GGSRDN
Educational Services Private Limited
9th, 10th, NEET, JEE(Main/Advanced)
अभ्यास ही सबसे बड़ा गुरु है।

CLASS : XII (PHYSICS)

DPP

DAILY PRACTICE PROBLEM

DPP-31 TO 40

DPP 31 : String Wave, Newton's Law of Motion, Electrostatics, Projectile Motion, Circular Motion, Center of Mass
DPP 32 : Newton's Law of Motion, Fluid, Surface Tension, Gravitation, Electrostatics
DPP 33 : Electrostatics, Gravitation,Work, Power and Energy, Projectile Motion, Elasticity & Viscosity, Geometrical Optics,Sound Wave, Friction
DPP 34 : Gravitation ,Work, Power and Energy, Elasticity & Viscosity, Sound Wave, Relative Motion, Electrostatics.
DPP 35 : Friction, Electrostatics, Geometrical Optics, Relative Motion, Rigid Body Dynamics, Newton's Law of Motion
DPP 36 : Circular Motion, Gravitation, Rigid Body Dynamics, Work, Power and Energy, Center of Mass, Electrostatics.
DPP 37 : Center of Mass, Rigid Body Dynamics, String Wave, Fluid, Electromagnetic Induction, Rigid Body Dynamics
DPP 38 : Elasticity & Viscosity, Electrostatics, Geometrical Optics, String Wave, Rigid Body Dynamics
DPP 39 : Elasticity & Viscosity, Geometrical Optics, String Wave, Friction, Simple Harmonic Motion, Rigid Body Dynamics
DPP 40 : Surface Tension, Elasticity & Viscosity, Geometrical Optics, Circular Motion, Rigid Body Dynamics

DPP No. 31

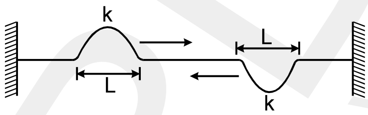
Total Marks : 32

Max. Time : 37 min.

Topics : String Wave, Newton's Law of Motion, Electrostatics, Projectile Motion, Circular Motion, Center of Mass

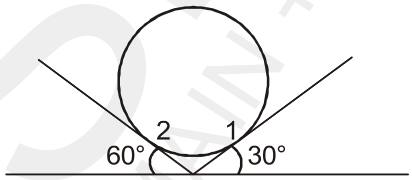
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1	(3 marks, 3 min.)	[3, 3]
Subjective Questions ('–1' negative marking) Q.2 to Q.4	(4 marks, 5 min.)	[12, 15]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]
Match the Following (no negative marking) (2 × 4)Q.8	(8 marks, 10 min.)	[8, 10]

1. Two identical pulses move in opposite directions with same uniform speeds on a stretched string. The width and kinetic energy of each pulse is L and k respectively. At the instant they completely overlap, the kinetic energy of the width L of the string where they overlap is :

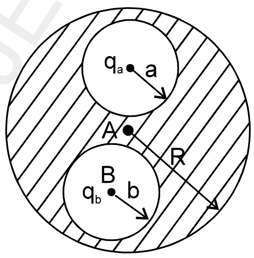


(A) k (B) 2k (C) 4k (D) 8 k

2. A solid sphere of mass 10 kg is placed over two smooth inclined planes as shown in figure. The normal reactions at 2 is 10x N. Find x ($g = 10\ m/s^2$)



3. A conducting sphere of radius R has two spherical cavities of radius a and b. The cavities have charges q_a and q_b respectively at their centres. 'A' is the centre of the sphere and 'B' is the centre of the cavity of radius 'b'. Find:



(i) electric field and electrical potential at
 (a) r (distance from A)> R,
 (b) r (distance from B)< b

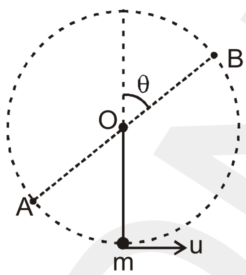
(ii) surface charge densities on the surface of radius R, radius a and radius b.

(iii) What is the force on q_a and q_b?

4. A particle moves along the plane trajectory y = f(x) with velocity v whose modulus is constant. Find the acceleration of the particle at the point x = 0 and the curvature radius of the trajectory at that point if the trajectory has the form
(a) of a parabola $y = ax^2$.
(b) of an ellipse $(x/a)^2 + (y/b)^2 = 1$; a and b are constants here.

COMPREHENSION

A ball is hanging vertically by a light inextensible string of length L from fixed point O. The ball of mass m is given a speed u at the lowest position such that it completes a vertical circle with centre at O as shown. Let AB be a diameter of circular path of ball making an angle θ with vertical as shown. (g is acceleration due to gravity)



5. Let T_A and T_B be the magnitude of tension in string when ball is at A and B respectively, then $T_A - T_B$ is equal to

(A) 6 mg $\cos\theta$ (B) 6 mg (C) 12 mg $\cos\theta$ (D) None of these

6. Let $\vec{a}_A$ and $\vec{a}_B$ be acceleration of ball when it is at A and B respectively, then $|\vec{a}_A + \vec{a}_B|$ is equal to

(A) $2g\sin\theta$ (B) $g\sqrt{12\cos^2\theta + 4}$ (C) $4g\cos\theta$ (D) None of these

7. Let K_A and K_B be kinetic energy of ball when it is at A and B respectively, then $K_A - K_B$ is equal to

(A) mgL $\cos\theta$ (B) 2mgL $\cos\theta$ (C) 4mgL $\cos\theta$ (D) None of these

8. Two identical uniform solid smooth spheres each of mass m each approach each other with constant velocities such that net momentum of system of both spheres is zero. The speed of each sphere before collision is u. Both the spheres then collide. The condition of collision is given for each situation of column-I. In each situation of column-II information regarding speed of sphere(s) is given after the collision is over. Match the condition of collision in column-I with statements in column-II.

Column-I	Column-II
(A) Collision is perfectly elastic and head on	(p) speed of both spheres after collision is u
(B) Collision is perfectly elastic and oblique	(q) velocity of both spheres after collision is different
(C) Coefficient of restitution is $e = \frac{1}{2}$ and collision is head on	(r) speed of both spheres after collision is same but less than u.
(D) Coefficient of restitution is $e = \frac{1}{2}$ and collision is oblique	(s) speed of one sphere may be more than u.

PHYSICS DPP
DAILY PRACTICE PROBLEMS

DPP No. 32

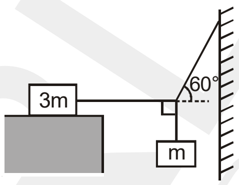
Total Marks : 30

Max. Time : 33 min.

Topics : Newton's Law of Motion, Fluid, Surface Tension, Gravitation, Electrostatics

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 to Q.6	(4 marks, 5 min.)	[12, 15]
Comprehension ('–1' negative marking) Q.7 to Q.9	(3 marks, 3 min.)	[9, 9]

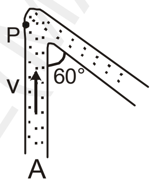
1. A mass m is supported as shown in the figure by ideal strings connected to a rigid wall and to a mass $3m$ at rest on a fixed horizontal surface. The string connected to larger mass is horizontal, that connected to smaller mass is vertical and the one connected to wall makes an angle 60° with horizontal.Then the minimum coefficient of static friction between the larger mass and the horizontal surface that permits the system to remain in equilibrium in the situation shown is:



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

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

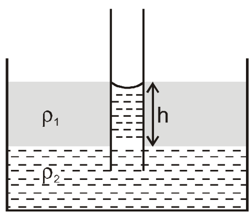
2. Water (density ρ) is flowing through the uniform tube of cross-sectional area A with a constant speed v as shown in the figure. The magnitude of force exerted by the water on the curved corner of the tube is(neglect viscous forces)



(A) $\sqrt{3}\,\rho A v^2$ (B) $2\rho A v^2$

(C) $\sqrt{2}\rho A v^2$ (D) $\frac{\rho A v^2}{\sqrt{2}}$

3. A container is partially filled with a liquid of density ρ_2. A capillary tube of radius r is vertically inserted in this liquid. Now another liquid of density ρ_1 ($\rho_1 < \rho_2$) is slowly poured in the container to a height h as shown. There is only denser liquid in the capillary tube. The rise of denser liquid in the capillary tube is also h. Assuming zero contact angle, the surface tension of heavier liquid is



(A) $r\rho_2 gh$ (B) $2\pi r\,\rho_2 gh$

(C) $\frac{r}{2}(\rho_2 - \rho_1)gh$ (D) $2\pi r(\rho_2 - \rho_1)gh$

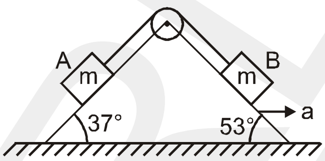
4. A point P lies on the axis of a fixed ring of mass M and radius a, at a distance a from its centre C. A small particle starts from P and reaches C under gravitational attraction only. Its speed at C will be ________.

5. Three conducting concentric spherical shells of radius R, 2R and 3R have charges Q, $\frac{Q}{3}$ and –2Q respectively. Q = 1.6 × 10^{-6}C. The intermediate shell is grounded. Find the number of electrons that will flow through the connecting wire. Also tell whether, the electrons flow into the earth or into the shell.

6. A non–uniform string of mass 45 kg and length 1.5 m has a variable linear mass density given by μ = kx, where x is the distance from one end of the string and k is a constant. Tension in the string is 15 N which is uniform. Find the time (in second) required for a pulse generated at one end of the string to travel to the other end.

COMPREHENSION

Two blocks A and B of equal masses m kg each are connected by a light thread, which passes over a massless pulley as shown. Both the blocks lie on wedge of mass m kg. Assume friction to be absent everywhere and both the blocks to be always in contact with the wedge. The wedge lying over smooth horizontal surface is pulled towards right with constant acceleration a (m/s^2). (g is acceleration due to gravity).



7. Normal reaction (in N) acting on block B is

(A) $\frac{m}{5}$ (3g + 4a) (B) $\frac{m}{5}$ (3g – 4a) (C) $\frac{m}{5}$ (4g + 3a) (D) $\frac{m}{5}$ (4g – 3a)

8. Normal reaction (in N) acting on block A.

(A) $\frac{m}{5}$ (3g + 4a) (B) $\frac{m}{5}$ (3g – 4a) (C) $\frac{m}{5}$ (4g + 3a) (D) $\frac{m}{5}$ (4g – 3a)

9. The maximum value of acceleration a (in m/s^2) for which normal reactions acting on the block A and block B are nonzero.

(A) $\frac{3}{4}$g (B) $\frac{4}{3}$g (C) $\frac{3}{5}$g (D) $\frac{5}{3}$g

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 33

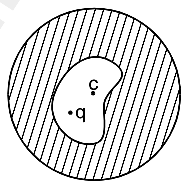
Total Marks : 33

Max. Time : 36 min.

Topics :Electrostatics, Gravitation,Work, Power and Energy, Projectile Motion, Elasticity & Viscosity, Geometrical Optics,Sound Wave, Friction

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.7	(3 marks, 3 min.)	[21, 21]
Subjective Questions ('–1' negative marking) Q.8	(4 marks, 5 min.)	[4, 5]
Match the Following (no negative marking) (2 × 4) Q.9	(8 marks, 10 min.)	[8, 10]

1. The figure shows a charge q placed inside a cavity in an uncharged conductor. Now if an external electric field is switched on :
(A) only induced charge on outer surface will redistribute.
(B) only induced charge on inner surface will redistribute.
(C) both induced charge on outer and inner surface will redistribute.
(D) force on charge q placed inside the cavity will change.



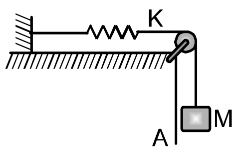
2. A certain quarternary star system consists of three stars, each of mass m, moving in same circular orbit about a stationary central star of mass M. The three identical stars orbit in same sense and are symmetrically located with respect to each other. Considering gravitational force of all remaining bodies on every star, the time period of each of three stars is :

(A) $2\pi\sqrt{\dfrac{r^3}{G\left(M+\dfrac{m}{3}\right)}}$ (B) $2\pi\sqrt{\dfrac{r^3}{G\left(M+\dfrac{m}{\sqrt{3}}\right)}}$ (C) $2\pi\sqrt{\dfrac{r^3}{G(M+3m)}}$ (D) $2\pi\sqrt{\dfrac{r^3}{G(M+\sqrt{3}m)}}$

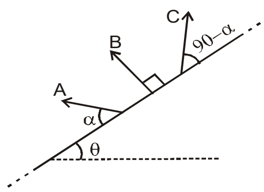
3. Block A in the figure is released from rest when the extension in the spring is x_0. ($x_0 < Mg/k$). The maximum downwards displacement of the block is (ther is no friction) :

(A) $\dfrac{2Mg}{K}-2x_0$ (B) $\dfrac{Mg}{2K}+x_0$

(C) $\dfrac{2Mg}{K}-x_0$ (D) $\dfrac{2Mg}{K}+x_0$



4. Three stones A, B, C are projected from surface of very long inclined plane with equal speeds and different angles of projection as shown in figure. The incline makes an angle θ with horizontal.If H_A, H_B and H_C are maximum height attained by A, B and C respectively above inclined plane then : (Neglect air friction)

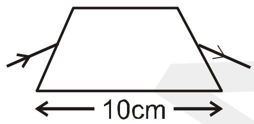


(A) $H_A + H_C = H_B$ (B) $H_A^2 + H_C^2 = H_B^2$ (C) $H_A + H_C = 2H_B$ (D) $H_A^2 + H_C^2 = 2H_B^2$

5. When a ball is released from rest in a very long column of viscous liquid, its downward acceleration is 'a'(just after release). Then its acceleration when it has acquired two third of the maximum velocity :

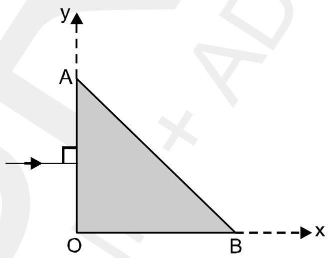
(A) $\frac{a}{3}$ (B) $\frac{2a}{3}$ (C) $\frac{a}{6}$ (D) none of these

6. An isosceles trapezium of reflecting material of refractive index $\sqrt{2}$ and dimension of sides being 5cm, 5cm, 10cm and 5cm. The angle of minimum deviation by this when light is incident from air and emerges in air is:



(A) $22\frac{1}{2}°$ (B) 45° (C) 30° (D) 60°

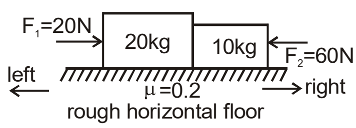
7. A triangular medium has varying refracting index $n = n_0 + ax$, where x is the distance (in cm) along x–axis from origin and $n_0 = \frac{4}{3}$. A ray is incident normally on face OA at the mid–point of OA. The range of a so that light does not escape through face AB when it falls first time on the face AB (OA = 4 cm, OB = 3 cm and AB = 5 cm) : (Surrounding medium is air)



(A) $a > \frac{1}{9}$ (B) $a > \frac{2}{9}$ (C) $a > \frac{1}{3}$ (D) None of these

8. A string 25 cm long fixed at both ends and having a mass of 2.5 g is under tension. A pipe closed from one end is 40 cm long. When the string is set vibrating in its first overtone and the air in the pipe in its fundamental frequency, 8 beats per second are heard. It is observed that decreasing the tension in the string decreases the beat frequency. If the speed of sound in air is 320 m/s. Find tension in the string.

9. 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 $\mu = 0.2$. 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).

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 34

Total Marks : 32

Max. Time : 36 min.

Topics : Gravitation ,Work, Power and Energy, Elasticity & Viscosity, Sound Wave, Relative Motion, Electrostatics.

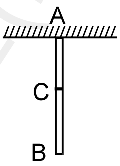
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1	(3 marks, 3 min.)	[3, 3]
Multiple choice objective ('–1' negative marking) Q.2	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.3 to Q.6	(4 marks, 5 min.)	[16, 20]
Comprehension ('–1' negative marking) Q.7 to Q.9	(3 marks, 3 min.)	[9, 9]

1. The orbital velocity of an artificial satellite in a circular orbit just above the earth's surface is V_0. The value of orbital velocity for another satellite orbiting at an altitude of half of earth's radius is

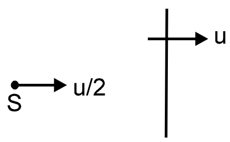
(A) $\left(\frac{3}{2}\right)V_0$ (B) $\sqrt{\frac{3}{2}}V_0$ (C) $\sqrt{\frac{2}{3}}V_0$ (D) $\left(\frac{2}{3}\right)V_0$

2. The potential energy (in joules) of a particle of mass 1kg moving in a plane is given by V = 3x + 4y, the position coordinates of the point being x and y, measured in metres. If the particle is at rest at (6, 4) ; then
(A) its acceleration is of magnitude $5 m/s^2$
(B) its speed when it crosses the y–axis is 10m/s
(C) it crosses the y-axis (x = 0) at y = –4
(D) it moves in a striaght line passing through the origin (0, 0)

3. A wire of uniform cross section is hanging vertically and due to its own weight its length changes. There is a point 'C' on the wire such that change in length AC is equal to the change in length BC. Points A, B & C are shown in figure. Find $\frac{AC}{BC}$.

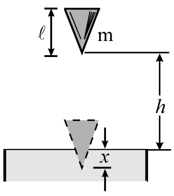


4. A wall is moving with velocity u and a source of sound moves with velocity $\frac{u}{2}$ in the same direction as shown in the figure. Assuming that the sound travels with velocity 10u. Find the ratio of incident sound wavelength on the wall to the reflected sound wavelength by the wall.



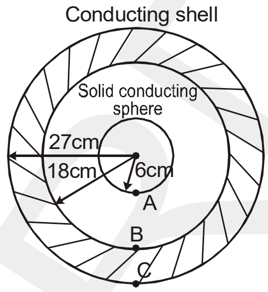
5. Two particles P and Q are moving with velocities of $(\hat{i}+\hat{j})$ and $\left(-\hat{i}+2\hat{j}\right)$ respectively. At time t = 0, P is at origin and Q is at a point with position vector $\left(2\hat{i}+\hat{j}\right)$. Find the equation of the path of Q with respect to P.

6. A cone of mass 'm' falls from a height 'h' and penetrates into sand. The resistance force R of the sand is given by $R = kx^2$. If the cone penetrates upto a distance x = d where d < ℓ , then find the value of 'k'.

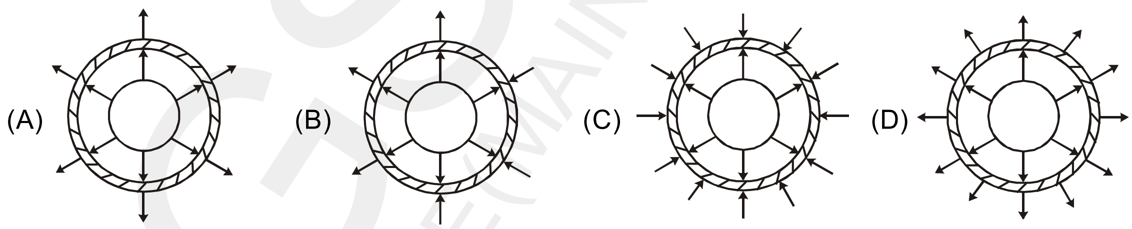


COMPREHENSION

A solid, conducting sphere of radius 6 cm carries a charge 3nC. This sphere is located centrally inside a thick, conducting sphere with an inner radius of 18 cm and an outer radius of 27 cm. The hollow sphere is also given a charge 3nC.Three points A, B and C are marked on the surfaces as shown.



7. Which one of the following figures shows a qualitatively accurate sketch of the electric field lines in and around this system ?



8. Suppose V_A,V_B and V_C are potentials at points A,B and C respectively then values of potential differences $V_C – V_B$ and $V_B – V_A$ respectively are :

(A) 0 V and – 300 V
(B) 0 V and 300 V
(C) 450 V and 150 V
(D) 0 V and – 150 V

9. Suppose the shell is given additional charge 3nC. The potential difference $V_B – V_A$ will become :

(A) –100 V
(B) –200 V
(C) 300 V
(D) –300 V

PHYSICS DPP
DAILY PRACTICE PROBLEMS

DPP No. 35

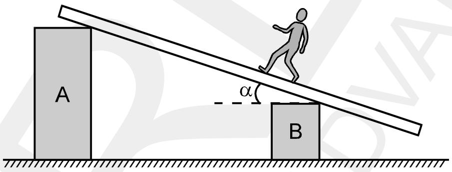
Total Marks : 30

Max. Time : 33 min.

Topics : Friction, Electrostatics, Geometrical Optics, Relative Motion, Rigid Body Dynamics, Newton's Law of Motion

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]
Match the Following (no negative marking) (2 × 4) Q.8	(8 marks, 10 min.)	[8, 10]

1. A plank is held at an angle α to the horizontal (Fig.) on two fixed supports A and B. The plank can slide against the supports (without friction) because of its weight Mg. With what acceleration and in what direction, a man of mass m should move so that the plank does not move.



(A) $g \sin\alpha\left(1+\frac{m}{M}\right)$ down the incline
(B) $g \sin\alpha\left(1+\frac{M}{m}\right)$ down the incline
(C) $g \sin\alpha\left(1+\frac{m}{M}\right)$ up the incline
(D) $g \sin\alpha\left(1+\frac{M}{m}\right)$ up the incline

2. Two small electric dipoles each of dipole moment $p\hat{i}$ are situated at (0, 0, 0) and (r, 0, 0). The electric potential at a point $\left(\frac{r}{2}, \frac{\sqrt{3}r}{2}, 0\right)$ is :

(A) $\frac{p}{4\pi\epsilon_0 r^2}$
(B) 0
(C) $\frac{p}{2\pi\epsilon_0 r^2}$
(D) $\frac{p}{8\pi\epsilon_0 r^2}$

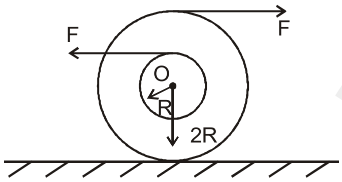
3. A mango tree is at the bank of a river and one of the branch of tree extends over the river. A tortoise lives in river. A mango falls just above the tortoise. The acceleration of the mango falling from tree appearing to the tortoise is (Refractive index of water is 4/3 and the tortoise is stationary)

(A) g
(B) $\frac{3g}{4}$
(C) $\frac{4g}{3}$
(D) None of these

4. A balloon is ascending vertically with an acceleration of 0.4 m/s^{-2}. Two stones are dropped from it at an interval of 2 sec. Find the distance between them 1.5 sec. after the second stone is released. (g = 10 m/sec^2)

COMPREHENSION

In the given figure F=10N, R=1m mass of the body is 2kg and moment of inertia of the body about an axis passing through O and perpendicular to plane of body is $4kgm^2$. O is the centre of mass of the body.



5. Find the frictional force acting on the body if it performs pure rolling.

(A) $\frac{20}{3}$ (B) $\frac{10}{3}$ (C) $\frac{5}{3}$ (D) None of these

6. The kinetic energy of the body in the above question after 3 seconds will be.

(A) 75J (B) 80J (C) 82J (D) 85J

7. If ground is smooth, then the total kinetic energy after 3 seconds will be :

(A) 105.5J (B) 112.5J (C) 115.5J (D) None of these

8. In the column-I, a system is described in each option and corresponding time period is given in the column-II. Suitably match them.

Column-I	Column-II
(A) A simple pendulum of length 'ℓ' oscillating with small amplitude in a lift moving down with retardation g/2.	(p) $T = 2\pi\sqrt{\frac{2\ell}{3g}}$
(B) A block attached to an end of a vertical spring, whose other end is fixed to the ceiling of a lift, stretches the spring by length 'ℓ' in equilibrium. It's time period when lift moves up with an acceleration g/2 is	(q) $T = 2\pi\sqrt{\frac{\ell}{g}}$
(C) The time period of small oscillation of a uniform rod of length 'ℓ' smoothly hinged at one end. The rod oscillates in vertical plane.	(r) $T = 2\pi\sqrt{\frac{2\ell}{g}}$
(D) A cubical block of edge 'ℓ' and specific gravity 1/2 is in equilibrium with some volume inside water filled in a large fixed container. Neglect viscous forces and surface tension. The time period of small oscillations of the block in vertical direction is	(s) $T = 2\pi\sqrt{\frac{\ell}{2g}}$

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 36

Total Marks : 25

Max. Time : 25 min.

Topics : Circular Motion, Gravitation, Rigid Body Dynamics, Work, Power and Energy, Center of Mass, Electrostatics.

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

1. A particle is projected along a horizontal field whose coefficient of friction varies as $\mu = \frac{A}{r^2}$ where r is the distance from the origin in meters and A is a positive constant. The initial distance of the particle is 1 m from the origin and its velocity is radially outwards. The minimum initial velocity at this point so that particle never stops is :

(A) ∞ (B) $2\sqrt{gA}$ (C) $\sqrt{2gA}$ (D) $4\sqrt{gA}$

2. An automobile enters a turn of radius R. If the road is banked at an angle of 45^0 and the coefficient of friction is 1, the minimum and maximum speed with which the automobile can negotiate the turn without skidding is:

(A) $\sqrt{\frac{rg}{2}}$ and $\sqrt{rg}$ (B) $\frac{\sqrt{rg}}{2}$ and $\sqrt{rg}$

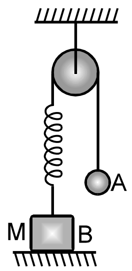
(C) $\frac{\sqrt{rg}}{2}$ and $2\sqrt{rg}$ (D) 0 and infinite

3. A hollow cylinder has mass M, outside radius R_2 and inside radius R_1. Its moment of inertia about an axis parallel to its symmetry axis and tangential to the outer surface is equal to :

(A) $\frac{M}{2}(R_2^2 + R_1^2)$ (B) $\frac{M}{2}(R_2^2 - R_1^2)$

(C) $\frac{M}{4}(R_2 + R_1)^2$ (D) $\frac{M}{2}(3R_2^2 + R_1^2)$

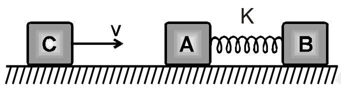
4. In the Figure, the ball A is released from rest when the spring is at its natural length. For the block B, of mass M to leave contact with the ground at some stage, the minimum mass of A must be:



(A) 2 M (B) M

(C) M/2 (D) A function of M and the force constant of the spring.

5. Two blocks A and B each of mass m are connected to a massless spring of natural length L and spring constant K. The blocks are initially resting on a smooth horizontal floor with the spring at its natural length as shown in the figure. A third identical block C also of mass m moves on the floor with speed v along the line joining A and B and collides elastically with A, then :



(A) the K.E. of the A–B system at maximum compression of the spring is zero

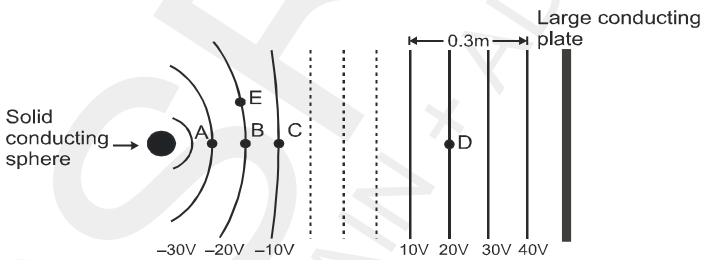
(B) the K.E. of the A–B system at maximum compression of the spring is $mv^2/4$

(C) the maximum compression of the spring is $v\sqrt{(m/K)}$

(D) the maximum compression of the spring is $v\sqrt{(m/2K)}$

COMPREHENSION

The sketch below shows cross-sections of equipotential surfaces between two charged conductors that are shown in solid black. Some points on the equipotential surfaces near the conductors are marked as A,B,C,........ . The arrangement lies in air. (Take $\in_0 = 8.85 \times 10^{-12}$ $C^2/N\ m^2$]



6. Surface charge density of the plate is equal to

(A) 8.85×10^{-10} C/m^2
(B) -8.85×10^{-10} C/m^2
(C) 17.7×10^{-10} C/m^2
(D) -17.7×10^{-10} C/m^2

7. A positive charge is placed at B. When it is released :

(A) no force will be exerted on it.
(B) it will move towards A.
(C) it will move towards C.
(D) it will move towards E.

8. How much work is required to slowly move a – 1μC charge from E to D ?

(A) 2×10^{-5} J
(B) -2×10^{-5} J
(C) 4×10^{-5} J
(D) -4×10^{-5} J

PHYSICS DPP

DAILY PRACTICE PROBLEMS

DPP No. 37

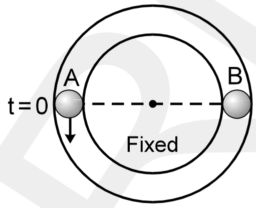
Total Marks : 29

Max. Time : 31 min.

Topics : Center of Mass, Rigid Body Dynamics, String Wave, Fluid, Electromagnetic Induction, Rigid Body Dynamics

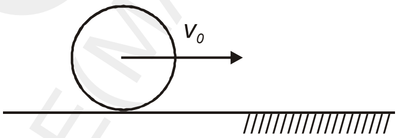
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4	(4 marks 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks 3 min.)	[9, 9]
Match the Following (no negative marking)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

1. Particle 'A' moves with speed 10 m/s in a frictionless circular fixed horizontal pipe of radius 5 m and strikes with 'B' of double mass that of A. Coefficient of restitution is 1/2 and particle 'A' starts its journey at t = 0. The time at which second collision occurs is :



(A) $\frac{\pi}{2}$ s (B) $\frac{2\pi}{3}$ s (C) $\frac{5\pi}{2}$ s (D) 4π s

2. A solid cylinder is sliding on a smooth horizontal surface with velocity v_0 without rotation. It enters on the rough surface. After that it has travelled some distance, select the correct statement:



(A) Friction force increases its translational kinetic energy.
(B) Friction force increases its rotational kinetic energy.
(C) Friction force increases its total mechanical energy.
(D) Friction force increases its angular momentum about an axis passing through point of contact of the cylinder and the surface.

3. Equation of a standing wave is generally expressed as y = 2A sinωt coskx. 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.

4. A block of density 2000 kg/m^3 and mass 10 kg is suspended by a spring of stiffness 100 N/m. The other end of the spring is attached to a fixed support. The block is completely submerged in a liquid of density 1000 kg/m^3 . If the block is in equilibrium position.
(A) the elongation of the spring is 1 cm.
(B) the magnitude of buoyant force acting on the block is 50 N.
(C) the spring potential energy is 12.5 J.
(D) magnitude of spring force on the block is greater than the weight of the block.

COMPREHENSION

In a certain region, there are non-uniform electrical potential (V_e) as well as gravitational potential (V_g). The electrical potential varies only with x as shown in figure (i), and the gravitational potential varies only with y as shown in figure (ii).

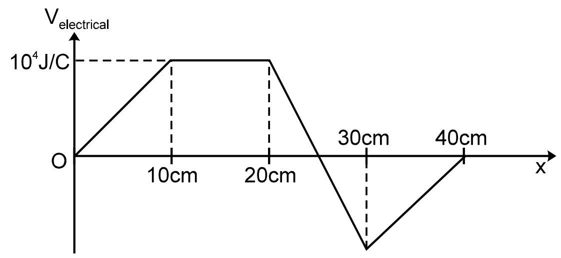


Figure (i)

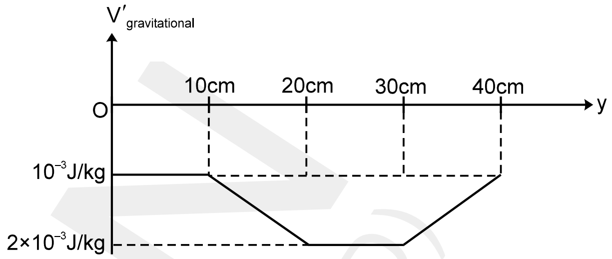


Figure (ii)

Consider a particle of mass 200 kg and charge 20 μC in this field.

5. If the particle is released from point (5cm, 15 cm), it will try to move toward

(A) +x direction and +y direction
(B) +x direction and – y direction
(C) – x direction, +y direction
(D) – x direction, – y direction

6. What will be acceleration of the particle at point (25, 35)

(A) $(2\hat{i}-\hat{j})\times10^{-2}$ m/sec^2
(B) $(2\hat{i}+\hat{j})\times10^{-2}$ m/sec^2
(C) $(-2\hat{i}+\hat{j})\times10^{-2}$ m/sec^2
(D) $(3\hat{i}-2\hat{j})\times10^{-2}$ m/sec^2

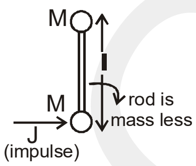
7. Minimum work required to bring the particle from (5, 15) to (25, 35) is :

(A) 0.2 J (B) 0.1 J (C) – 0.2 J (D) – 0.1 J

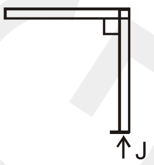
8. Match the columns : (All the rigid bodies lie on a smooth horizontal plane. No object is hinged. J is impulse of an impulsive force. Initially system is at rest.)

Column-I

(A)

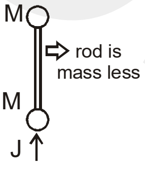


(B)

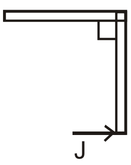


(uniform mass distribution)

(C)



(D)



(uniform mass distribution)

Column-II

(p) Translation occurs
(q) Rotation occurs
(r) Angular momentum (about centre of mass)increases
(s) Linear momentum increases
(t) Angular momentum will be conserved about more than one points in space.

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 38

Total Marks : 29

Max. Time : 30 min.

Topics : Elasticity & Viscosity, Electrostatics, Geometrical Optics, String Wave, 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]
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]
Comprehension ('–1' negative marking) Q.7 to Q.9	(3 marks, 3 min.)	[9, 9]

1. If η represents the coefficient of viscosity and T the surface tension, then the dimension of $\frac{T}{\eta}$ is same as that of:

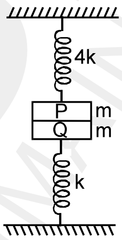
(A) length (B) mass (C) time (D) speed

2. The elongation in a metallic rod hinged at one end and rotating in a horizontal plane becomes four times of the initial value. The angular velocity of rotation becomes :

(A) two times the initial value (B) half of initial value

(C) one third of initial value (D) four times the initial value.

3. In the figure shown, blocks P and Q are in contact but do not stick to each other. The lower face of P behaves as a plane mirror. The springs are in their natural lengths. The system is released from rest. Then the distance between P and Q when Q is at the lowest point first time will be



(A) $\frac{2mg}{K}$ (B) $\frac{4mg}{K}$ (C) $\frac{3mg}{K}$ (D) 0

4. In the above question, the velocity of the image of Q in plane mirror of block P with respect to ground when Q is at the lowest point first time is :

(A) $\sqrt{\frac{2mg^2}{K}}$ (B) $\sqrt{\frac{4mg^2}{K}}$ (C) $\sqrt{\frac{3mg^2}{K}}$ (D) 0

5. The length, tension, diameter and density of a wire B are double than the corresponding quantities for another stretched wire A. Then (both are fixed at the ends)

(A) Fundamental frequency of B is $\frac{1}{2\sqrt{2}}$ times that of A.

(B) The velocity of wave in B is $\frac{1}{\sqrt{2}}$ times that of velocity in A.

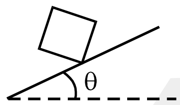
(C) The fundamental frequency of A is equal to the third overtone of B.

(D) The velocity of wave in B is half that of velocity in A.

6. A sample of a liquid has an initial volume of 1.5 L. The volume is reduced by 0.2 mL, when the pressure increases by 140 kPa. What is the bulk modulus of the liquid.

COMPREHENSION

A square frame of mass m is made of four identical uniform rods of length L each. This frame is placed on an inclined plane such that one of its diagonals is parallel to the inclined plane as shown in figure, and is released.



7. The moment of inertia of square frame about the axis of the frame is :

(A) $\frac{mL^2}{3}$ (B) $\frac{2mL^2}{3}$ (C) $\frac{4mL^2}{3}$ (D) $\frac{mL^2}{12}$

8. The frictional force acting on the frame just after the release of the frame assuming that it does not slide is :

(A) $\frac{mg\sin\theta}{3}$ (B) $\frac{2mg\sin\theta}{7}$ (C) $\frac{3mg\sin\theta}{5}$ (D) $\frac{2mg\sin\theta}{5}$

9. The acceleration of the center of square frame just after the release of the frame assuming that it does not slide is :

(A) $\frac{g\sin\theta}{3}$ (B) $\frac{2g\sin\theta}{7}$ (C) $\frac{3g\sin\theta}{5}$ (D) $\frac{2g\sin\theta}{5}$

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 39

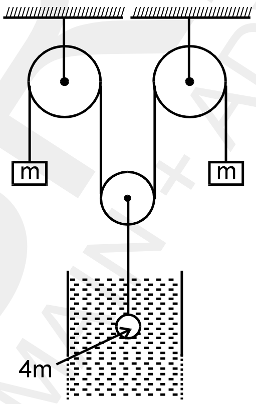
Total Marks : 30

Max. Time : 33 min.

Topics : Elasticity & Viscosity, Geometrical Optics, String Wave, Friction, Simple Harmonic Motion, Rigid Body Dynamics

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.3	**(12 marks, 12 min.)**	**[9, 9]**
Subjective Questions ('–1' negative marking) Q.4 to Q.6	**(4 marks, 5 min.)**	**[12, 15]**
Comprehension ('–1' negative marking) Q.7 to Q.9	**(3 marks, 3 min.)**	**[9, 9]**

1. A spherical ball of mass 4m, density σ and radius r is attached to a pulley-mass system as shown in figure. The ball is released in a liquid of coefficient of viscosity η and density ρ $(<\frac{\sigma}{2})$. If the length of the liquid column is sufficiently long, the terminal velocity attained by the ball is given by (assume all pulleys to be massless and string as massless and inextensible) :



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

(C) $\frac{2}{9}\frac{r^2(\sigma-4\rho)g}{\eta}$ (D) $\frac{2}{9}\frac{r^2(\sigma-3\rho)g}{\eta}$

2. Which of the following relations is correct for a spherical mirror if a point object is kept on the principal axis. ['P' is pole, 'C' is centre object is at point 'O', image is at point 'I']

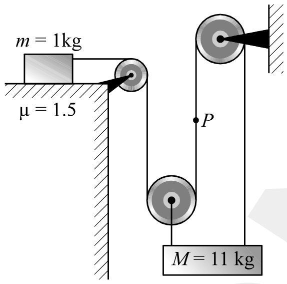
(A) $\frac{OP}{OC}=\frac{IP}{IC}$ (B) $\frac{OP}{IC}=\frac{IP}{OC}$ (C) $\frac{PC}{PO}=\frac{PI}{PC}$ (D) $\frac{IO}{CP}=\frac{IP}{CO}$

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

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

4. Figure shows an ideal pulley block of mass m = 1 kg, resting on a rough ground with friction coefficient μ = 1.5. Another block of mass M = 11 kg is hanging as shown. When system is released it is found that the magnitude of acceleration of point P on string is a. Find value of 4a in m/s^2. (Use g = 10 m/s^2)

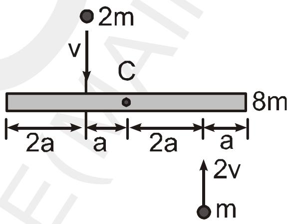


5. A 900 kg elevator hangs by a steel cable for which the allowable stress is 1.15×10^8 N/m^2. What is the minimum diameter required if the elevator accelerates upward at 1.5 m/s^2. Take g = 10m/s^2 and leave your answer in terms of π.

6. A 40 kg mass, hanging at the end of a rope of length ℓ, oscillates in a vertical plane with an angular amplitude of θ_0. What is the tension in the rope, when it makes an angle θ with the vertical ? If the breaking strength of the rope is 80 kg f, what is the maximum angular amplitude θ with which the mass can oscillate without the rope breaking ?

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.



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

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

8. 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) $\frac{v}{10a}$

9. 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. 40

Total Marks : 28

Max. Time : 29 min.

Topics : Surface Tension, Elasticity & Viscosity, Geometrical Optics, Circular Motion, Rigid Body Dynamics

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]
Comprehension ('–1' negative marking) Q.7 to Q.9	(3 marks, 3 min.)	[9, 9]

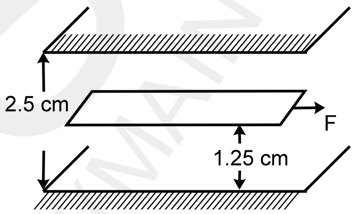
1. A capillary tube with inner cross-section in the form of a square of side *a* is dipped vertically in a liquid of density ρ and surface tension σ which wet the surface of capillary tube with angle of contact θ. The approximate height to which liquid will be raised in the tube is : (Neglect the effect of surface tension at the corners capillary tube)

(A) $\frac{2\sigma\cos\theta}{a\rho g}$ (B) $\frac{4\sigma\cos\theta}{a\rho g}$ (C) $\frac{8\sigma\cos\theta}{a\rho g}$ (D) None of these

2. Four uniform wires of the same material are stretched by the same force. The dimensions of wire are as given below. The one which has the minimum elongation has :

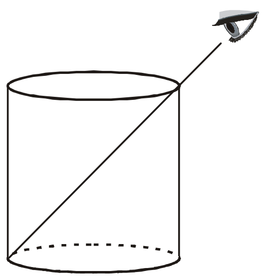
(A) radius 3mm, length 3m
(B) radius 0.5 mm, length 0.5 m
(C) radius 2mm, length 2m
(D) radius 3mm, length 2m

3. A space 2.5 cm wide between two large plane surfaces is filled with oil. Force required to drag a very thin plate of area 0.5 m^2 just midway the surfaces at a speed of 0.5 m/sec is 1N. The coefficient of viscosity in kg–s/m^2 is :



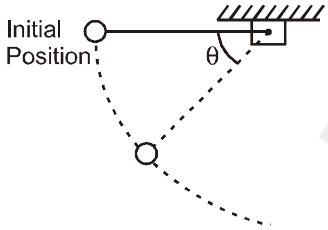
(A) 5×10^{-2} (B) 2.5×10^{-2} (C) 1×10^{-2} (D) 7.5×10^{-2}

4. A glass beaker has diameter 4cm wide at the bottom. An observer observes the edge of bottom when beaker is empty as shown in figure. When the beaker is completely filled with liquid of refractive index n = $\sqrt{5/2}$, he can just see the centre of bottom, then the height of glass beaker is :



(A) 4 cm
(B) $\sqrt{5/2}$ cm
(C) 16 cm
(D) None of these

5. The given figure shows a small mass connected to a string, which is attached to a vertical post. If the mass is released from rest when the string is horizontal as shown, the magnitude of the total acceleration of the mass as a function of the angle θ is

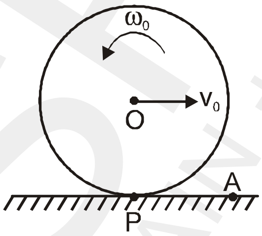


(A) $2\,g\sin\theta$ (B) $2\,g\cos\theta$ (C) $g\sqrt{3\cos^2\theta+1}$ (D) $g\sqrt{3\sin^2\theta+1}$

6. A 40 cm long wire having a mass 3.2 gm and area of cross section 1 mm^2 is stretched between the support 40.05 cm apart. In its fundamental mode, it vibrates with a frequency 1000/64 Hz. Find the young's modulus of the wire in the form $X \times 10^8$ N/m^2 and fill value of X.

COMPREHENSION

A uniform wheel is released on a rough horizontal floor after imparting it an initial horizontal velocity v_0 and angular velocity ω_0 as shown in the figure below. Point O is the centre of mass of the wheel and point P is its instantaneous point of contact with the ground. The radius of wheel is r and its radius of gyration about O is k. Coefficient of friction between wheel and ground is μ. A is a fixed point on the ground.



7. Which of the following is conserved ?
(A) linear momentum of wheel
(B) Angular momentum of wheel about O
(C) Angular momentum of wheel about A
(D) none of these

8. If the wheel comes to permanent rest after sometime, then :

(A) $v_0 = \omega_0 r$ (B) $v_0 = \frac{\omega_0 k^2}{r}$ (C) $v_0 = \frac{\omega_0 r^2}{R}$ (D) $V_0 = \omega_0\left(r + \frac{k^2}{r}\right)$

9. In above question, distance travelled by centre of mass of the wheel before it stops is -

(A) $\frac{v_0^2}{2\mu g}\left(1+\frac{r^2}{k^2}\right)$ (B) $\frac{v_0^2}{2\mu g}$ (C) $\frac{v_0^2}{2\mu g}\left(1+\frac{k^2}{r^2}\right)$ (D) None of these

DPP 31 TO 40 (ANSWER KEY)

DPP NO. - 31

1. (C) **2.** 5

3. (i) (a) $v = \frac{K(q_a + q_b)}{r}$; $E = \frac{K(q_a+q_b)}{r^2}$ (b) $E = \frac{Kq_b}{r^2}$ (ii) $\sigma_b = \frac{-q_b}{4\pi b^2}$ (iii) 0

4. (a) $\omega = 2av^2$, $R = \frac{1}{2a}$ (b) $\omega = \pm\, bv^2/a^2$, $R = a^2/b$

5. (A) **6.** (B) **7.** (B)

8. (A) p,q (B) p,q (C) q,r (D) q,r

DPP NO. - 32

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

4. $\sqrt{\frac{2GM}{a}\left(1-\frac{1}{\sqrt{2}}\right)}$

5. $\frac{Q}{3}$,which is same as that before earthing

6. 2 **7.** (A) **8.** (D) **9.** (B)

DPP NO. - 33

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

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

8. 27.04 N **9.** (A) p,s (B) p,s (C) q,s (D) r

DPP NO. - 34

1. (C) **2.** (A,B,C) **3.** $\frac{AC}{PC} = \frac{\ell - x}{x} = (\sqrt{2} - 1)$

4. $\frac{9}{11}$ **5.** **x + 2y = 4** **6.** $\frac{3mg}{d^3}(h+d)$

7. (D) **8.** (A) **9.** (D)

DPP NO. - 35

1. (B) **2.** (B) **3.** (C) **4.** 52 m

5. (B) **6.** (A) **7.** (B)

8. (A) p (B) q (C) p (D) s

DPP NO. - 36

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

5. (B)(D) **6.** (A) **7.** (B) **8.** (D)

DPP NO. - 37

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

5. (C) **6.** (A)

7. (D) **8.** (A) p, q, r, s,t; (B) p, q, r, s,t; (C) p, s,t; (D) p, q, r, s,t

DPP NO. - 38

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

5. (C) (D) **6.** 1.05×10^9 Pa.

7. (A) **8.** (D) **9.** (C)

DPP NO. - 39

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

4. [13] **5.** $\frac{6 \times 10^{-2}}{\sqrt{10\,\pi}}$ m

6. (a) $T = 40\,(3\cos\theta - 2\cos\theta_0)$ kg f. (b) θ_0 **= 60°**

7. (D) **8.** (A) **9.** (A)

DPP NO. - 40

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

5. (D) **6.** 1×10^9 N/m^2 **7.** (C)

8. (B) **9.** (B)

GGSRDN
Educational Services Private Limited
9th, 10th, NEET, JEE(Main/Advanced)
अभ्यास ही सबसे बड़ा गुरू है।

CLASS : XII (PHYSICS)

DPP

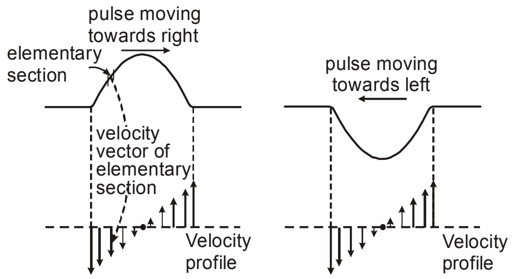
DAILY PRACTICE PROBLEM

Solutions

DPP-31 TO 40

DPP NO. - 31

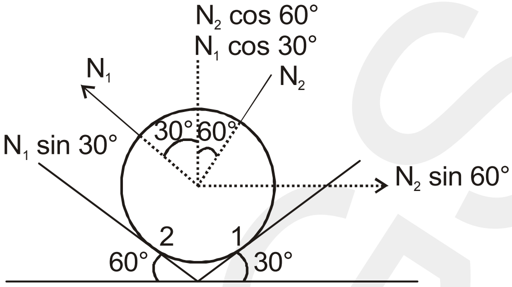
1. The velocity of profile of each elementary section of the pulse is shown in figure 1 and figure 2.



(Figure-1) (Figure-2)

When both the pulses completely overlaps, the velocity profiles of both the pulses in overlap region are identical. By superposition, velocity of each elementary section doubles. Therefore K.E. of each section becomes four times. Hence the K.E. in the complete width of overlap becomes four times, i.e., 4k.

2.



$N_1 \sin 30° = N_2 \sin 60°$

$N_1 \cos 30° + N_2 \cos 60° = mg$

Solving above equation

$$N_2 = \frac{mg}{2} = \frac{10 \times 10}{2} = 50$$

3. (i) (a) The charge on the outer most surface will be $(q_a + q_b)$ and it will be uniformly distributed

$\therefore$ $\mathbf{v} = \dfrac{K(q_a + q_b)}{r}$ **Ans.** ;

$\mathbf{E} = \dfrac{K(q_a + q_b)}{r^2}$ **Ans.**

where $K = \dfrac{1}{4\pi \in_0}$

(b) At a point inside the cavity of radius 'b' the potential will be due to q_b, $-q_b$ induced on its inner surface and due to $(q_a + q_b)$ on the outer surface of the sphere.

$$\mathbf{v} = \frac{Kq_b}{r} - \frac{Kq_b}{b} + \frac{K(q_a + q_b)}{R} \quad \textbf{Ans.}$$

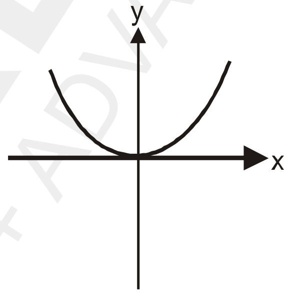
and E at that point will be only due to q_b (which is placed at B)

$$\mathbf{E} = \frac{Kq_b}{r^2} \quad \textbf{Ans.}$$

(ii) $\sigma_R = \dfrac{q_a + q_b}{4\pi R^2}$, $\sigma_a = \dfrac{-q_a}{4\pi a^2}$, $\sigma_b = \dfrac{-q_b}{4\pi b^2}$ **Ans.**

(iii) **0 Ans.**

4. (a) Parabola $y = ax^2$ is shown. It is clear from diagram that at x = 0 velocity is along x-axis and constant a_N is along y-axis. So,



$$a_N = \frac{d^2y}{dt^2}$$

$$\frac{dy}{dt} = 2a \times \frac{dx}{dt} = 2aVx$$

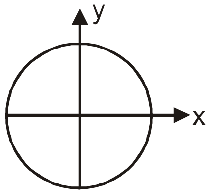
$$\frac{d^2y}{dt^2} = 2av\frac{dx}{dt} = 2av^2 \quad \left(\because \frac{d^2x}{dt^2} = 0\right)$$

$a_N = 2av^2$

$$R = \frac{v^2}{2av^2} = \frac{1}{2a}.$$

(b) $\left(\dfrac{x}{a}\right)^2 + \left(\dfrac{y}{b^2}\right)^2 = 1$

Here again at x = 0 particle is at (0, ± b) moving along positive or negative x-axis hence a_N is along y-axis only.



$a_N = \frac{d^2y}{dt^2}$

$\frac{2x}{a^2}\frac{dx}{dt} + \frac{2y}{b^2}\frac{dy}{dt} = 0$

$\frac{2vx}{a^2} + \frac{2y}{b^2}\left(\frac{dy}{dt}\right) = 0$

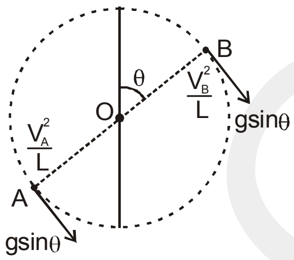
$\frac{2v}{a^2}\frac{dx}{dt} + \frac{2}{b^2}\left(\frac{dy}{dt}\right)^2 + \frac{2y}{b^2}\left(\frac{d^2y}{dt^2}\right) = 0$

[$\because$ v = const. along x-axis only $\frac{dy}{dt}$ = 0]

$\frac{2v^2}{a^2} = -\frac{2(b)}{b^2}\left(\frac{d^2y}{dt^2}\right) \Rightarrow a_N = -\frac{bv^2}{a^2}$

$R = -\frac{v^2}{a_N} = \frac{a^2}{b}$

7. The difference in K.E. at positions A and B is



$K_A - K_B = \frac{1}{2}mv_A^2 - \frac{1}{2}mv_B^2$ = mg (2L cosθ)

= 2mgLcosθ .... (1) **Ans.**

$T_A = \frac{mv_A^2}{L}$ + mg cosθ

$T_B = \frac{mv_B^2}{L}$ – mg cosθ

$\therefore T_A - T_B = \frac{mv_A^2 - mv_B^2}{L}$ + 2 mg cosθ .... (2)

from equation (1) and (2)

$T_A - T_B$ = 6 mg cosθ **Ans.**

The component of accelerations of ball at A and B are as shown in figure.

$\therefore |\vec{a}_A + \vec{a}_B| = \sqrt{(2g\sin\theta)^2 + \left(\frac{V_A^2}{L} - \frac{V_B^2}{L}\right)^2}$

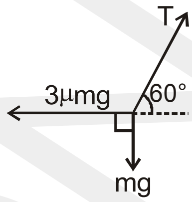
$= \sqrt{4g\sin^2\theta + 16g^2\cos^2\theta} = g\sqrt{4 + 12\cos^2\theta}$ **Ans.**

8. (A) p,q (B) p,q (C) q,r (D) q,r

Sol. In all cases speed of balls after collision will be same. In case of elastic collision speed of both balls after collision will be u, otherwise it will be less than u.

DPP NO. - 32

1. At the instant 3m is about to slip, tension in all the strings are as shown



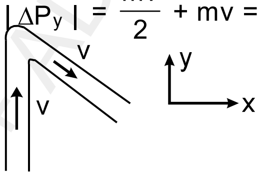
$\therefore$ 3 μmg = T cos 60° .... (1)

and mg = T sin 60° .... (2)

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

2. $|\overrightarrow{\Delta P_x}|$ = mv sin 60° = $\frac{\sqrt{3}}{2}$ mv

$|\overrightarrow{\Delta P_y}| = \frac{mv}{2}$ + mv = $\frac{3}{2}$ mv



$\Rightarrow |\overrightarrow{\Delta P}_{net}| = \sqrt{\Delta P_x^2 + \Delta P_y^2} = \sqrt{\left(\frac{9}{4} + \frac{3}{4}\right)}$ mv

$|\overrightarrow{\Delta P}_{net}| = \sqrt{3}$ mv

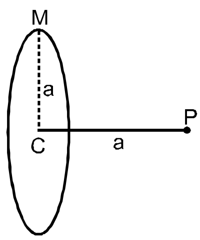
$\left(\begin{array}{l}\text{Since, } dm = A(v\,dt)\rho \\ \Rightarrow \frac{dm}{dt} = A\rho v\end{array}\right)$

$\Rightarrow |\overrightarrow{\Delta F}_{net}| = \sqrt{3}\left(\frac{dm}{dt}\right).v = \sqrt{3}\rho A v^2$ **Ans.**

3. $P_0 + \rho_1 gh - \rho_2 gh + \frac{2T}{r} = P_0$

$\Rightarrow T = \frac{r}{2}(\rho_2 - \rho_1)$ gh

4.



KE = $V_1 - V_2$ $\frac{1}{2}$ mυ² = $\frac{GMm}{\sqrt{2}a} - \left(\frac{-GMm}{a}\right)$

$\upsilon = \sqrt{\frac{2GM}{a}\left(1 - \frac{1}{\sqrt{2}}\right)}$

5. Let the charge on intermediate shell be q (after earthing)

Potential of the intermediate shell = 0

$$\Rightarrow \frac{KQ}{2R} + \frac{Kq}{2R} - \frac{K2Q}{3R} = 0$$

$$\frac{Q}{2} + \frac{q}{2} - \frac{2Q}{3} = 0$$

$$q = \left(\frac{2Q}{3} - \frac{Q}{2}\right)2 = \left(\frac{4Q - 3Q}{6}\right)2$$

$= \frac{Q}{3}$, which is same as that before earthing

$\therefore$ **No charge will flow.**

6. 2

$$\mu = Kx = \frac{dM}{dx}$$

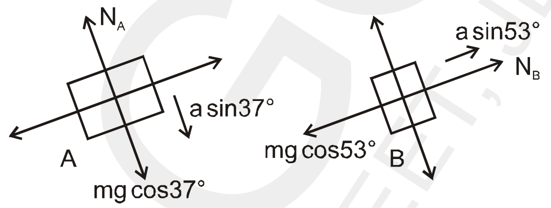
$$\int_O^M dM = \int_O^{\ell} Kx\,dx \text{ and } K = \frac{2M}{\ell^2}$$

$$V = \sqrt{\frac{F}{\mu}} = \sqrt{\frac{F}{Kx}} = \frac{dx}{dt} \qquad \int_O^{\ell} \sqrt{x}\,dx = \sqrt{\frac{F}{K}} \int_o^t dt$$

$$\therefore \quad t = \sqrt{\frac{4\ell^3}{9} \cdot \frac{K}{f}} = \sqrt{\frac{4\ell^3}{9F} \cdot \frac{2m}{\ell^2}}$$

$$= \sqrt{\frac{8M\ell}{9F}} = \sqrt{\frac{8 \times 45 \times 1.5}{9 \times 15}} = 2.$$

Sol. 7 to 9.



The FBD of A and B are

Applying Newton's second law to block A and B along normal to inclined surface

N_B – mg cos 53° = ma sin 53°

mg cos 37° – N_A = ma sin 37°

Solving $N_A = \frac{m}{5}(4g - 3a)$ and $N_B = \frac{m}{5}(3g + 4a)$

For N_A to be non zero

$4g - 3a \geq 0$

or $a \leq \frac{4g}{3}$

DPP NO. - 33

1. The distribution of charge on the outer surface, depends only on the charges outside, and it distributes itself such that the net, electric field inside the outer surface due to the charge on outer surface and all the outer charges is zero. Similarly the distribution of charge on the inner surface, depends only on the charges inside the inner surface, and it distributes itself such that the net, electric field outside the inner surface due to the charge on inner surface and all the inner charges is zero.

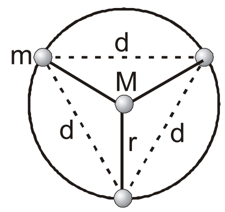
Also the force on charge inside the cavity is due to the charge on the inner surface. Hence answer is option **(A)**.

2. The distance between the orbiting stars is $d = 2r\cos30° = \sqrt{3}\,r$. The net inward force on orbiting stars is

$$\frac{Gm^2}{d^2}\cos 30° + \frac{GMm}{r^2} + \frac{Gm^2}{d^2}\cos 30° = \frac{mv^2}{r}$$

$$\therefore \quad G\left[\frac{m}{\sqrt{3}} + M\right] = \frac{4\pi^2 r^3}{T^2}$$

$$\text{or} \quad T = 2\pi\sqrt{\frac{r^3}{G\left(M + \frac{m}{\sqrt{3}}\right)}}$$



3. $\frac{1}{2}k x_0^2 + Mgh = \frac{1}{2}k(x_0+h)^2 + 0$

$\Rightarrow h = \frac{2Mg}{k} - 2x_0$

Maximum downward displacement

$= [\frac{2Mg}{k} - 2x_0]$

4. $H = \frac{u_\perp^2}{2a_\perp}$

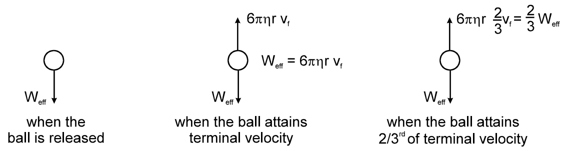
$a_\perp$ is same for all the three cases.

$H_A = \frac{(u\sin\alpha)^2}{2a_\perp}$, $H_B = \frac{u^2}{2a_\perp}$

and $H_C = \frac{(u\cos\alpha)^2}{2a_\perp}$

$\therefore H_B = H_A + H_C$

5. (A)



when the ball is released — Figure (1); when the ball attains terminal velocity — Figure (2); when the ball attains 2/3[rd] of terminal velocity — Figure (3)

When the ball is just released, the net force on ball is W_{eff} (= mg – buoyant force)
The terminal velocity 'v_f' of the ball is attained when net force on the ball is zero.

$\therefore$ Viscous force $6\pi\eta r\, v_f = W_{eff}$

When the ball acquires $\frac{2}{3}$rd of its maximum velocity v_f

the viscous force is $= \frac{2}{3} W_{eff}$.

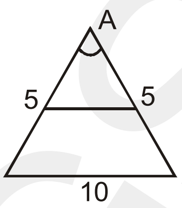
Hence net force is $W_{eff} - \frac{2}{3}W_{eff} = \frac{1}{3}W_{eff}$

$\therefore$ required acceleration is $= \frac{a}{3}$

6. If we complete the trapezium as shown It becomes an equilateral triangle

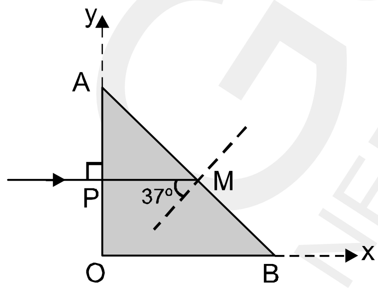
$\Rightarrow$ A = 60°

$$\frac{\sin\left[\frac{A+\delta_{min}}{2}\right]}{\text{Smn}\frac{A}{2}} = \mu$$



$$\frac{\sin\left[\frac{60+\delta_{min}}{2}\right]}{\sin\frac{60}{2}} = \sqrt{2}\,, \quad \delta_{min} = 30°$$

7.



Clearly, PM $= \frac{3}{2}$ cm

$$37° > \sin^{-1}\frac{1}{n_0 + a(3/2)}$$

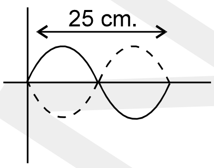
$$\frac{3}{5} > \frac{1}{n_0 + \frac{3a}{2}}$$

$$3n_0 + \frac{9a}{2} > 5$$

$$\frac{9a}{2} > 1$$

$$a > \frac{2}{9}$$

8.



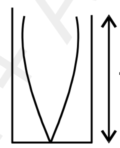
$\mu = \frac{2.5}{25}$ = 0.1 g / cm = 10^{-2} Kg/m

I[st] overtone

λ_s = 25 cm = 0.25 m

$$f_s = \frac{1}{\lambda_s}\sqrt{\frac{T}{\mu}}$$

pipe in fundamental freq



λ_p = 160 cm = 1.6 m

$$f_p = \frac{V}{\lambda_p}$$

$\because$ by decreasing the tension , beat freq is decreased

$\therefore$ $f_s > f_p$

$\Rightarrow$ $f_s - f_p = 8$

$$\Rightarrow \frac{1}{0.25}\sqrt{\frac{T}{10^{-2}}} - \frac{320}{1.6} = 8$$

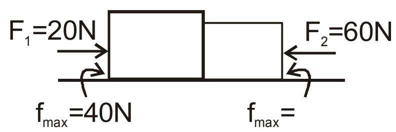
$\Rightarrow$ T = 27.04 N

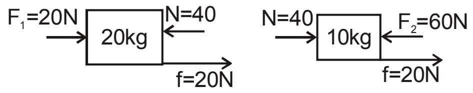
9. (A) p,s (B) p,s (C) q,s (D) r

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. - 34

2. U = 3x + 4y

$$a_y = \frac{F_y}{m} = \frac{-(\partial U/\partial x)}{m} = -3$$

$$a_x = \frac{F_y}{m} = \frac{-(\partial U/\partial y)}{m} = -4$$

$\Rightarrow$ $|\vec{a}|$ = **5 m/s²**

Let at time 't' particle crosses y-axis

then $-6 = \frac{1}{2}(-3)t^2$

$\Rightarrow$ t = 2 sec.

Along y-direction :

$$\Delta y = \frac{1}{2}(-4)(2)^2 = -8$$

$\Rightarrow$ particle crosses y-axis at **y = – 4**

At (6, 4) : U = 34 & KE = 0

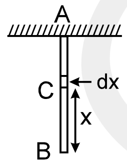
At (0, – 4) : U = – 16

$\Rightarrow$ KE = 50

or, $\frac{1}{2}mv^2 = 50$

$\Rightarrow$ **v = 10 m/s** while crossing y-axis

3.



Tension in elementary section of width dx is

T = λ xg (λ = mass / length)

$\therefore$ extension of length x (= BC) of wire is

$$\Delta x = \int_0^x \frac{(\lambda x g)}{YA}dx = \frac{\lambda x^2}{2YA} \quad ...(1)$$

$\Rightarrow$ extension in total length of wire l(=AB) is 2Δx

$$2\Delta x = \frac{\lambda \ell^2 g}{2YA} \quad ...(2)$$

$\therefore$ from equation (1) and (2)

$$x = \frac{\ell}{\sqrt{2}}$$

Ans. $\frac{AC}{PC} = \frac{\ell - x}{x} = (\sqrt{2} - 1)$

4. λ_i = wavelength of the incident sound

$$= \frac{10u - \frac{u}{2}}{f} = \frac{19u}{2f}$$

f_i = frequency of the incident sound

$= \frac{10u - u}{10u - \frac{u}{2}} f = \frac{18}{19} f = f_r$ = frequency of the reflected sound

λ_r = wavelength of the reflected sound

$$= \frac{10u + u}{f_r} = \frac{11u}{18f} \times 19 = \frac{11 \times 19}{18} \cdot \frac{u}{f}$$

$$\frac{\lambda_i}{\lambda_r} = \frac{19u}{2f} \times \frac{18f}{11 \times 19u} = \frac{9}{11} \textbf{ Ans.}$$

5. $\vec{r}_P = (\hat{i} + \hat{j})t$

$\vec{r}_Q = (2\hat{i} + \hat{j}) + (-\hat{i} + 2\hat{j})t$

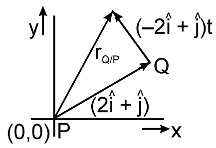
$\vec{r}_{QP} = \vec{r}_Q - \vec{r}_P = 2\hat{i} + \hat{j} + (-2\hat{i} + t\hat{j})$

$\vec{r}_{QP} = (2 - 2t)\hat{i} + (1 + t)\hat{j}$

x = 2 – 2t y = 1 + t

$\Rightarrow$ x = 2 – 2 (y – 1)

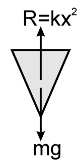
x + 2y = 4 Ans.



6. Force on cone while it is penetrating the sand is shown in F.B.D. below

Applying work energy theorem to the cone as x changes from 0 to d

ΔKE = work done by mg + work done by resistive force R



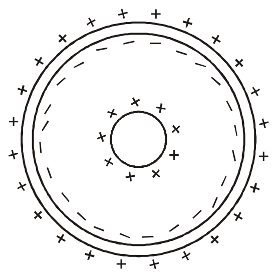
$$K_{Final} - K_{Initial} = mgd - \int_0^d kx^2\,dx$$

$$0 - mgh = mgd - \int_0^d kx^2\,dx$$

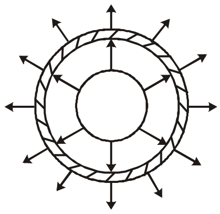
$$\therefore \frac{kd^3}{3} = (mgd + gh)$$

$$\Rightarrow k = \frac{3mg}{d^3}(h + d)$$

7. (A) Charge distribution on system is shown below



So electric lines of forces are as shown below



Since number of lines of force are proportional to charge so no. of lines of forces emerging from inner sphere should be equal to the no. of lines of forces emerging from outer shell.

8. $V_B = K\left[\frac{6\times10^{-9}}{27\times10^{-2}} - \frac{3\times10^{-9}}{18\times10^{-2}} + \frac{3\times10^{-9}}{18\times10^{-2}}\right] = 200\text{ V}$

$V_A = K\left[\frac{6\times10^{-9}}{27\times10^{-2}} - \frac{3\times10^{-9}}{18\times10^{-2}} + \frac{3\times10^{-9}}{6\times10^{-2}}\right]$

= 200 V – 150 V + 450 V

= 500 V

$V_C = V_B$ (as shell is conducting)

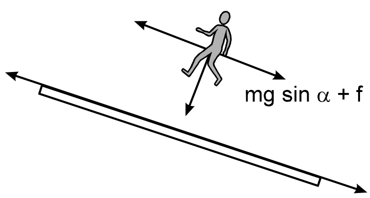
Therefore, $V_C - V_B = 0$

$V_B - V_A = -300$ V

9. Potential at point B and point C increases by same value, keeping their difference unchanged.

DPP NO. - 35

1. F.B.D. of man and plank are -



For plank be at rest, applying Newtons second law to plank along the incline

$Mg \sin\alpha = f$ ....(1)

and applying Newton's second law to man along the incline.

$mg \sin\alpha + f = ma$ ....(2)

$a = g\sin\alpha\left(1+\frac{M}{m}\right)$ down the incline

Alternate Solution :

If the friction force is taken up the incline on man, then application of Newton's second law to man and plank along incline yields.

$f + Mg\sin\alpha = 0$ ....(1)

$mg\sin\alpha - f = ma$ ....(2)

Solving (1) and (2)

$a = g\sin\alpha\left(1+\frac{M}{m}\right)$ down the incline

Alternate Solution :

Application of Newton's seconds law to system of man + plank along the incline yields

$mg\sin\alpha + Mg\sin\alpha = ma$

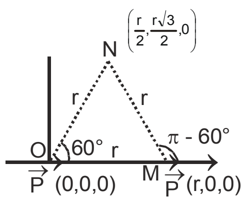
$a = g\sin\alpha\left(1+\frac{M}{m}\right)$ down the incline

2. As ON = MN = OM = r

So it is equilateral triangle :

∴ Potential at N due to two dipoles ;

$V = V_1 + V_2$



$= \frac{Kp\cos60^\circ}{r^2} + \frac{Kp\cos(\pi-60^\circ)}{r^2} = 0$

3. $\frac{x}{1} = \frac{x_{rel}}{\mu}$ $x_{rel} = \mu x$

$\frac{d^2x_{rel}}{dt^2} = \mu\frac{d^2x}{dt^2}$

$a_{rel} = \mu g$

4. At position A balloon drops first particle
So, $u_A = 0$, $a_A = -g$, $t = 3.5$ sec.

$$S_A = \left(\frac{1}{2}gt^2\right) \quad ....(i)$$

Balloon is going upward from A to B in 2 sec.so distance travelled by balloon in 2 second.

$$\left(S_B = \frac{1}{2}a_B t^2\right) \quad ....(ii)$$

$a_B = 0.4\ m/s^2$, $t = 2$ sec.

$S_1 = BC = (SB + SA)$ ....(iii)

Distance travell by second stone which is droped from balloon at B

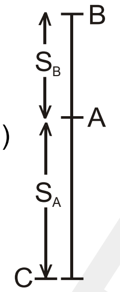
$u_2 = u_B = a_B t = 0.4 \times 2 = 0.8$ m/s

$t = 1.5$ sec.

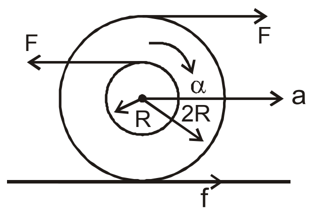
$$\left(S_2 = u_2 t - \frac{1}{2}gt^2\right) \quad ....(iv)$$

Distance between two stone

$\Delta S = S_1 - S_2$.



5.



f = ma ...(i)

F2R – FR – fR = Iα ...(ii)

a = Rα ...(iii)

$$FR - fR = I.\frac{a}{R}$$

$$F - ma = \frac{Ia}{R^2}$$

$$F = \left(m + \frac{I}{R^2}\right)a.$$

$$a = \frac{F}{m + I/R^2}$$

$$f = ma = \frac{mF}{m + \frac{I}{R^2}}$$

$$f = \frac{mF}{m + \frac{I}{R^2}}$$

$$f = \frac{10}{3}N$$

6. $$a = \frac{F}{m + \frac{I}{R^2}} = \frac{5}{3}$$

$$\alpha = \frac{a}{2} = \frac{5}{6}$$

$$v = 0 + \frac{5}{6}\times 3 = \frac{5}{2}$$

$$\omega = \omega_0 + \alpha t = 0 + \frac{5}{3}\times 3 = 5$$

$$KE = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

$$= \frac{1}{2}\times 2\times 5\times 5 + \frac{1}{2}\times 4\times \frac{5}{2}\times\frac{5}{2}$$

$$= 25 + \frac{25}{2} = \frac{75}{2}\ J$$

7. F2R – FR = Iα

$$\alpha = \frac{FR}{I}$$

$$\omega = 0 + \left(\frac{FR}{I}\right)t$$

$$KE = \frac{1}{2}Iw^2$$

$$= \frac{1}{2}\times I\left(\frac{F^2R^2}{I^2}\right)t^2$$

$$= \frac{F^2R^2}{2I} = \frac{100\times 1\times 3\times 3}{2\times 4} = \frac{25\times 9}{2} = 112.5\ J.$$

8. (A) p (B) q (C) p (D) s

(A) In frame of lift effective acceleration due to gravity is $g + \frac{g}{2} = \frac{3g}{2}$ downwards

$$\therefore T = 2\pi\sqrt{\frac{2\ell}{3g}}$$

(B) $K\ell = mg$ $\therefore \frac{k}{m} = \frac{g}{L}$

constant acceleration of lift has no effect in time period of oscillation.

$$\therefore T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{\ell}{g}}$$

(C) $T = 2\pi\sqrt{\frac{I}{mgd}} = 2\pi\sqrt{\frac{\frac{m\ell^2}{3}}{mg\frac{\ell}{2}}} = 2\pi\sqrt{\frac{2\ell}{3g}}$

(D) $T = 2\pi\sqrt{\frac{m}{\rho A g}} = 2\pi\sqrt{\frac{\rho/2A\ell}{\rho A g}} = 2\pi\sqrt{\frac{\ell}{2g}}$

DPP NO. - 36

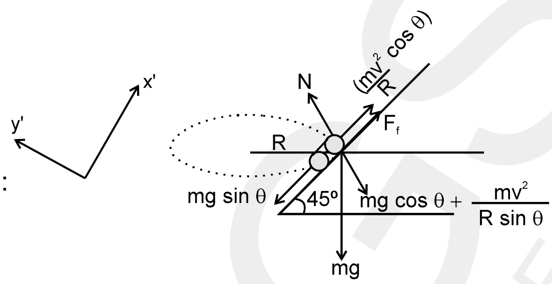
1. **(C)** Work done against friction must equal the initial kinetic energy.

$\therefore \quad \frac{1}{2}mv^2 = \int_1^\infty \mu mg dx \quad ; \quad \frac{v^2}{2} = Ag\int_1^\infty \frac{1}{x^2}dx \quad ;$

$\frac{v^2}{2} = Ag\left[-\frac{1}{x}\right]_1^\infty$

$v^2 = 2gA \qquad \Rightarrow v = \sqrt{2gA}$

2. F.B.D. for minimum speed (w.r.t. automobile)

: 

$\Sigma f_{y'} = N - mg\cos\theta - \frac{mv^2}{R}\sin\theta = 0.$

$\Sigma f_{x'} = \frac{mv^2}{R}\cos\theta + \mu N - mg\sin\theta = 0$

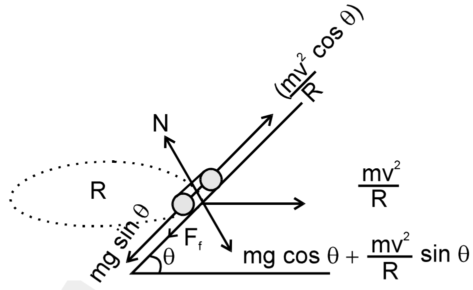
$\Rightarrow \frac{mv^2}{R}\cos\theta + \mu(mg\cos\theta + \frac{mv^2}{R}$

$\sin\theta) - mg\sin\theta = 0$

$\Rightarrow v^2 = \frac{(\mu Rg\cos\theta - Rg\sin\theta)}{(\cos\theta + \mu\sin\theta)}$

for $\theta = 45°$ and $\mu = 1$:

$v_{min} = \frac{Rg - Rg}{1+1} = 0$



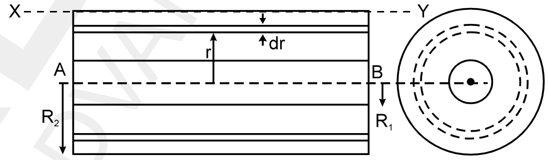
F.B.D for maximum speed (w.r.t. automobile)

$\Sigma f_{x'} = \frac{mv^2}{R}\cos\theta - mg\sin\theta - \mu(mg\cos\theta$

$+ \frac{mv^2}{R}\sin\theta) = 0$

for $\theta = 45°$ and $\mu = 1$

$v_{max} = \infty$ (infinite)

3. 

Taking cylindrical element of radius r and thickness dr

$dm = \frac{M}{\pi(R_2^2 - R_1^2)\ell} \times (2\pi r\,\ell\,dr)$

$I_{AB} = \int dI_{e\ell} = \int dmr^2 = \int_{R_1}^{R_2} \frac{2M}{(R_2^2 - R_1^2)}.r^3\,dr$

$= \frac{1}{2}m(R_2^2 + R_1^2)$

Using parallel axis theorem

$I_{XY} = \frac{1}{2}m(R_2^2 + R_1^2) + MR_2^2$

4. *Let m be minimum mass of ball.*
Let mass A moves downwards by x.
From conservation of energy,

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

$x = \left(\frac{2mg}{k}\right)$

For mass M to leave contact with ground,
$kx = Mg$

$K\left(\frac{2mg}{k}\right) = Mg$

$m = \frac{M}{2}.$

5. In elastic collision the velocities are exchanged if masses are same.

$\therefore$ after the collision ;

$V_C = 0$

$V_A = v$

Now the maximum compression will occure when both the masses A and B move with same velocity.

$\therefore$ mv = (m + m) V (for system of A – B and spring)

$$\therefore V = \frac{v}{2}$$

$$\therefore \text{KE of the A – B system} = \frac{1}{2} \times 2m\left(\frac{v}{2}\right)^2$$

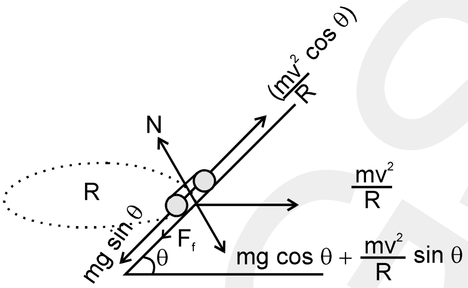
$$= \frac{mv^2}{4}$$

And at the time of maximum compression ;

$$\frac{1}{2}mv^2 = \frac{1}{2} \times 2m\left(\frac{v}{2}\right)^2 + \frac{1}{2}K X^2max$$

$$\therefore X_{max} = v\sqrt{\frac{m}{2K}}$$

6.



$$E = \frac{40 - 10}{0.3} = 100 \text{ V/m}$$

(near the plate the electric field has to be uniform $\therefore$ it is almost due to the plate).

For conducting plate

$$E = \frac{\sigma}{\epsilon_0}$$

$\Rightarrow \sigma = \epsilon_0 E$

Therefore :, $\sigma = 8.85 \times 10^{-12} \times 100$

$= 8.85 \times 10^{-10}$ C/m²

7. Direction of E.F. at B is towards A that will exert force in this direction only, causing the positive charge to move. [$\vec{E}$ is perpendicular to equipotential surface and its direction is from high potential to low potential.]

8. W = q.dV

$= -1 \times 10^{-6}[20 - (-20)]$

$= -4 \times 10^{-5}$ J.

DPP NO. - 37

1. For first collision

v = 10 m/s.

$$t_1 = \frac{\pi(5)}{10}$$

$= \pi/2$ sec.

velocity of sep = e. velocity of opp.

$$v_2 - v_1 = \frac{1}{2}(10)$$

$v_2 - v_1 = 5$ m/s

for second collision

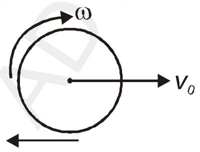
$$\therefore \quad t_2 = \frac{2\pi(5)}{5} = 2\pi$$

$\therefore$ total time $t = t + t_2$

$= \pi/2 + 2\pi$

$t = 2.5\,\pi$

2.

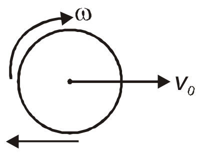


The friction force will reduce v_0, hence translational K.E.

The friction force will increase ω

There is no torque about the line of contact, angular momentum will remain constant

The frictional force will decrease the mechanical energy.



3. Equation of the component waves are :

y = A sin(ωt – kx) and y = A sin (ωt + kx)

where; ωt – kx = constant or ωt + kx = cosntant

Diffeentaiting w.r.t. 't' ;

$$\omega - k\frac{dx}{dt} = 0 \qquad \text{and } \omega + k\frac{dx}{dt} = 0$$

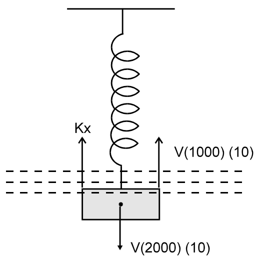
$$\Rightarrow v = \frac{dx}{dt} = \frac{\omega}{k} \qquad \text{and } v = -\frac{\omega}{k}$$

i.e.; the speed of component waves is $\left(\frac{\omega}{k}\right)$.

Hence (B)

4. Kx = V(2000) (10) – V (1000) (10)

$= \frac{10}{2000}$ [1000 × 10]



Kx = 50 N ... (b)

$U_{stored} = \frac{1}{2} \times (100) \left(\frac{50}{100}\right)^2 = \frac{1}{2} \times \frac{2500}{100}$

= 12.5 J

5. At x = 5 cm, $\frac{\partial V_e}{\partial x}$ = slope of figure 1

at x = 5 = +ve

So $F_x = -q\frac{\partial V_e}{\partial x} = -ve$

at y = 15 cm, $\frac{\partial V_g}{\partial y}$ = slope of figure 2

at y = 15 = – ve

So $F_y = -m\frac{\partial V_g}{\partial y} = +ve$

So particle will try to move towards – x direction and +y direction.

6. at (25, 35),

$F_x\big|_{x=25} = -q\frac{\partial V_e}{\partial x}\Big|_{x=25}$

$= -\left(-\frac{2\times10^4}{0.1}\right) \times (20 \times 10^{-6}) = 4\text{ N}$

$F_y\big|_{y=35} = -m\frac{\partial V_g}{\partial y}\Big|_{y=35}$

$= -(200)\left(\frac{10^{-3}}{0.10}\right) = -2\text{N}$

$F_{net} = 4\hat{i} - 2\hat{j} = (200)\ a$

$\frac{4}{200}\hat{i} - \frac{2}{200}\hat{j} = a$

$a = (2\hat{i} - \hat{j}) \times 10^{-2}\ \text{m/sec}^2$

7. $W_{(5,\,15)\rightarrow(25,\,35)} = U_{(25,\,35)} - U_{(5,\,15)}$

$= (0 + (200)(-1.5 \times 10^{-3})) - [(20 \times 10^{-6})$

$(1/2 \times 10^4) + (200)(-1.5 / 10^{-3})]$

$= -0.1$ J

8. **(A) p, q, r, s,t; (B) p, q, r, s,t; (C) p, s,t; (D) p, q, r, s,t**

(p, s) since there is net impulse, translations motion will occurs for all cases.

(r,q) only in C, impulse is passing through centre of mass. Hence rotation will occur and angular momentum will increase in all cases except (C).

(t) About all the points on the line of action of the impulse, torque is zero. Hence angular momentum will conserve for many points.

DPP NO. - 38

1. $T = \frac{F}{L}$ ....(i)

$F = \eta A\frac{dv}{dx} \equiv \eta L^2\frac{V}{L} = \eta LV$

$\eta = \frac{F}{LV}$ ....(ii)

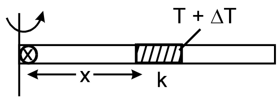
From (i) (ii),(i) (ii)

$\left[\frac{F}{\eta}\right] \equiv [V].$

2. $-\int_T^0 \Delta T = \int_0^{\ell}\frac{m}{\ell}dx\,\omega^2 x$

$\Rightarrow\ T = \frac{m}{\ell}\omega^2\frac{x^2}{2}$

$\Rightarrow\ Y = \frac{F\ell}{A\Delta\ell} \qquad \Delta\ell = \frac{F\ell}{Ay}$



$\Delta\ell = \frac{\frac{m}{\ell}\frac{\omega^2x^2}{2}dx}{AY}$

$\Delta\ell = \frac{m}{\ell}\frac{\omega^2\ell^3}{6AY}$

$\Delta\ell = \frac{\rho\omega^2\ell^3}{6y}$

$\Delta\ell = \omega^2$

$\omega_2 = 2\omega_1$

3. Both blocks loose contact immediately after the release.

$T_P = 2\pi\sqrt{\frac{m}{4K}}$,

$T_Q = 2\pi\sqrt{\frac{m}{K}}$

$\Rightarrow \therefore \quad T_Q = 2T_P$

Q comes at lowest position at time $\frac{T_Q}{2}$ travelling a distance $\frac{2mg}{K}$ downwards.

In time $\frac{T_Q}{2}$, i.e. time period of P (T_P) the block P come back to original position

$\therefore$ The distance between P and Q is $\frac{2mg}{K}$

4. At t = $\frac{T_Q}{2}$ both the blocks are at extreme position and their velocity is zero. **[Soln. of SSI Sir]**

$\therefore \quad V_P = V_Q = 0$

6. $B = -\frac{\Delta P}{\Delta V/V} = -\frac{V\,\Delta P}{\Delta V} = -\frac{1.5\times140\times10^3}{-0.2\times10^{-3}}$

$= 1.05 \times 10^9$ Pa .

Ans. 1.05×10^9 Pa.

7. Moment of inertia of one rod about the axis of frame

$= \left(\frac{m}{4}\right)\frac{L^2}{12} + \frac{m}{4}\left(\frac{L}{2}\right)^2 = \frac{m}{4}L^2\left(\frac{1}{12}+\frac{1}{4}\right)$

$= \frac{mL^2}{12}$

$\therefore$ Moment of inertia of frame = $ML^2/3$.

9. **(For the above two questions)**

Newton's law applied on C.M. gives

$mg\sin\theta - f = ma$ .... (1)

Writing $\tau = I\alpha$ about C.M., we have

$f.\frac{L}{\sqrt{2}} = \frac{mL^2}{3}\alpha$ .... (2)

from the condition of rolling, we have

$a = \frac{L}{\sqrt{2}}\alpha$ .... (3)

from (1), (2) and (3)

$f = \frac{2mg\sin\theta}{5}$ and $a = \frac{3}{5}g\sin\theta$

DPP NO. - 39

1. From the free body diagram of the sphere :

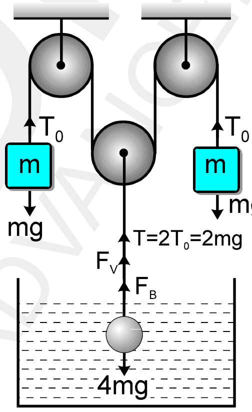
$F_V = 4\,mg - 2\,mg - F_B$

$\Rightarrow F_V = 2\,mg - F_B$

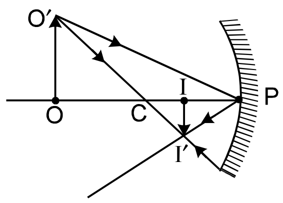
$\Rightarrow 6\pi\eta r V = \frac{4}{3}\pi r^3\left(\frac{\sigma}{2}-\rho\right)g$

(since $4m = \frac{4}{3}\pi r^3 \times \sigma$)

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



2. In the figure shown



$\because \quad \Delta OO'P$ & $\Delta II'P$ are similar

$\frac{OO'}{II'} = \frac{OP}{IP}$ ....(1)

also $\because \Delta OO'C$ & $\Delta II'C$ are similar

$\frac{OO'}{II'} = \frac{OC}{IC}$ ....(2)

By equation (1) and (2)

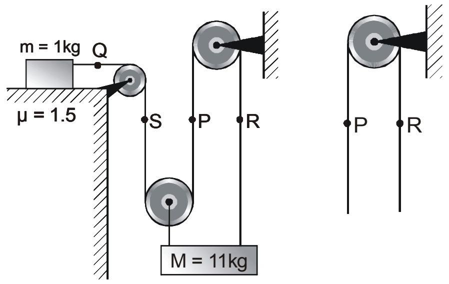
$\frac{OP}{IP} = \frac{OC}{IC} \Rightarrow \frac{OP}{OC} = \frac{IP}{IC}$ **Ans.**

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

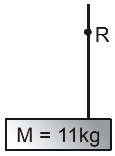
$y = 0.5A\sin(-kx - \omega t + \theta)$

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

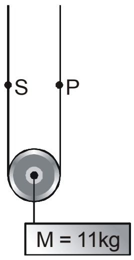
4.



If the point P has an acceleration a upwards then the acceleration of point R will be a downwards.



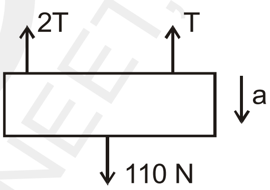
The point R has an acceleration a downwards so the block will also have an acceleration a downwards.



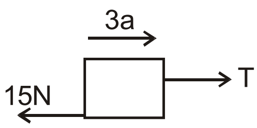
The point P has an acceleration a upwards, the block has an acceleration a downwards so the acceleration of S will be 3a downwards. (because $\frac{\vec{a}_S + \vec{a}_P}{2} = \vec{a}_{block}$).

The point Q will also have an acceleration 3a towards right.

The F.B.D. of 11kg block



The F.B.D. of 1kg block



Using FBD of 11 kg block, which will have acceleration a downwards.

$110 - 3T = 11a$ .... (1) (in downwards direction)

For 1 kg block, which will have acceleration 3a,

$T - 15 = 3a$ (in horizontal direction)

or $3T - 45 = 9a$ .... (2)

on adding equation (1) & (2) we get

$20a = 65 \Rightarrow 4a = 13\ m/s^2$

5. $1.15 \times 10^8 = \dfrac{900(10 + a)}{\left(\dfrac{\pi d^2}{4}\right)}$

$\Rightarrow \quad d = \dfrac{6}{\sqrt{10\ \pi}}\ cm = \dfrac{0.06}{\sqrt{10\ \pi}}$

$m = \dfrac{6 \times 10^{-2}}{\sqrt{10\ \pi}}\ m$

Ans. $\dfrac{6 \times 10^{-2}}{\sqrt{10\ \pi}}$ **m**

6. The situation is shown in figure.

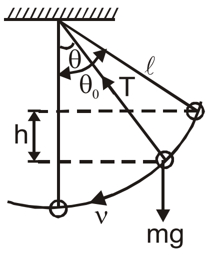
(a) From figure $h = \ell(\cos\theta - \cos\theta_0)$

and $v^2 = 2gh$

$= 2g\ell(\cos\theta - \cos\theta_0)$ .... (1)

Again $T - mg\cos\theta = mv^2 / \ell$ .... (2)

Substituting the value of v^2 from eq. (1) in eq. (2) we get



$T - mg\cos\theta = m\{2g\ell(\cos\theta - \cos\theta_0) / \ell\}$

or $T = mg\cos\theta + 2mg(\cos\theta - \cos\theta_0)$

or $T = mg(3\cos\theta - 2\cos\theta_0)$

or $T = 40g(3\cos\theta - 2\cos\theta_0)$ newton

Ans. $T = 40(3\cos\theta - 2\cos\theta_0)$ kg f.

(b) Let θ_0 be the maximum amplitude. The maximum tension T will be at mean position where $\theta = 0$.

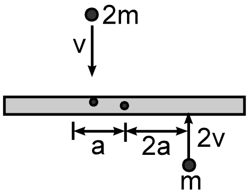
$\therefore \quad T_{max} = 40(3 - 2\cos\theta_0)$

But $T_{max} = 80$

Solving we get θ_0 **= 60°**

Ans. θ_0 **= 60°**

9. (i) Cons. linear momentum



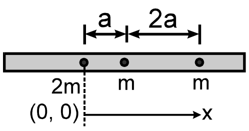
$-2m.v + 2v.m = 0 = MV_{cm}$

$V_{cm} = 0$

(ii) As ball sticks to Rod

Conserving angular momentum about C

$2v.m.\,2a + 2mva = I\omega$



$= \left(\frac{8m.\,36a^2}{12} + 2m.\,a^2 + m.4a^2\right)$

$6mv.a = 30\ ma^2.\omega$

$\Rightarrow \quad \omega = \frac{v}{5a}$

(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. - 40

1. Upward force by capillary tube on top surface of liquid is

$f_{up} = 4\sigma a \cos\theta$

If liquid is raised to a height h then we use

$4\sigma a \cos\theta = ha^2\rho g$

or $h = \frac{4\sigma\cos\theta}{a\rho g}$ **Ans.**

2. $\Delta l = \frac{F\ell}{\pi r^2 y} \Rightarrow \quad \Delta l \ \alpha \ \frac{\ell}{r^2}$

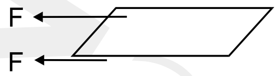
Only option 'radius 3mm, length 2m' is satisfying the above relation.

3. Velocity gradient $= \frac{0.5}{\frac{2.5}{2} \times 10^{-2}}$

as force on the plate due to viscocity is from upper as well as lower portion of the oil, equal from each part,

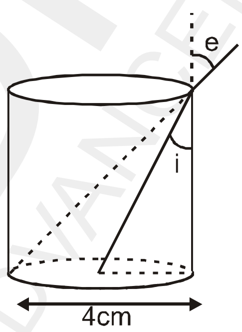
Then, $\quad F = 2\eta A\frac{dv}{dz}$

$= \quad 2 \times \ \eta \times (0.5)\ \frac{0.5}{1.25 \times 10^{-2}}$



$\Rightarrow \ \eta = 2.5 \times 10^{-2}$ kg – sec/m^2

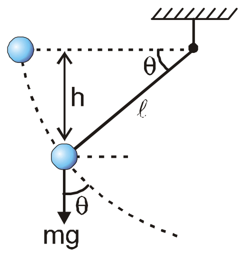
4.



$\sqrt{\frac{5}{2}}$ sin i = 1 sin e $\qquad \Rightarrow \sqrt{\frac{5}{2}}\ \frac{2\,cm}{\sqrt{4cm^2 + h^2}}$

$= 1 \times \frac{4\,cm}{\sqrt{16cm^2 + h^2}} \qquad \Rightarrow$ h = 4 cm

5.



From conservation of energy

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

$\Rightarrow \ mg\ell\sin\theta = \frac{1}{2}\ mv^2$

$\Rightarrow \ 2g\sin\theta = \frac{v^2}{\ell} = a_c$

$g\cos\theta = a_t$

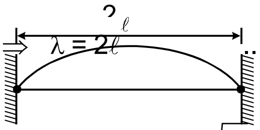
Total acceleration $a = \sqrt{a_c^2 + a_t^2}$

$= g\sqrt{\cos^2\theta + (2\sin\theta)^2} = g\sqrt{3\sin^2\theta + 1}$

6. $\mu = \frac{3.2\,gm}{40\text{ cm}} = \frac{3.2\times10^{-3}}{40\times10^{-2}} = \frac{3.2}{40} = \frac{32}{4000}$ kg/m

$$\ell = \frac{\lambda}{2}$$

$\Rightarrow \lambda = 2\ell$ ....(1)



$$f = \frac{v}{\lambda} = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}}$$

$$\Rightarrow \frac{1000}{64} = \frac{1}{2\times40\times10^{-2}}\sqrt{\frac{T}{32/4000}}$$

$$\Rightarrow \left[\frac{1000}{64}\times2\times40\times10^{-2}\right]^2 \frac{32}{4000} = T$$

$$\frac{1000}{64}\times\frac{32}{4000} = T$$

$$\Rightarrow T = \frac{10}{8}\text{ N}$$

अब $y = \dfrac{\frac{10/8}{10^{-6}}}{\frac{.05\times10^{-2}}{40\times10^{-2}}} = \frac{10^7}{8}\,\frac{40}{(.05)}$

$= 10^9$ N/m^2. **[Ans. 1×10^9 N/m^2]**

7. Torque of friction about A is zero.

8. Angular momentum conservation about point A.
$L_{in} = mv_0r - mk^2\omega_0$
$L_{fin} = 0$
$L_{fin} = L_{in}$
$\Rightarrow v_0 = \omega_0 k^2/r$.

9. $a_{cm} = -\mu g$

$0^2 = v_0^2 - 2\mu gs \quad \Rightarrow S = \frac{v_0^2}{2\mu g}$