instant

$F_{ext} - F_V = m \frac{dv}{dt}$



$\Rightarrow 100 - \eta A \frac{v}{D} = m \frac{dv}{dt}$.

$\therefore 100 - 1.5 v = 150 \frac{dv}{dt}$

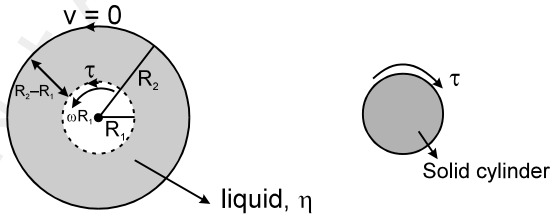
from (1) $\int_0^t dt = \int_0^{V_{max}/2} 150 \frac{dv}{100 - 1.5v}$

$\Rightarrow t = 150 \int_0^{100/3} \frac{\ell n(100 - 1.5v)}{-1.5}$

$\Rightarrow t = 100\ \ell n2$ seconds

3. $F = \eta A \frac{dv}{dz}$, where $\frac{dv}{dz} = \frac{\omega R_1 - 0}{R_2 - R_1}$

$F = \eta \frac{2\pi R_1 \ell \omega R_1}{R_2 - R_1}$



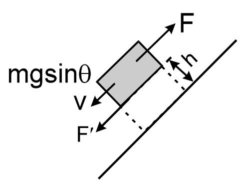
and $\tau = FR_1 = \frac{2\pi\eta R_1^3 \omega \ell}{R_2 - R_1}$

$I\alpha = \frac{2\pi\eta R_1^3 \omega \ell}{R_2 - R_1}$

$\Rightarrow \frac{MR_1^2}{2}\left(-\frac{d\omega}{dt}\right) = \frac{2\pi\eta R_1^3 \omega \ell}{R_2 - R_1}$

or $-\int_{\omega_0}^{\omega_0/2} \frac{d\omega}{\omega} = \frac{4\pi\eta R_1 \ell}{m(R_2 - R_1)} \int_0^t dt$

$\Rightarrow t = \frac{m(R_2 - R_1)\ell n2}{4\pi\eta\ell R_1}$



$h = \frac{40 \times 10^{-2}}{100}$ – [$\eta = 10^{-1}$ poise = 10^{-2} N-sec-m^{-2}]

= 4×10^{-3} m = 4 mm

DPP NO. - 92

1. **Ans.** 6000

2. **Ans.** 360 poise

3. The velocity attained by the sphere in falling freely from a height h is

$v = \sqrt{2gh}$ ....(i)

This is the terminal velocity of the sphere in water. Hence by Stokes''s law, we have

$$v = \frac{2}{9}\frac{r^2(\rho - \sigma)g}{\eta}$$

where r is the radius of the sphere, ρ is the density of the material of the sphere

σ (= 1.0×10^3 kg/m^3) is the density of water and η is coefficient of viscosity of water.

$\therefore$ v =

$$\frac{2 \times (1.0 \times 10^{-3})^2 (1.0 \times 10^4 - 1.0 \times 10^3) \times 10}{9 \times 1.0 \times 10^{-3}}$$

= 20 m/s

from equation (i), we have

$$h = \frac{v^2}{2g} = \frac{20 \times 20}{2 \times 10} = 20 \text{ m}$$