GGSRDN
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9th, 10th, NEET, JEE(Main/Advanced)
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CLASS : XII (PHYSICS)

DPP

DAILY PRACTICE PROBLEM

DPP-21 to 30

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 21

Total Marks : 38

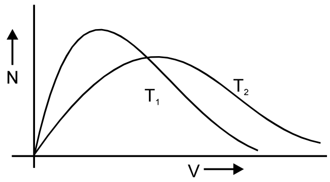
Max. Time : 40 min.

Topics : Calorimetry & Thermal Expansion, Kinetic Theory of Gases, Center of Mass, Geometrical Optics, Circular 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 to Q.6	(4 marks, 4 min.)	[12, 12]
Comprehension ('–1' negative marking) Q.7 to Q.9	(3 marks, 3 min.)	[9, 9]
Match the Following (no negative marking) (2 × 4)Q.10	(8 marks, 10 min.)	[8, 10]

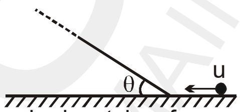
1. A cubical block of copper of side 10 cm is floating in a vessel containing mercury. Water is poured into the vessel so that the copper block just gets submerged. The height of water column is
(ρ_{Hg} = 13.6 g/cc , ρ_{Cu}= 7.3 g/cc, ρ_{water} =1 gm/cc)
(A) 1.25 cm (B) 2.5 cm (C) 5 cm (D) 7.5 cm

2. Maxwell's velocity distribution curve is given for the same quantity two different temperatures. For the given curves.



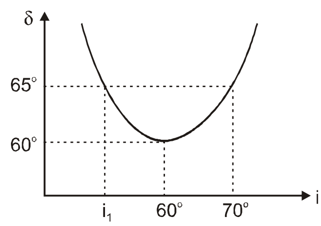
(A) $T_1 > T_2$ (B) $T_1 < T_2$
(C) $T_1 \le T_2$ (D) $T_1 = T_2$

3. A particle of mass m is given initial horizontal velocity of magnitude u as shown in the figure. It transfers to the fixed inclined plane without a jump, that is, its trajectory changes sharply from the horizontal line to the inclined line. All the surfaces are smooth and $90° \ge \theta > 0°$. Then the height to which the particle shall rise on the inclined plane (assume the length of the inclined plane to be very large)



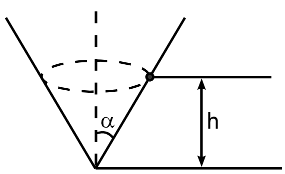
(A) increases with increase in θ (B) decreases with increase in θ
(C) is independent of θ (D) data insufficient

4. The angle of deviation (δ) vs angle of incidence (i) is plotted for a prism. Pick up the correct statements.



(A) The angle of prism is 60°
(B) The refractive index of the prism is n = $\sqrt{3}$
(C) For deviation to be 65° the angle of incidence i_1 = 55°
(D) The curve of 'δ' vs 'i' is parabolic

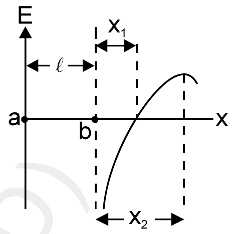
5. A particle is describing circular motion in a horizontal plane in contact with the smooth inside surface of a fixed right circular cone with its axis vertical and vertex down. The height of the plane of motion above the vertex is h and the semivertical angle of the cone is α. The period of revolution of the particle:



(A) increases as h increases (B) decreases as h increases
(C) increases as α increases (D) decreases as α increases

6. Two identical straight wires are stretched so as to produce 6 beats/sec. when vibrating simultaneously. On changing the tension slightly in one of them the beat frequency remains unchanged. Denoting by T_1, T_2, the higher & the lower initial tensions in the strings, then it could be said that while making the above changes in tension:
(A) T_2 was decreased (B) T_2 was increased (C) T_1 was increased (D) T_1 was decreased

COMPREHENSION



Two point charges are placed at point a and b. The field strength to the right of the charge Q_b on the line that passes through the two charges varies according to a law that is represented graphically in the figure. The electric field is taken positive if its direction is towards right and negative if its direction is towards left.

7. Choose the correct statement regarding the signs of the charges.
(A) Charge at point a is positive and charge at point b is negative.
(B) Charge at point a is negative and charge at point b is positive.
(C) Both charges are positive
(D) Both charges are negative

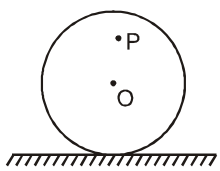
8. Ratio of magnitudes of charges $\left|\frac{Q_a}{Q_b}\right|$ will be equal to

(A) $\left(1+\frac{\ell}{x_1}\right)$ (B) $\left(1+\frac{\ell}{x}\right)^2$ (C) $1+\left(\frac{\ell}{x}\right)^2$ (D) $\left(1+\frac{\ell}{x}\right)^4$

9. The distance x_2 from point b where the field is maximum, will be

(A) $\dfrac{\ell}{\left(\frac{\ell+x_1}{x_1}\right)^{\frac{2}{3}}-1}$ (B) $\dfrac{\ell}{\left(\frac{\ell+x_1}{x_1}\right)^{\frac{1}{3}}-1}$ (C) $\dfrac{\ell}{\left(\frac{\ell+2x_1}{x_1}\right)^{\frac{2}{3}}-1}$ (D) $\dfrac{\ell}{\left(\frac{\ell+2x_1}{x_1}\right)^{\frac{1}{3}}-1}$

10. A uniform disc rolls without slipping on a rough horizontal surface with uniform angular velocity. Point O is the centre of disc and P is a point on disc as shown. In each situation of column I a statement is given and the corresponding results are given in column-II. Match the statements in column-I with the results in column-II.



Column I	Column II
(A) The velocity of point P on disc	(p) Changes in magnitude with time
(B) The acceleration of point P on disc	(q) Is always directed from that point (the point on disc given in column-I) towards centre of disc.
(C) The tangential acceleration of point P on disc	(r) is always zero
(D) The acceleration of point on disc which is in contact with rough horizontal surface	(s) is non-zero and remains constant in magnitude

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 22

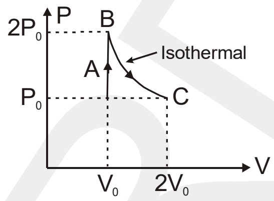
Total Marks : 33

Max. Time : 33 min.

Topics : String Wave, Circular Motion, Projectile Motion, Center of Mass, Rectilinear Motion, Sound Wave, Geometrical Optics, Rigid Body Dynamics

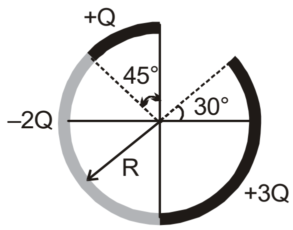
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.7	(3 marks, 3 min.)	[21, 21]
Multiple choice objective ('–1' negative marking) Q.8 to Q.10	(4 marks, 4 min.)	[12, 12]

1. A diatomic ideal gas undergoes a thermodynamic change according to the P–V diagram shown in the figure. The total heat given to the gas is nearly (use $\ell n2 = 0.7$) :



(A) $2.5\ P_0V_0$ (B) $1.4\ P_0V_0$
(C) $3.9\ P_0V_0$ (D) $1.1\ P_0V_0$

2. Figure shows three circular arcs, each of radius R and total charge as indicated.
The net elecric potential at the centre of curvature is :



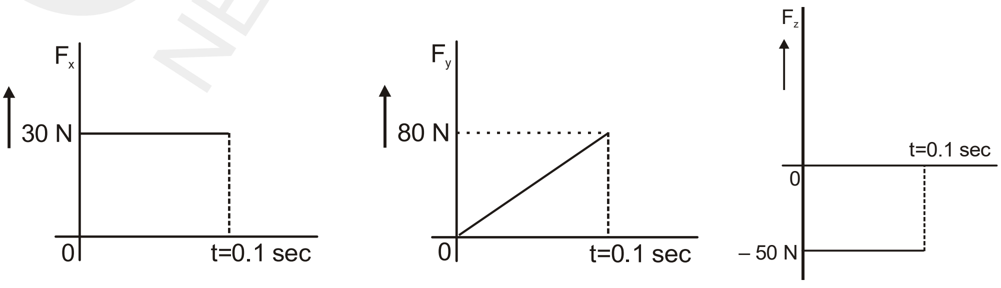
(A) $\dfrac{Q}{2\pi\varepsilon_0 R}$ (B) $\dfrac{Q}{4\pi\varepsilon_0 R}$

(C) $\dfrac{2Q}{\pi\varepsilon_0 R}$ (D) $\dfrac{Q}{\pi\varepsilon_0 R}$

3. A heavy body of mass 25 kg is to be dragged along a horizontal plane ($\mu = 1/\sqrt{3}$). The least force required is

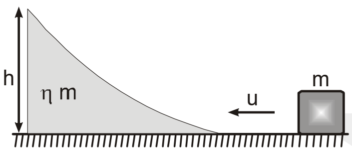
(A) 25 kg f (B) 2.5 kg f (C) 12.5 kg f (D) $25/\sqrt{3}$ kg f

4. A particle is acted upon by a force whose component's variations with time are shown in diagrams. Then the magnitude of change in momentum of the particle in 0.1 sec will be



(A) $2\ kg\ \dfrac{m}{sec}$ (B) $10\ kg\ \dfrac{m}{sec}$ (C) $12\ kg\ \dfrac{m}{sec}$ (D) $5\sqrt{2}\ kg\ \dfrac{m}{sec}$

5. A small block of mass m is pushed towards a movable wedge of mass ηm and height h with initial velocity u. All surfaces are smooth. The minimum value of u for which the block will reach the top of the wedge



(A) $\sqrt{2gh}$ (B) $\eta\sqrt{2gh}$ (C) $\sqrt{2gh\left(1+\frac{1}{\eta}\right)}$ (D) $\sqrt{2gh\left(1-\frac{1}{\eta}\right)}$

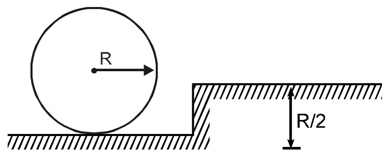
6. A bird flies for 4 seconds with a velocity of $|t-2|$ m/sec. in a straight line, where t = time in seconds. It covers a distance of
(A) 4 m (B) 6 m (C) 8m (D) none of these

7. A violin string oscillating in its fundamental mode, generates a sound wave with wavelength λ. To generate a sound wave with wavelength $\lambda/2$ by the string, still oscillating in its fundamental mode, tension must be changed by the multiple :
(A) 2 (B) 1/2 (C) 4 (D) 1/4

8. In displacement method, the distance between object and screen is 96 cm. The ratio of length of two images formed by a convex lens placed between them is 4.84.
(A) Ratio of the length of object to the length of shorter image is 11/5.
(B) Distance between the two positions of the lens is 36 cm.
(C) Focal length of the lens is 22.5 cm.
(D) Distance of the lens from the shorter image is 30 cm.

9. A source emit sound waves of frequency 1000 Hz. The source moves to the right with a speed of 32 m/s relative to ground. On the right a reflecting surface moves towards left with a speed of 64 m/s relative to ground. The speed of sound in air is 332 m/s :
(A) wavelength of sound infront of source is 0.3 m
(B) number of waves arriving per second which meets the reflected surface is 1320
(C) speed of reflected wave is 268 m/s
(D) wavelength of reflected waves is nearly 0.2 m

10. A wheel (to be considered as a ring) of mass m and radius R rolls without sliding on a horizontal surface with constant velocity v. It encounters a step of height R/2 at which it ascends without sliding.



(A) the angular velocity of the ring just after it comes in contact with the step is 3v/4R

(B) the normal reaction due to the step on the wheel just after the impact is $\frac{mg}{2}+\frac{9\,mv^2}{16\,R}$

(C) the normal reaction due to the step on the wheel increases as the wheel ascends
(D) the friction will be absent during the ascent.

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 23

Total Marks : 36

Max. Time : 39 min.

Topics : String Wave, Circular Motion, Projectile Motion, Geometrical Optics, Electrostatics, Center of Mass

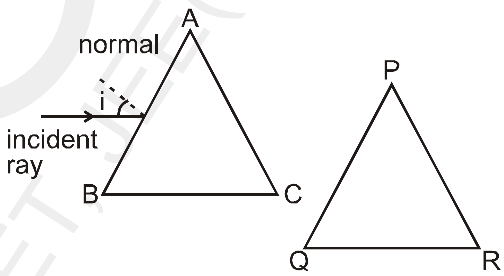
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Subjective Questions ('–1' negative marking) Q.6	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.7 to Q.9	(3 marks, 3 min.)	[9, 9]
Match the Following (no negative marking) (2 × 4) Q.10	(8 marks, 10 min.)	[8, 10]

1. 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

2. A particle is projected horizontaly with speed 10m/s from a certain point above ground. Find the tangential acceleration of particle at t = 2 sec. (Take g = 10 m/s²).
(A) $\frac{10}{\sqrt{5}}$ (B) $\frac{25}{\sqrt{5}}$ (C) $4\sqrt{5}$ (D) $10\sqrt{5}$

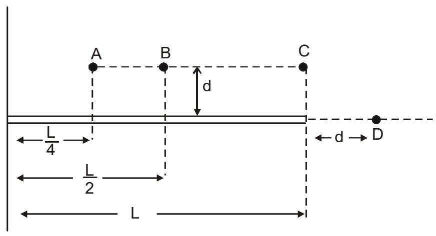
3. A ball is thrown eastward across level ground. A wind blows horizontally to the east, and assume that the effect of wind is to provide a constant force to the east, equal in magnitude to the weight of the ball. The angle θ (with respect to horizontal) at which the ball should be projected so that it travels maximum horizontal distance is
(A) 45° (B) 37° (C) 53° (D) 67.5°

4. Two equilateral glass prisms of refractive index $\sqrt{2}$ are placed as shown in figure. A ray is incident on side AB of left prism as shown in figure. This ray further suffers refraction at sides AC, PQ and PR in succession. The prisms are adjusted such that for each refraction the deviation is clockwise. Then the angle between sides AC and PQ of two prisms for net minimum deviation of incident ray is



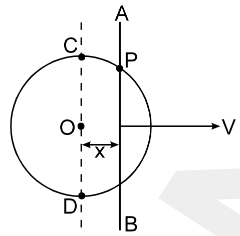
(A) 30° (B) 60°
(C) 90° (D) 120°

5. Figure given below shows uniformly positively charged, thin rod of length L and four points A, B, C and D at the same distance d from the rod, with position as marked. If V_A, V_B, V_C and V_D are their respective potentials then:



(A) $V_B > V_A > V_C > V_D$ (B) $V_B > V_A > V_C = V_D$
(C) $V_A = V_B > V_C = V_D$ (D) $V_D > V_B > V_A > V_C$

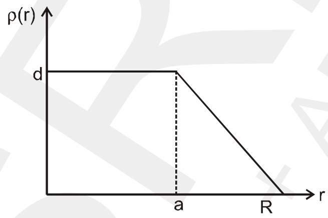
6. A rod AB is moving on a fixed circle of radius R with constant velocity 'v' as shown in figure. P is the point of intersection of the rod and the circle. At an instant the rod is at a distance $x = \frac{3R}{5}$ from centre of the circle. The velocity of the rod is perpendicular to the rod and the rod is always parallel to the diameter CD.



(a) Find the speed of point of intersection P.
(b) Find the angular speed of point of intersection P with respect to centre of the circle.

COMPREHENSION

The nuclear charge (Ze) is non–uniformly distributed within a nucleus of radius R. The charge density $\rho(r)$ [charge per unit volume] is dependent only on the radial distance r from the centre of the nucleus as shown in figure. The electric field is only along the radial direction. Figure **[JEE-2008 ; 12/163]**



7. The electric field at r = R is :
(A) independent of a
(B) directly proportional to a
(C) directly proportional to a^2
(D) inversely proportional to a

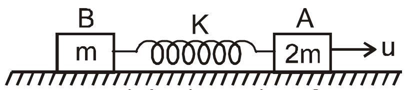
8. For a = 0, the value d (maximum value of ρ as shown in the figure) is :

(A) $\frac{3Ze^2}{4\pi R^3}$ (B) $\frac{3Ze}{\pi R^3}$ (C) $\frac{4Ze}{3\pi R^3}$ (D) $\frac{Ze}{3\pi R^3}$

9. The electric field within the nucleus is generally observed to be linearly dependent on r. This implies :

(A) a = 0 (B) $a = \frac{R}{2}$ (C) a = R (D) $a = \frac{2R}{3}$

10. Two blocks A and B of mass m and 2m respectively are connected by a massless spring of spring constant K. This system lies over a smooth horizontal surface. At t = 0 the block A has velocity u towards right as shown while the speed of block B is zero, and the length of spring is equal to its natural length at that instant. In each situation of column I, certain statements are given and corresponding results are given in column II. Match the statements in column I corresponding results in column II and indicate your answer by darkening appropriate bubbles in the 4 × 4 matrix given in the OMR.



Column I	Column II
(A) The velocity of block A	(p) can never be zero
(B) The velocity of block B	(q) may be zero at certain instants of time
(C) The kinetic energy of system of two blocks	(r) is minimum at maximum compression of spring
(D) The potential energy of spring	(s) is maximum at maximum extension of spring

PHYSICS

DPP

DAILY PRACTICE PRACTICE PROBLEMS

DPP No. 24

Total Marks : 38

Max. Time : 48 min.

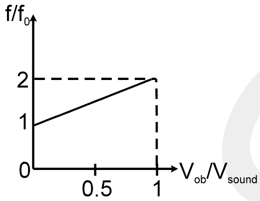
Topics : Projectile Motion, Sound Wave, Relative Motion, Center of Mass, Geometrical Optics, Simple Harmonic Motion, Circular Motion, Fluid

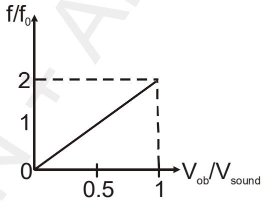
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks, 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.8 to Q.9	(4 marks, 5 min.)	[8, 10]
Match the Following (no negative marking) (2 × 4) Q.10	(8 marks ,10 min.)	[8, 10]

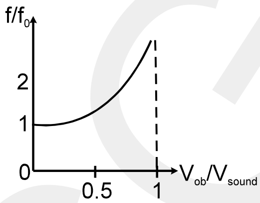
1. Two stones are projected simultaneously from a tower at different angles of projection with same speed 'u'. The distance between two stones is increasing at constant rate 'u'. Then the angle between the initial velocity vectors of the two stones is :

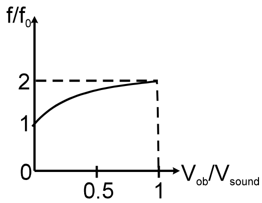
(A) 30° (B) 60° (C) 45° (D) 90°

2. A curve is plotted to represent the dependence of the ratio of the received frequency f to the frequency f_0 emitted by the source on the ratio of the speed of observer V_{ob} to the speed of sound V_{sound} in a situation in which an observer is moving towards a stationary sound source. The curve is best represented by :

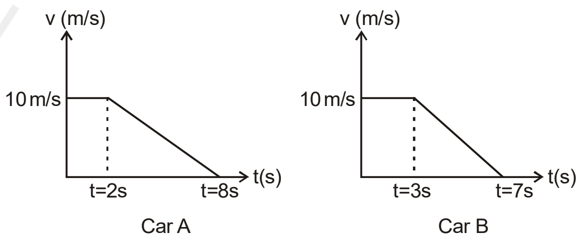
(A) 

(B) 

(C) 

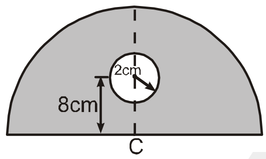
(D) 

3. Car A and car B move on a straight road and their velocity versus time graphs are as shown in figure. Comparing the motion of car A in between t = 0 to t = 8 sec. and motion of car B in between t = 0 to t = 7 sec., pick up the correct statement.



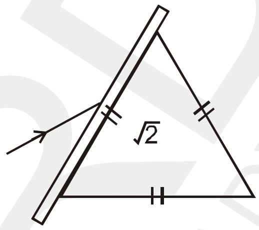
(A) Distance travelled by car A is less than distance travelled by car B.
(B) Distance travelled by car A is greater than distance travelled by car B.
(C) Average speed of both cars are equal.
(D) Average speed of car A is less than average speed of car B.

4. In the figure shown a hole of radius 2 cm is made in a semicircular disc of radius 6π cm at a distance 8 cm from the centre C of the disc. The distance of the centre of mass of this system from point C is:



(A) 4 cm (B) 8 cm (C) 6 cm (D) 12 cm

5. A parallel glass slab of refractive index $\sqrt{3}$ is placed in contact with an equilateral prism of refractive index $\sqrt{2}$. A ray is incident on left surface of slab as shown. The slab and prism combination is surrounded by air. The magnitude of minimum possible deviation of this ray by slab-prism combination is



(A) 30° (B) 45° (C) 60° (D) $60° - \sin^{-1}\sqrt{\frac{2}{3}}$

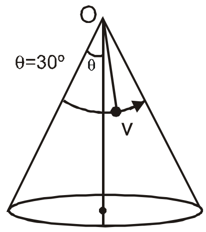
6. The amplitude of a particle due to superposition of following S.H.Ms. Along the same line is

$X_1 = 2 \sin 50\pi t$; $X_2 = 10 \sin (50\pi t + 37^o)$

$X_3 = -4 \sin 50\pi t$; $X_4 = -12 \cos 50\pi t$

(A) $4\sqrt{2}$ (B) 4 (C) $6\sqrt{2}$ (D) none of these

7. A bob of mass 2 kg is suspended from point O of a cone with an inextensible string of length $\sqrt{3}$ m. It is moving in horizontal circle over the surface of cone as shown in the figure. Then : (g = 10 m/s^2)



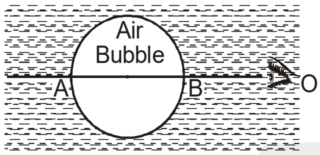
(A) bob looses contact with cone if $v > \sqrt{5}$ m/s

(B) normal force on bob is 19 N when v = 2 m/s

(C) tension in string is $\frac{38}{\sqrt{3}}$ N when v = 2 m/s

(D) normal force on bob is $\frac{17}{\sqrt{3}}$ N when v = 2m/s

8. Inside water $\left(\mu = \frac{4}{3}\right)$ there is an air bubble of radius 4 cm as shown an observer O is looking into the diametrical axis AB of bubble. Find the distance in cm of a point object from point A on the axis in water which appears to be at point A as seen by observer.



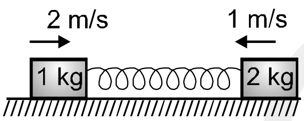
9. A wooden cube (density 0.5 gm/cc) of side 10 cm is floating in water kept in a cylindrical beaker of base area 1500 cm^2. When a mass m is kept on the wooden block the level of water rises in the beaker by 2mm. Find the mass m.

10. **Match the column:**

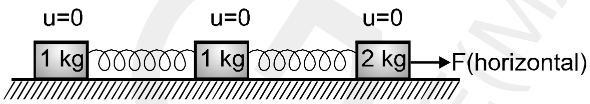
In all cases in column–I, the blocks are placed on the smooth horizontal surface.

Column–I

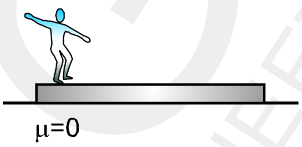
(A) When spring is relaxed. the initial velocities given to the blocks are as shown (friction is absent)



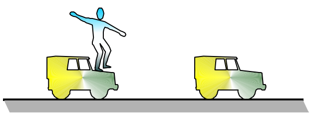
(B) A constant force is applied on 2 kg block. Springs are initially relaxed and friction is absent



(C) There is no friction between plank and ground and initially system is at rest. Man starts moving on a large plank with constant velocity.



(D) Two trolleys are resting on a smooth horizontal surface and a man standing on one of the trolleys jumps to the other with relative velocity of 4 m/s



Column–II

(p) Centre of mass of the complete system shown will not move horizontally

(q) Centre of mass of the complete system shown will move horizontally

(r) Mechanical energy of the system will be conserved

(s) Mechanical energy of the system will increase

(t) Linear momentum of the complete system will always remain constant

PHYSICS

DPP
DAILY PRACTICE PROBLEMS

DPP No. 25

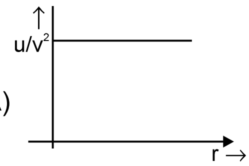
Total Marks : 32

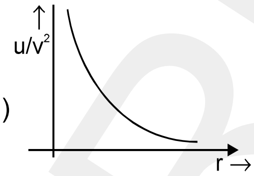
Max. Time : 33 min.

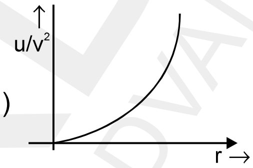
Topics : Electrostatics, Circular Motion, Geometrical Optics , Relative Motion, Work, Power and Energy, Fluid

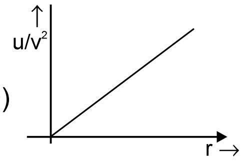
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Multiple choice objective ('–1' negative marking) Q.6	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.7	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.8 to Q.10	(3 marks, 3 min.)	[9, 9]

1. At distance 'r' from a point charge, the ratio $\frac{U}{V^2}$ (where 'U' is energy density and 'V' is potential) is best represented by :

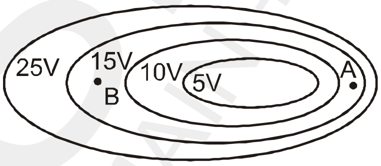
(A)


(B)


(C)


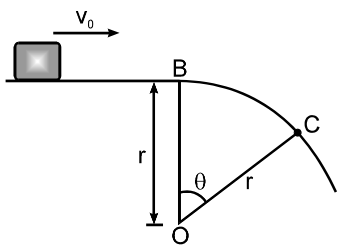
(D)


2. The figure shows several equipotential lines. Comparing between points A and B, pick up the best possible statement



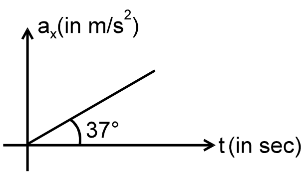
(A) the electric field has a greater magnitude at point A and is directed to left.
(B) the electric field has a greater magnitude at point A and is directed to right.
(C) the electric field has a greater magnitude at point B and is directed to left.
(D) the electric field has a greater magnitude at point B and is directed to right.

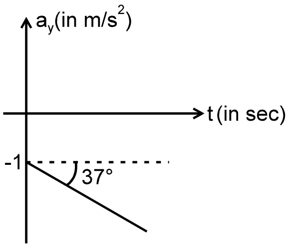
3. A small block slides with velocity $0.5\sqrt{gr}$ on the horizontal frictionless surface as shown in the Figure. The block leaves the surface at point C. The angle θ in the Figure is:



(A) $\cos^{-1}(4/9)$
(B) $\cos^{-1}(3/4)$
(C) $\cos^{-1}(1/2)$
(D) none of the above

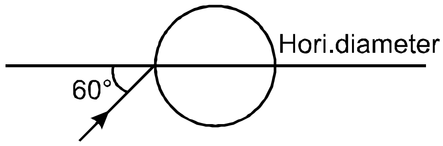
4. In the figure the variation of components of acceleration of a particle of mass 1 kg is shown w.r.t. time. The initial velocity of the particle is $\vec{u} = (-3\hat{i} + 4\hat{j})$ m/s. The total work done by the resultant force on the particle in time interval from t = 0 to t = 4 seconds is :





(A) 22.5 J
(B) 10 J
(C) 0
(D) None of these

5. A ray of light falls on a transparent sphere as shown in figure. If the final ray emerges from the sphere parallel to the horizontal diameter, then the refractive index of the sphere is (consider that sphere is kept in air) :



(A) $\sqrt{2}$ (B) $\sqrt{3}$

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

6. A boat moves relative to river with a velocity which is n times the river flow velocity.

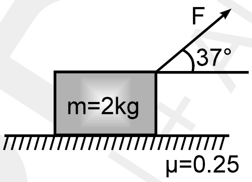
(A) If n < 1, boat cannot cross the river

(B) If n = 1, boat cannot cross the river without drifting

(C) If n > 1, boat can cross the river along shortest path

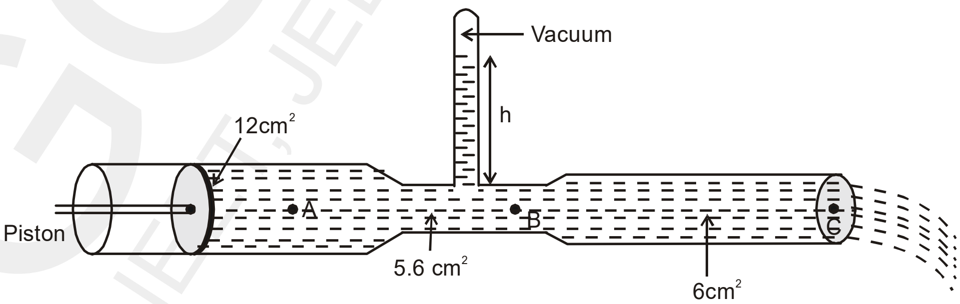
(D) Boat can cross the river whatever is the value of n (excluding zero)

7. A force F = 20 N is applied to a block (at rest) as shown in figure. After the block has moved a distance of 8 m to the right, the direction of horizontal component of the force F is reversed. Find the velocity with which block arrives at its starting point.



COMPREHENSION

A glass tube has three different cross sectional areas with the values indicated in the figure. A piston at the left end of the tube exerts pressure so that the mercury within the tube flows from the right end with a speed of 8.0 m/s. Three points within the tube are labeled A, B and C. The atmospheric pressure is 1.01×10^5 N/m^2; and the density of mercury is 1.36×10^4 kg/m^3. (use g = 10 m/s^2)



8. At what speed is mercury flowing through the point A ?

(A) 2.0 m/s (B) 4.0 m/s (C) 8.0 m/s (D) 12 m/s

9. The pressure at point A is equal to:

(A) 2.02×10^5 Pa (B) 2.25×10^5 Pa (C) 3.26×10^5 Pa (D) 4.27×10^5 Pa.

10. The height h of mercury in the manometer is

(A) 136 mm (B) 169 mm (C) 272 mm (D) 366 mm

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 26

Total Marks : 31

Max. Time : 31 min.

Topics : Kinetic Theory of Gases, Surface Tension, Rigid Body Dynamics, Center of Mass, Electrostatics, Sound Wave, Work, Power and Energy

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks, 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7	(4 marks, 4 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.8 to Q.10	(3 marks, 3 min.)	[9, 9]

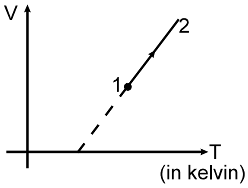
1. V–T diagram for a process of a given mass of ideal gas is as shown in the figure. During the process pressure of gas.

(A) first increases then decreases

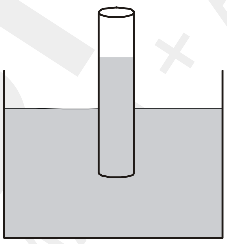
(B) continuously decreases

(C) continuously increases

(D) first decreases then increases.

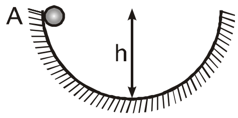


2. A long capillary tube of mass 'π' gm, radius 2mm and negligible thickness, is partially immersed in a liquid of surface tension 0.1 N/m. Take angle of contact zero and neglect buoyant force of liquid. The force required to hold the tube vertically, will be - (g = 10 m/s^2)



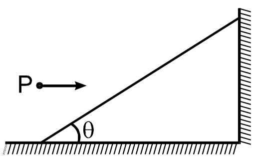
(A) 10.4 π mN
(B) 10.8 π mN
(C) 0.8 π mN
(D) 4.8 π mN

3. A small solid sphere of mass m is released from a point A at a height h above the bottom of a rough track as shown in the figure. If the sphere rolls down the track without slipping, its rotational kinetic energy when it comes to the bottom of track is



(A) mgh
(B) $\frac{10}{7}$ mgh
(C) $\frac{5}{7}$ mgh
(D) $\frac{2}{7}$ mgh

4. In the figure shown a particle P strikes the inclined smooth plane horizontally and rebounds vertically. If the angle θ is 60°, then the coefficient of restitution is:



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

5. A point charge 'q' is placed at the corner of an equilateral prism. Then the electric flux through the surface of the prism is:

(A) $\frac{q}{8\,\varepsilon_0}$ (B) $\frac{q}{6\,\varepsilon_0}$ (C) $\frac{q}{12\,\varepsilon_0}$ (D) $\frac{q}{24\,\varepsilon_0}$

6. There is a set of four tuning forks, one with the lowest frequency vibrating at 550 Hz. By using any two tuning forks at a time, the following beat frequencies are heard: 1, 2, 3, 5, 7, 8. The possible frequencies of the other three forks are:

(A) 552, 553, 560 (B) 557, 558, 560 (C) 552, 553, 558 (D) 551, 553, 558

7. Which of the following statements is/are true

(A) work done by kinetic friction on an object may be positive.

(B) A rigid body rolls up an inclined plane without sliding. The friction force on it will be up the incline. (only contact force and gravitational force is acting)

(C) A rigid body rolls down an inclined plane without sliding. The friction force on it will be up the incline. (only contact force and gravitational force is acting)

(D) A rigid body is release from rest and having no angular velocity from the top of a rough inclined plane. It moves down the plane with slipping. The friction force on it will be up the incline.

COMPREHENSION

A stone is projected from level ground with speed u and at an angle θ with horizontal. Some how the acceleration due to gravity (g) becomes double (that is 2g) immediately after the stone reaches the maximum height and remains same thereafter. Assume direction of acceleration due to gravity always vertically downwards.

8. The total time of flight of particle is :

(A) $\frac{3}{2}\frac{u\sin\theta}{g}$ (B) $\frac{u\sin\theta}{g}\left(1+\frac{1}{\sqrt{2}}\right)$ (C) $\frac{2u\sin\theta}{g}$ (D) $\frac{u\sin\theta}{g}\left(2+\frac{1}{\sqrt{2}}\right)$

9. The horizontal range of particle is

(A) $\frac{3}{4}\frac{u^2\sin2\theta}{g}$ (B) $\frac{u^2\sin2\theta}{2g}\left(1+\frac{1}{\sqrt{2}}\right)$ (C) $\frac{u^2}{g}\sin2\theta$ (D) $\frac{u^2\sin2\theta}{2g}\left(2+\frac{1}{\sqrt{2}}\right)$

10. The angle ϕ which the velocity vector of stone makes with horizontal just before hitting the ground is given by:

(A) $\tan\phi = 2\tan\theta$ (B) $\tan\phi = 2\cot\theta$ (C) $\tan\phi = \sqrt{2}\tan\theta$ (D) $\tan\phi = \sqrt{2}\cot\theta$

PHYSICS

DPP
DAILY PRACTICE PROBLEMS

DPP No. 27

Total Marks : 37

Max. Time : 40 min.

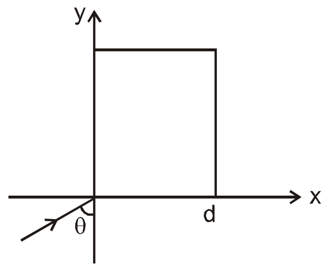
Topics : Kinetic Theory of Gases, Geometrical Optics, Electrostatics, Center of Mass, Relative Motion, Rigid Body Dynamics, String Wave

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

1. At pressure P and absolute temperature T a mass M of an ideal gas fills a closed container of volume V. An additional mass 2M of the same gas is added into the container and the volume is then reduced to $\frac{V}{3}$ and the temperature to $\frac{T}{3}$. The pressure of the gas will now be:

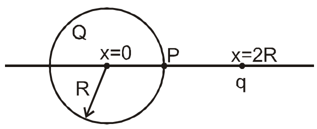
(A) $\frac{P}{3}$ (B) P (C) 3 P (D) 9 P

2. A ray hits the y-axis making an angle θ with y-axis as shown in the figure. The variation of refractive index with x-coordinate is $\mu = \mu_0\left(1-\frac{x}{d}\right)$ for $0 \le x \le d\left(1-\frac{1}{\mu_0}\right)$ and $\mu = \mu_0$ for x < 0, where d is a positive constant. The maximum x-coordinate of the path traced by the ray is



(A) $d(1 - \sin\theta)$ (B) $d(1 - \cos\theta)$ (C) $d \sin\theta$ (D) $d \cos\theta$

3. A sphere of radius R contains a total charge +Q which is uniformly distributed throughout its volume. At a distance 2R from the centre of sphere, a particle having charge +q is fixed. P is a point on surface of sphere and lying on line joining the centre of sphere and point charge. For what value of q will the electric field at P be zero.



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

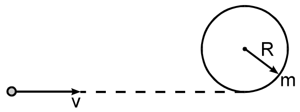
4. A particle 'A' of mass m collides head on with another stationary particle 'B' of the same mass 'm'.The kinetic energy lost by the colliding particle 'A' will be maximum if the coefficient of the restituition is

(A) 1 (B) 0 (C) 0.5 (D) none

5. An open elevator is ascending with zero acceleration and speed 10 m/s. A ball is thrown vertically up by a boy when he is at a height 10 m from the ground, the velocity of projection is 30m/s with respect to elevator. Choose correct option, assuming height of the boy very small : ($g = 10\ m/s^2$)

(A) Maximum height attained by the ball from ground is 90 m.
(B) Maximum height attained by the ball with respect to lift from the point of projection is 45 m.
(C) Time taken by the ball to meet the elevator again is 6 sec
(D) The speed of the ball when it comes back to the boy is 20 m/s with respect to ground.

6. A circular ring of mass m and radius R rests flat on a frictionless surface. A bullet also of mass m and moving with a velocity v, strikes the ring and gets embedded in it. The thickness of the ring is much smaller than R. Find the angular velocity with which the system rotates after the bullet strikes the ring.



COMPREHENSION

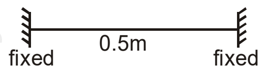
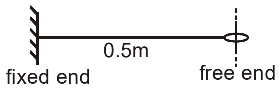
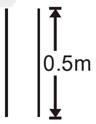
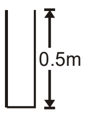
One end of massless inextensible string of length ℓ is fixed and other end is tied to a small ball of mass m. The ball is performing a circular motion in vertical plane. At the lowest position, speed of ball is $\sqrt{20g\ell}$. Neglect any other forces on the ball except tension and gravitational force. Acceleration due to gravity is g.

7. Motion of ball is in nature of
(A) circular motion with constant speed
(B) circular motion with variable speed
(C) circular motion with constant angular acceleration about centre of the circle.
(D) none of these

8. At the highest position of ball, tangential acceleration of ball is -
(A) 0 (B) g (C) 5 g (D) 16 g

9. During circular motion, minimum value of tension in the string -
(A) zero (B) mg (C) 10 mg (D) 15 mg

10. In each of the four situations of column -I , a stretched string or an organ pipe is given along with the required data. In case of strings the tension in string is T = 102.4 N and the mass per unit length of string is 1 g/m. Speed of sound in air is 320 m/s. Neglect end corrections. The frequencies of resonance are given in column -II. Match each situation in column-I with the possible resonance frequencies given in Column -II.

Column-I		Column-II
(A) String fixed at both ends		(p) 320 Hz
(B) String fixed at one end and free at other end		(q) 480 Hz
(C) Open organ pipe		(r) 640 Hz
(D) Closed organ pipe		(s) 800 Hz

PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 28

Total Marks : 39

Max. Time : 43 min.

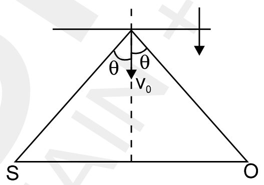
Topics : Geometrical Optics, Sound wave, Kinetic Theory of Gases, Rectilinear Motion, Projectile Motion, Electrostatics, Rigid Body Dynamics, Work, Power and Energy

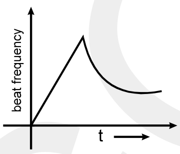
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3 to Q.4	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.5 to Q.6	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1'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

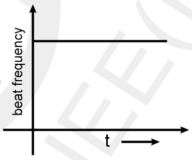
1. Two point objects are placed on principal axis of a thin converging lens. One is 20 cm from the lens and other is on the other side of lens at a distance of 40 cm from the lens. The images of both objects coincide. The magnitude of focal length of lens is

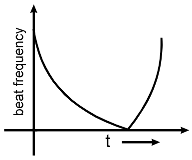
(A) $\frac{80}{3}$ cm (B) $\frac{40}{3}$ cm (C) 40 cm (D) $\frac{20}{3}$ cm

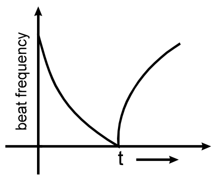
2. A stationary source 's' is producing sound of frequency ' f ' and an observer 'o' is at rest at some distance from source. A reflector is moving with constant speed ' v ' along perpendicular bisector of line joining source and observer. The variation of beat frequency registered by observer will be: [Reflector is moving from $-\infty$ to $+\infty$ along perpendicular bisector]



(A)


(B)


(C)


(D)


3. During an experiment, an ideal gas is found to obey a condition $\frac{P^2}{\rho}$ = constant [ρ = density of the gas]. The gas is initially at temperature T, pressure P and density ρ. The gas expands such that density changes to $\frac{\rho}{2}$

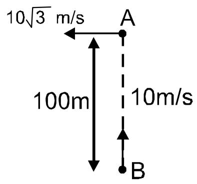
(A) The pressure of the gas changes to $\sqrt{2}$ P.

(B) The temperature of the gas changes to $\sqrt{2}$ T.

(C) The graph of the above process on the P-T diagram is parabola.

(D) The graph of the above process on the P-T diagram is hyperbola.

4. Consider two cars moving perpendicular to each other as shown. Initially distance between them is 100 m. Velocity of A is $10\sqrt{3}$ m/s and velocity of B is 10 m/s. Then:



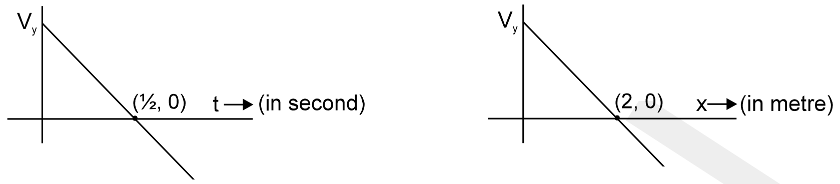
(A) magnitude of velocity of A w.r.t. B is 20 m/s

(B) minimum distance between them is 50 m

(C) minimum distance between them is $50\sqrt{3}$ m

(D) at t = 2 sec. they will be nearest to each other

5. Two graphs of the same projectile motion (in the xy plane) projected from origin are shown. X axis is along horizontal direction & Y axis is vertically upwards. Take $g = 10\ m/s^2$.

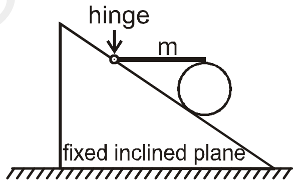


Find (i) Y component of initial velocity and (ii) X component of initial velocity

6. Electric dipole of moment $\vec{P} = p\hat{i}$ is kept at a point (x,y) in an electric field $\vec{E} = 4xy^2\,\hat{i} + 4x^2y\,\hat{j}$. Find the magnitude of force acting on the dipole.

COMPREHENSION

A horizontal uniform rod of mass 'm' has its left end hinged to the fixed incline plane, while its right end rests on the top of a uniform cylinder of mass 'm' which in turn is at rest on the fixed inclined plane as shown. The coefficient of friction between the cylinder and rod, and between the cylinder and inclined plane, is sufficient to keep the cylinder at rest.



7. The magnitude of normal reaction exerted by the rod on the cylinder is

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

8. The ratio of magnitude of frictional force on the cylinder due to the rod and the magnitude of frictional force on the cylinder due to the inclined plane is:

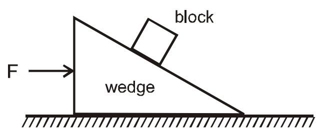
(A) 1 : 1 (B) $2 : \sqrt{3}$ (C) 2 : 1 (D) $\sqrt{2} : 1$

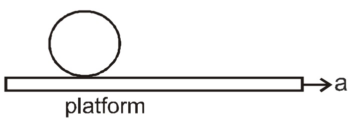
9. The magnitude of normal reaction exerted by the inclined plane on the cylinder is:

(A) mg (B) $\frac{3mg}{2}$ (C) 2mg (D) $\frac{5mg}{4}$

10. Match the statements in Column I with the results in Column II and indicate your answer by darkening appropriate bubbles in the 4 × 4 matrix given in the OMR.

	Column – I		Column – II
(A)	Work done by ideal gas during free expansion	(p)	zero
(B)	A wedge block system is as shown in the fig. The wedge lying on horizontal surface is accelerated to right by a horizontal force F. All surfaces are smooth. Work done by normal reaction exerted by wedge on block in any time interval is	(q)	non zero
(C)	Two identical conducting spheres of radius 'a' are separated by a distance 'b' (b>>a). Both spheres carry equal and opposite charge. Net electrostatic potential energy of system of both spheres is	(r)	negative
(D)	A uniform cylinder lies over a rough horizontal platform. The platform is accelerated horizontally as shown with acceleration a. The cylinder does not slip over the platform.The work done by the force of friction on the cylinder w.r.t ground in any time interval is	(s)	positive





PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 29

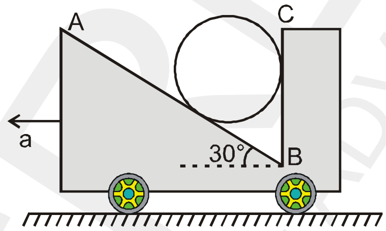
Total Marks : 25

Max. Time : 25 min.

Topics : Newton's Law of Motion, Center of Mass, Geometrical Optics, Surface Tension, Electrostatics

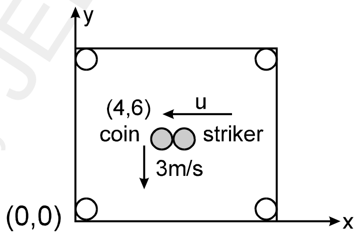
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Multiple choice objective ('–1' negative marking) Q.5	(4 marks, 4 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

1. A cylinder rests in a supporting carriage as shown. The side AB of carriage makes an angle 30° with the horizontal and side BC is vertical. The carriage lies on a fixed horizontal surface and is being pulled towards left with an horizontal acceleration '*a*'. The magnitude of normal reactions exerted by sides AB and BC of carriage on the cylinder be N_{AB} and N_{BC} respectively. Neglect friction everywhere. Then as the magnitude of acceleration '*a*' of the carriage is increased, pick up the correct statement:



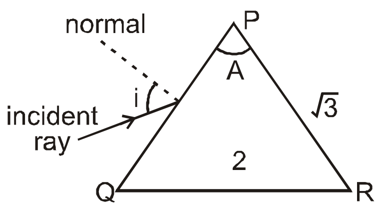
(A) N_{AB} increases and N_{BC} decreases.
(B) Both N_{AB} and N_{BC} increase.
(C) N_{AB} remains constant and N_{BC} increases.
(D) N_{AB} increases and N_{BC} remains constant.

2. On a smooth carom board, a coin moving in negative y–direction with a speed of 3 m/s is being hit at the point (4, 6) by a striker moving along negative x-axis. The line joining centres of the coin and the striker just before the collision is parallel to x-axis. After collision the coin goes into the hole located at the origin. Masses of the striker and the coin are equal. Considering the collision to be elastic, the initial and final speeds of the striker in m/s will be:



(A) (1.2, 0)
(B) (2, 0)
(C) (3, 0)
(D) none of these

3. A prism of angle A and refractive index 2 is surrounded by medium of refractive index $\sqrt{3}$. A ray is incident on side PQ at an angle of incidence i ($0 \le i \le 90°$) as shown. The refracted ray is then incident on side PR of prism. The minimum angle A of prism for which ray incident on side PQ does not emerge out of prism from side PR (for any value of i) is



(A) 30°
(B) 45°
(C) 60°
(D) 120°

4. Assuming the xylem tissues through which water rises from root to the branches in a tree to be of uniform cross-section find the maximum radius of xylum tube in a 10 m high coconut tree so that water can rise to the top. (surface tension of water = 0.1N/m, Angle of contact of water with xylem tube= 60°)
(A) 1 cm (B) 1 mm (C) 10 μm (D) 1 μm

5. A particle is attached to an end of a rigid rod. The other end of the rod is hinged and the rod rotates always remaining horizontal without in contact with any thing else. It's angular speed is increasing at constant rate. The mass of the particle is 'm'. The force exerted by the rod on the particle is $\vec{F}$, then :
(A) $F \geq mg$
(B) F is constant
(C) The angle between $\vec{F}$ and horizontal plane decreases.
(D) The angle between $\vec{F}$ and the rod decreases.

COMPREHENSION

An uncharged ball of radius R is placed at a point in space and the region out side (from R to ∞ measured from centre of the ball) the ball is non uniformly charged with a charge density $\rho = \frac{C}{r^3}$ coul/m^3 where 'C' is a positive constant and r is the distance of a point measured from centre of the ball.

6. Electric potential at the centre of the ball is :
(A) Directly proportional to R (B) Directly proportional to R^2
(C) Inversely proportional to R (D) Inversely proportional to R^2

7. Electric field intensity at a distance x from centre of the ball (x > R) is :
(A) $\frac{C}{\epsilon_0 R^2} \ell n \frac{x}{R}$ (B) $\frac{C}{2 \epsilon_0 R^2} \ell n \left(\frac{x-R}{R}\right)$ (C) $\frac{C}{2 \epsilon_0 R^2} (R^2 - x^2)$ (D) $\frac{C}{\epsilon_0 x^2} \ell n \frac{x}{R}$

8. As we move away from ball's surface, electric potential :
(A) decreases. (B) increases.
(C) decreases then increases. (D) increases then decreases.

PHYSICS DPP

DAILY PRACTICE PROBLEMS

DPP No. 30

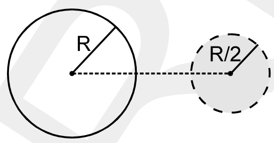
Total Marks : 27

Max. Time : 29 min.

Topics : Electrostatics, Calorimetry & Thermal Expansion, Rectilinear Motion, Fluid, Center of Mass, String Wave

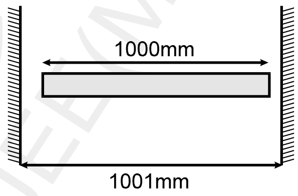
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.4 to Q.5	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative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

1. A ring of radius R having a linear charge density λ moves towards a solid imaginary sphere of radius $\frac{R}{2}$, so that the centre of ring passes through the centre of sphere. The axis of the ring is perpendicular to the line joining the centres of the ring and the sphere. The maximum flux through the sphere in this process is :



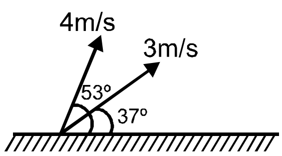
(A) $\frac{\lambda R}{\epsilon_0}$ (B) $\frac{\lambda R}{2\epsilon_0}$ (C) $\frac{\lambda \pi R}{4\epsilon_0}$ (D) $\frac{\lambda \pi R}{3\epsilon_0}$

2. A rod of length 1000 mm and co-efficient of linear expansion $\alpha = 10^{-4}$ per degree is placed symmetrically between fixed walls separated by 1001 mm. The Young's modulus of the rod is 10^{11} N/m^2. If the temperature is increased by 20 ºC, then the stress developed in the rod is (in N/m^2):



(A) 10 (B) 10^8
(C) 2×10^8 (D) cannot be calculated

3. Two particles are projected under gravity with speed 4m/s and 3m/s simultaneously from same point and at angles 53º and 37º with the horizontal surface respectively as shown in figure. Then :



(A) Their relative velocity is along vertical direction.
(B) Their relative acceleration is non-zero and it is along vertical direction.
(C) They will hit the surface simultaneously
(D) Their relative velocity (for time interval 0 < t < 0.36s) is constant and has magnitude 1.4 m/s.

DPP 21 TO 30 (ANSWER KEY)

DPP NO. - 21

1. (C) **2.** (B) **3.** (B) **4.** (A), (B), (C)
5. (A), (C) **6.** (B), (D) **7.** (A) **8.** (B)
9. (A) **10.** (A) p (B) q,s (C) p (D) q,s

DPP NO. - 22

1. (C) **2.** (A) **3.** (C) **4.** (D)
5. (C) **6.** (A) **7.** (C) **8.** (A), (B), (D)
9. (A), (B), (D) **10.** (A), (C)

DPP NO. - 23

1. (A) **2.** (C) **3.** (D) **4.** (C)
5. (A) **6.** **(a)** $V_P = \frac{5}{4}$ V **(b)** $\omega = \frac{V_P}{R} = \frac{5V}{4R}$
7. (A) **8.** (B) **9.** (C)
10. (A) p (B) q (C) p,r (D) q,s

DPP NO. - 24

1. (B) **2.** (A) **3.** (D) **4.** (B)
5. (A) **6.** (C) **7.** (A,C) **8.** 8
9. 300 gm
10. **(A)** – p,r,t, ; **(B)** – q, s ; **(C)** – p,s,t ; (D) – p,s,t

DPP NO. - 25

1. (B) **2.** (A) **3.** (B) **4.** (B)
5. (B) **6.** (B,C,D) **7.** $V = \frac{16\sqrt{7}}{3} m/s$
8. (B) **9.** (D) **10.** (C)

DPP NO. - 26

1. (B) **2.** (B) **3.** (D) **4.** (A)
5. (C) **6.** (D) **7.** (A, B, C, D)
8. (B) **9.** (B) **10.** (C)

DPP NO. - 27

1. (C) **2.** (B) **3.** (B) **4.** (A)
5. (A, B, C, D) **6.** $\omega = v/3R$
7. (B) **8.** (A) **9.** (D)
10. (A) p,r (B) q,s (C) p,r (D) q,s

DPP NO. - 28

1. (A) **2.** (D) **3.** (B, D) **4.** (A, C)
5. (i) $u_y = 5$ m/s (ii) $u_x = 4$ m/s
6. 4 py $(y^2 + 4x^2)^{1/2}$ **7.** (C) **8.** (A)
9. (B) **10.** (A) p (B) q,s (C) q,s (D) q,s

DPP NO. - 29

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

DPP NO. - 30

1. (D) **2.** (B) **3.** (A), (D) **4.** 0.3 m
5. (a) 4.5 m/s (b) 1.5 m/s (c) 3.75 cm
6. (B) **7.** (C) **8.** (D)

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CLASS : XII (PHYSICS)

DPP

DAILY PRACTICE PROBLEM

Solutions

DPP-21 to 30

DPP NO. - 21

1. Let h = height to of water column

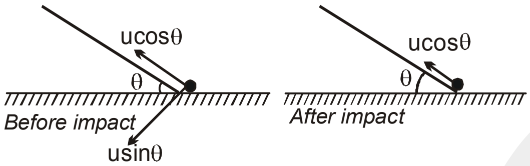
then $\rho_w gh + \rho_{Hg} g(10-h) = \rho_{Cu}\, g10$

$\Rightarrow$ h + 13.6 (10 – h) = 73

$\Rightarrow$ 63 = 12.6 h $\Rightarrow$ h = 5 cm

2. Higher is the temperature greater is the most probable velocity.

3. Just before the particle transfers to inclined surface, we resolve its velocity along and normal to the plane.



For the trajectory of the particle to sharply change from the horizontal line to the inclined line, the impact of the particle with inclined plane should reduce the usinθ component of velocity to zero. Hence the particle moves up the incline with speed u cosθ.

Hence as θ increases, the height to which the particle rises shall decrease.

4. **[Moderate]** δ = i + e – A (for minimum derivation i = e)

$\therefore$ minimum deviation = 2i – A

60 = 2 × 60 – A $\Rightarrow \because$ A = 60°

$$n = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{60+60}{2}\right)}{\sin\left(\frac{60}{2}\right)} = \sqrt{3}$$

$\delta_1 = i_1 + e - A$

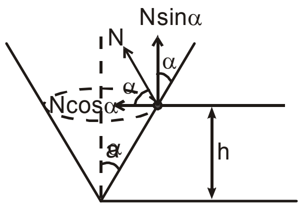
65° = i_1 + 70° – 60° or i_1 = 55°

the δ versus i curve is not parabolic

5. As N sin α = mg

N cos α = mω^2 r

$\tan\alpha = \frac{g}{\omega^2 r}$ $\qquad \therefore T^2 \propto \tan\alpha$



$\therefore$ when α increases T also increases

Also $T^2 \propto r \tan\alpha$

but r = h tan α

$\therefore T^2 \propto h \tan^2\alpha$

for constant α

$T^2 \propto h$

Thus when h increases T also increases

9. $\because$ Electric field near point b is $-\infty$

$\therefore$ 'b' should be negative electric field at x_1 is O which possible only if 'a' and 'b' are of opposite sign.

$\therefore$ 'a' is positive

Charge b is negative and charge a is positive

E at A = 0

$$\Rightarrow \frac{|Q_a|}{(\ell+x_1)^2} = \frac{|Q_b|}{(x_1)^2}$$

$$\therefore \left|\frac{Q_a}{Q_b}\right| = \left(\frac{\ell+x_1}{x_1}\right)^2 = \left(1+\frac{\ell}{x_1}\right)^2$$

E at a general X

$$\frac{K|Q_a|}{(\ell+x^2)} - \frac{K|Q_b|}{(x^2)}$$

$$= K|Q_a|\left\{\frac{1}{(\ell+x)^2} - \left|\frac{Q_b}{Q_a}\right|\frac{1}{x^2}\right\}$$

If E is a maximum , $\frac{dE}{dx} = 0$

$$\Rightarrow \frac{-2}{(\ell+x\ )^3} + \left(\frac{x_1}{\ell+x_1}\right)^2 \frac{2}{x^3} = 0$$

$$(\ell+x)^3 = x^3\left(\frac{\ell+x_1}{x_1}\right)^2 ; \qquad \ell+x = x\left(\frac{\ell+x_1}{x_1}\right)^{\frac{2}{3}}$$

$$\therefore \quad x_2 = \frac{\ell}{\left(\frac{\ell + x_1}{x_1}\right)^{\frac{2}{3}} - 1}$$

Ans: $x_2 = \frac{\ell}{\left(\frac{\ell + x_1}{x_1}\right)^{\frac{2}{3}} - 1}$, $\left|\frac{Q_a}{Q_b}\right| = \left(1 + \frac{\ell}{x_1}\right)^2$,

Charge b is negative and charge a is positive

10. (A) p (B) q,s (C) p (D) q,s
(A) Speed of point P changes with time
(B) Acceleration of point P is equal to $\omega^2 x$ (ω = angular speed of disc and x = OP). The acceleration is directed from P towards O.
(C) The angle between acceleration of P (constant in magnitude) and velocity of P changes with time. Therefore, tangential acceleration of P changes with time.
(D) The acceleration of lowest point is directed towards centre of disc and remains constant with time

DPP NO. - 22

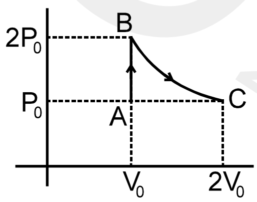
1. $Q_{AB} = \Delta U_{AB} + W_{AB}$

$W_{AB} = 0$

$\Delta U_{AB} = \frac{f}{2} nR\Delta T$

$\Rightarrow \frac{f}{2}(\Delta PV)$

$\Delta U_{AB} = \frac{5}{2}(\Delta PV)$



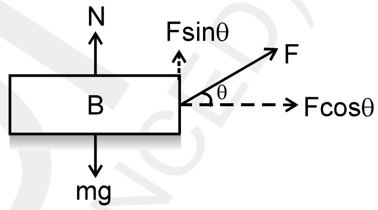
$Q_{AB} = 2.5\, P_0 V_0$
Process BC
$Q_{BC} = \Delta U_{BC} + W_{BC}$
$Q_{BC} = 0 + 2P_0 V_0\, \ell n 2$
$= 1.4\, P_0 V_0$
$Q_{net} = Q_{AB} + Q_{BC} = 3.9\, P_0 V_0$

2. $V = V_1 + V_2 + V_3$

$= \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{R} + \frac{1}{4\pi\varepsilon_0}\left(\frac{-2Q}{R}\right) + \frac{1}{4\pi\varepsilon_0}\left(\frac{3Q}{R}\right)$

$= \frac{1}{4\pi\varepsilon_0} \cdot \left(\frac{2Q}{R}\right)$

3. Let the body is acted upon by a force at an angle θ with horizontal.
FBD :



$F\cos\theta = \mu(mg - F\sin\theta)$

$\Rightarrow F = \frac{\mu mg}{\cos\theta + \mu\sin\theta}$. For min. force ;

$(\cos\theta + \mu\sin\theta)$ should be max.
$\Rightarrow -\sin\theta + \mu\cos\theta = 0$
$\Rightarrow \tan\theta = \mu$. or $\theta = \tan^{-1}(1/\sqrt{3}) = 30°$ Substituting ; F_{min} = **12.5 kg f**

4. Change in momentum = Impulse

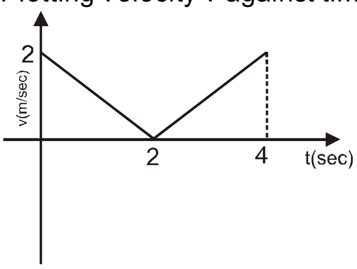
$\Delta\vec{P} = J_x\hat{i} + J_y\hat{j} + J_z\hat{k}$

$= 30(0.1)\hat{i} + \frac{1}{2}(80)(0.1)\hat{j} + (-50) \times (0.1)\hat{k}$

$= 3\hat{i} + 4\hat{j} - 5\hat{k}$

$|\Delta\vec{P}| = 5\sqrt{2}\ \text{kg}\frac{\text{m}}{\text{sec.}}$

6. Plotting velocity v against time t, we get



Area under the v–t curve gives distance.

Distance = $\frac{1}{2} \times 2 \times 2 + \frac{1}{2} \times 2 \times 2 = 4\text{m}$

7. (C) $v \propto \sqrt{T}$; and as there is no change in length

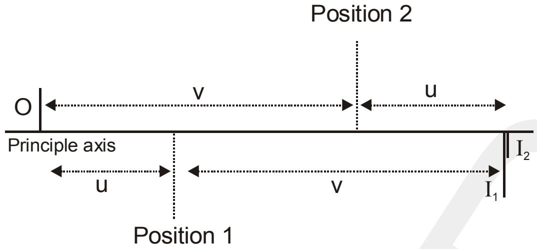
$\Rightarrow \lambda \propto \frac{1}{\sqrt{T}}$

$\frac{\lambda'}{\lambda} = \frac{\sqrt{T}}{\sqrt{T'}}$

$\Rightarrow \sqrt{T'} = \frac{\lambda}{\lambda'}\sqrt{T}$

$\Rightarrow$ T' = $(2)^2$ T = 4T.
Hence (C).

8.



For first & second position $\frac{v}{u} = \frac{I_1}{O}$, $\frac{u}{v} = \frac{I_2}{O}$

$\Rightarrow \frac{v^2}{u^2} = \frac{I_1}{I_2}$ = 4.84

$\Rightarrow \frac{v}{u} = 2.2$ and v + u = 96 $\Rightarrow$ v = 66 , u = 30

$\frac{O}{I_2} = \frac{v}{u} = 2.2 = \frac{11}{5}$ $\Rightarrow$ A is True

Distance between two position of lens = v - u
= 36 cm
$\Rightarrow$ B is True

Focal length of lens f = $\frac{uv}{u+v} = \frac{66 \times 30}{66+30}$ = 20.63

$\Rightarrow$ C is False
Distance of lens from shorter image = u = 30 cm
$\Rightarrow$ D is True

9. $\lambda' = \frac{V - V_s}{f} = \frac{332-32}{1000}$ = 0.3 m

$f' = f\frac{(V+V_0)}{V-V_s}$ = 1000 × $\frac{332+64}{332-32}$ = 1320 Hz

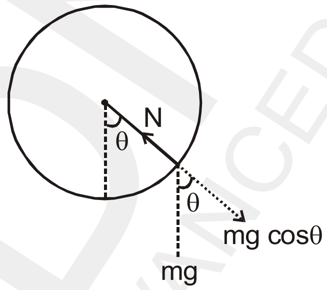
$\lambda'' = \frac{V - V_0}{f'}$ = 0.2 m.

10. By angular momentum conservation ;

$L = I\omega \Rightarrow mv\frac{R}{2} + mvR = 2mR^2\omega$

$\frac{3}{2}mvR = 2mR^2\omega$

$\omega = \frac{3v}{4R}$



Also at the time of contact ;

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

$\therefore N = mg\cos\theta - \frac{mv^2}{R}$

when it ascends θ decreases so cosθ increases and v decreases.

$\therefore$ mgcosθ is increasing and $\frac{mv^2}{R}$ is decreasing

$\therefore$ we can say N increases as wheel ascends.

DPP NO. - 23

1. $\lambda = 2\ell = 3m$
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 $\frac{2\pi}{\lambda} . x = \frac{5\pi}{6}$

$\Rightarrow x_2 = 1.25\ m \Rightarrow x_2 - x_1 = 1m$

2. $\tan\theta = \frac{1}{2}$, $g\cos\theta = a_t$

$$10 \times \frac{20}{\sqrt{10^2+20^2}} = \frac{200}{\sqrt{100+400}} = \frac{20}{\sqrt{5}} \text{ m/s}^2.$$

3. Since time of flight depends only on vertical component of velocity and acceleration . Hence time of flight is

$T = \frac{2u_y}{g}$ where $u_x = \cos\theta$ and $u_y = u \sin\theta$

$\therefore$ In horizontal (x) direction

$d = u_x t + ½ gt^2$

$$= u\cos\theta\left(\frac{2u\sin\theta}{g}\right) + \frac{1}{2}g\left(\frac{2u\sin\theta}{g}\right)^2$$

$$= \frac{2u^2}{g}(\sin\theta\cos\theta + \sin^2\theta)$$

We want to maximise $f(\theta) = \cos\theta \sin\theta + \sin^2\theta$

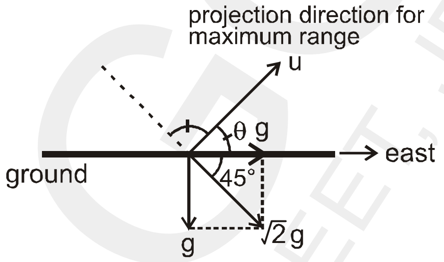
$\Rightarrow f'(\theta) = -\sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta = 0$

$\Rightarrow \cos 2\theta + \sin 2\theta = 0 \qquad \Rightarrow \tan 2\theta = -1$

or $2\theta = \frac{3\pi}{4}$ or $\theta = \frac{3\pi}{8} = 67.5°$

Alternate :

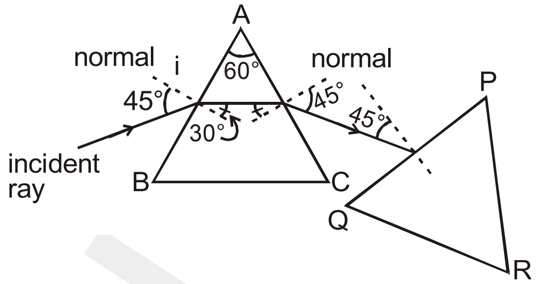
As shown in figure, the net acceleration of projectile makes on angle 45° with horizontal. For maximum range on horizontal plane, the angle of projection should be along angle bisector of horizontal and opposite direction of net acceleration of projectile.



$\therefore \theta = \frac{135°}{2} = 67.5°$

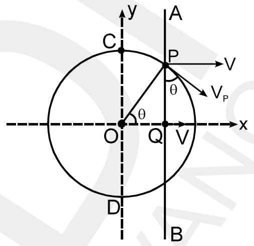
4. Let angle of incidence i for which deviation due to first prism is minimum, then $\sin i = n \sin 30°$ or i = 45°.

The net deviation shall be minimum if deviation due to each prism is minimum. From the ray diagram in figure, it is clear that angle between AC and PQ for net deviation to be minimum is 90°.



5. One can create a mental view of distribution of charge i.e. how much charge is nearer and how much is comparatively farther away.

6.



As a rod AB moves, the point 'P' will always lie on the circle.

$\therefore$ its velocity will be along the circle as shown by 'V_P' in the figure. If the point P has to lie on the rod 'AB' also then it should have component in 'x' direction as 'V'.

$\therefore V_P \sin\theta = V \qquad \Rightarrow V_P = V \operatorname{cosec}\theta$

here $\cos\theta = \frac{x}{R} = \frac{1}{R} \cdot \frac{3R}{5} = \frac{3}{5}$

$\therefore \sin\theta = \frac{4}{5} \qquad \therefore \operatorname{cosec}\theta = \frac{5}{4}$

$\therefore V_P = \frac{5}{4}V$ **...Ans.**

Sol. (b) $\omega = \frac{V_P}{R} = \frac{5V}{4R}$

ALTERNATIVE SOLUTION :

Sol. (a) Let 'P' have coordinate (x, y)

$x = R\cos\theta,\ y = R\sin\theta.$

$$V_x = \frac{dx}{dt} = -R\sin\theta\frac{d\theta}{dt} = V$$

$$\Rightarrow \frac{d\theta}{dt} = \frac{-V}{R\sin\theta} \text{ and}$$

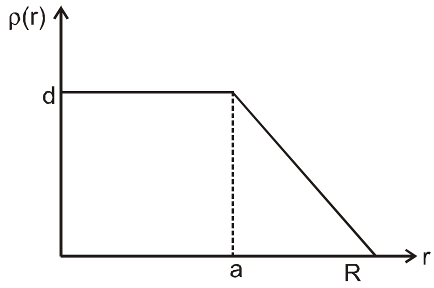
$$V_Y = R\cos\theta\frac{d\theta}{dt} = R\cos\theta\left(-\frac{V}{R\sin\theta}\right) = -V\cot\theta$$

$$\therefore V_P = \sqrt{V_x^2 + V_y^2} = \sqrt{V^2 + V^2\cot^2\theta}$$

$= V\operatorname{cosec}\theta$ **...Ans.**

Sol. (b) $\omega = \frac{V_P}{R} = \frac{5V}{4R}$

7. **(A)** Electric field at r = R



$E = \frac{KQ}{R^2}$

where Q = Total charge within the nucleus = Ze

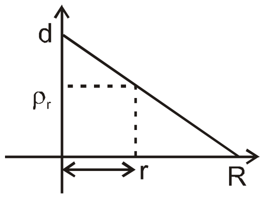
So $E = \frac{KZe}{R^2}$

So electric field is independent of a

8. $Q = \int \rho_r 4\pi r^2 dr$

for a = 0, $\frac{d}{R} = \frac{\rho_r}{R-r}$

$\therefore \quad \rho_r = \frac{d}{R}(R-r)$



or, $Q = \int_0^R \frac{d}{R}(R-r)\, 4\pi r^2\, dr$

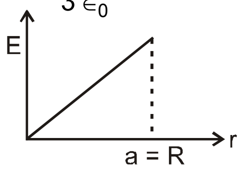
$= \frac{4\pi d}{R}\left[R\int_0^R r^2\, dr - \int_0^R r^3\, dr\right] = \frac{4\pi d}{R}\left[\frac{R^4}{3} - \frac{R^4}{4}\right]$

$= \frac{\pi d R^3}{3}$

$\therefore \quad Q = Ze = \frac{\pi d R^3}{3} \quad$ or $\quad d = \frac{3Ze}{\pi R^3}$

9. From the formula of uniformly (volume) charged solid sphere

$E = \frac{\rho r}{3\epsilon_0}$



For E ∝ r, ρ should be constant throughout the volume of nucleus
This will be possible only when a = R.

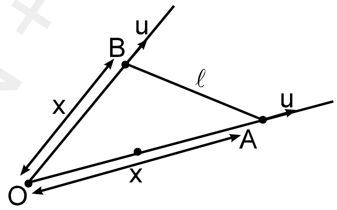
10. (A) p (B) q (C) p,r (D) q,s
(A) If velocity of block A is zero, from conservation of momentum, speed of block B is 2u. Then K.E. of block B = $\frac{1}{2}m(2u)^2 = 2mu^2$ is greater than net mechanical energy of system. Since this is not possible, velocity of A can never be zero.
(B) Since initial velocity of B is zero, it shall be zero for many other instants of time.
(C) Since momentum of system is non-zero, K.E. of system cannot be zero. Also KE of system is minimum at maximum extension of spring.
(D) The potential energy of spring shall be zero whenever it comes to natural length. Also P.E. of spring is maximum at maximum extension of spring.

DPP NO. - 24

1. **(B)** To an observer who starts falling freely under gravity from rest at the instant stones are projected, the motion of stone A and B is seen as

$\frac{dx}{dt} = u \qquad$ ....(1)

$\frac{d\ell}{dt} = u \qquad$ ....(2)



$\therefore \quad x = \ell$ and $\angle BOA = 60°$

2. $f = f_0\left(1 + \frac{V_{ob}}{V_{sound}}\right)$

$\Rightarrow \frac{f}{f_0} = 1 + \frac{V_{ob}}{V_{sound}}$ (straight line) ;

when $\frac{V_{ob}}{V_{sound}} = 0$; $\frac{f}{f_0} = 1$.

and as $\frac{V_{ob}}{V_{sound}} \to 1 \quad \Rightarrow \quad \frac{f}{f_0} \to 2$

3. Distance travelled by

$A = s = 10 \times 2 + \frac{1}{2} \times 10 \times 8 = 60$

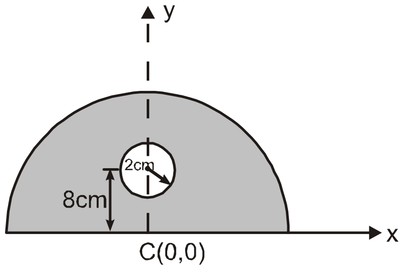
Distance travelled by

$B = s = 10 \times 3 + \frac{1}{2} \times 10 \times 4 = 50$

Average speed of A = $\frac{60}{8} = 7.5$

Average speed of B = $\frac{50}{7} = 7.1$

4. Taking C as origin and x & y–axes as shown in figure.
Due to symmetry about y–axis
$x_{cm} = 0$



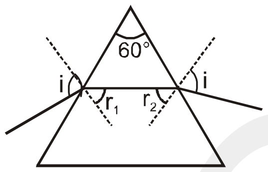
$$y_{cm} = \left(\frac{m_1y_1 - m_2y_2}{m_1 - m_2}\right)$$

$$= \frac{\left(\frac{\pi(6\pi)^2}{2}\right)\left(\frac{4(6\pi)}{3\pi}\right) - [\pi(2)^2(8)]}{\frac{\pi(6\pi)^2}{2} - \pi(2)^2}$$

($m \propto$ Area)

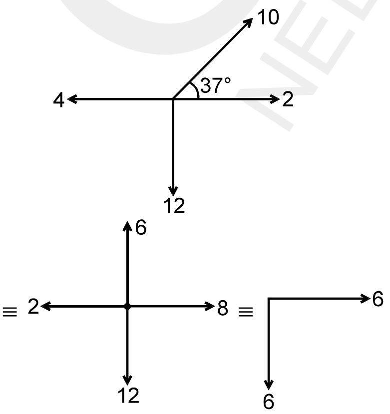
$$= \frac{8(18\pi^2 - 4)}{(18\pi^2 - 4)} = 8 \text{ cm.}$$

5.



The slab does not contribute to deviation.
For minimum deviation by prism,
$r_1 = r_2 = 30°$ as shown in figure.
$\Rightarrow$ sini = $\sqrt{2}$ sin 30° or i = 45°
$\therefore$ Minimum deviation = 2i – A = 90° – 60° = 30°

6. Amplitude phasor diagram :



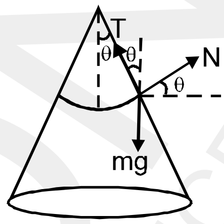
$\therefore$ resultant amplitude = $6\sqrt{2}$.

7. T cos30° + N sin30° = mg

$\Rightarrow \sqrt{3}\,T + N = 2\text{ mg}$ ....(i)

$$T \sin 30° - N \cos 30° = \frac{mv^2}{(\sqrt{3}/2)}$$

$\Rightarrow$ T sin30° – 3N = 4mv² $\sqrt{3}T - 3N$
= 4mv² ....(ii)



by (i),)(ii)

$$\Rightarrow N = \frac{2mg - 4mv^2}{4} \quad ;$$

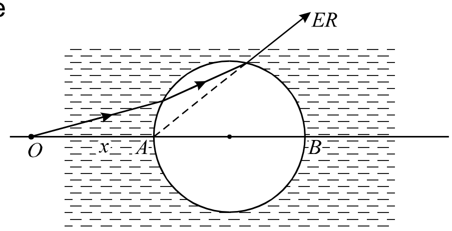
$$T = \frac{6mg - 4mv^2}{4\sqrt{3}}$$

for N > 0

$\Rightarrow v < \sqrt{5}$ m/s

at v = 2 पर $T = \frac{38}{\sqrt{3}}$ N ; N = 2N.

8. 8
For the given case Ray diagram will be as given here



Here say ER will be seen by observer which appear to becoming from point A. To find x, the distance of object from A we reverse the light rays by considering ER as incident ray & find the position of image after two refractions.
For I refraction we use

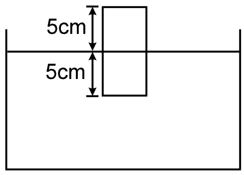
$$\frac{1}{v} - \frac{4/3}{2R} = \frac{1 - 4/3}{-R}$$

$\Rightarrow$ v = – 3R
For II refraction we use

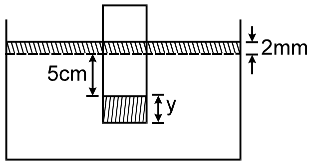
$$\frac{4/3}{x} - \frac{1}{-R} = \frac{4/3 - 1}{R}$$

$\Rightarrow$ x = – 2R
Hence OA = 2× 4 = 8 cm.

9. Let the cube dips further by y cm and water level rises by 2 mm.



Initial situation



Final situation

Then equating the volumes
(/// volume = \\\ volume in figure)
$\Rightarrow$ volume of water raised
= volume of extra depth of wood

$\Rightarrow$ 100 y = (1500 – 100) $\frac{2}{10}$ = 1400 × $\frac{2}{10}$

= 280
$\therefore$ y = 2.8 cm
$\therefore$ Extra upthrust
ρ_{water} × (2.8 + 0.2) × 100 g = mg
$\Rightarrow$ m = 300 gm.
m = 300 gm. ....Ans.

10. A – p,r,t
$\Sigma F = 0$
So, linear momentum conservation and centre of mass will not move.
B – q,s
So, linear momentum will not be conserved and centre of mass will accelerate $W_{ext} = \Delta E$.
C – p,s,t
D – p,s,t

DPP NO. - 25

1. $U = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\frac{\varepsilon_0 K^2 Q^2}{r^4}$

$V = \frac{KQ}{r}$

$$\frac{U}{V^2} = \frac{\frac{1}{2}\varepsilon_0 K^2 \frac{Q^2}{r^4}}{\frac{K^2Q^2}{r^2}} = \frac{1}{2}\frac{\varepsilon_0}{r^2}$$

because $\frac{U}{V^2} \propto \frac{1}{r^2}$

so the correct option is B.

2. The magnitude of the electric field is maximum where the equipotentials are close together. The direction of the field is from high potential to low potential.

4. From given graphs :

$a_x = \frac{3}{4}t$ and $a_y = -\left(\frac{3}{4}t+1\right)$

$\Rightarrow v_x = \frac{3}{8}t^2 + C$

At t = 0 : $v_x = -3$
$\Rightarrow$ C = – 3

$\therefore v_x = \frac{3}{8}t^2 - 3$

$\Rightarrow dx = \left(\frac{3}{8}t^2 - 3\right)dt$ .... (1)

Similarly

$dy = \left(-\frac{3}{8}t^2 - t + 4\right)dt$ .... (2)

As $dw = \vec{F}.\vec{ds} = \vec{F}.(dx\,\hat{i} + dy\,\hat{j})$

$\therefore \int_0^W dw = \int_0^4 \left[\frac{3}{4}t\hat{i} - \left(\frac{3}{4}t+1\right)\hat{j}\right].\left[\left(\frac{3}{8}t^2-3\right)\hat{i}+\left(-\frac{3}{8}t^2-t+4\right)\hat{j}\right]dt$

$\therefore$ **W = 10 J**

Alternate Solution :

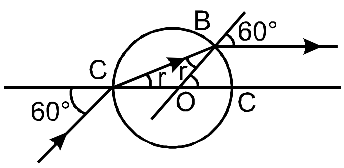
Area of the graph ;

$\int a_x\,dt = 6 = V_{(x)f} - (-3) \Rightarrow V_{(x)f} = 3.$

and $\int a_y\,dt = -10 = V_{(y)f} - (4) \Rightarrow V_{(y)f}$ = – 6.

Now work done = ΔKE = 10 J

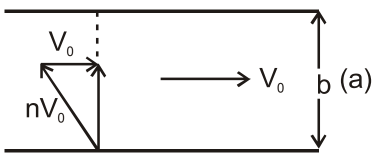
5.

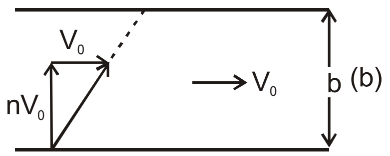


In diagram angle of emergence = 60°
$\therefore$ $\angle$BOC = 60°
$\therefore$ r + r = 60°
$\Rightarrow$ r = 30°

$\therefore \mu = \frac{\sin 60°}{\sin 30°} \Rightarrow \mu = \sqrt{3}$

6.





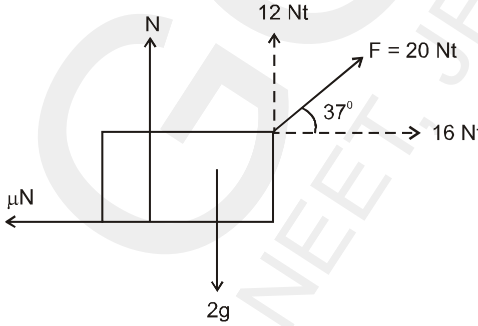
If V_0 be the flow velocity of the river, then velocity of boat relative to water = nV_0.
If the boat has to adopt the shortest path, then direction of velocity of boat relative to water should make an angle greater than 90° with the flow direction of river

Resultant velocity of boat = $\sqrt{(nV_0)^2 - V_0^2}$. This velocity can have a real value only when n > 1. If n = 1, then resultant velocity = 0. So the boat will follow the shortest path only when n > 1. So options (b) and (c) are correct.
If boat is moved normal to flow direction, then it will cross the river in a time $\frac{b}{nV_0}$, where b is the width of the river. If $n \neq 0$, the boat will cross the river. So option (d) is also correct.

7. $\mu N = 2$, $N = 8$, $a = \frac{16-2}{2} = 7$ $(\rightarrow)$

$v^2 = 2(7)8 \rightarrow$ ....(i)
when the direction of horizontal component of the force F is reversed
$a_1 = 9$ m/s² $(\leftarrow)$
and distance covered by the block before it stops

$= s_1 = \frac{16 \times 7}{2 \times 9}$



Again $s_2 = 8 + s_1 = 8 + \frac{16 \times 7}{2 \times 9}$

and $a_2 = 7$ $(\leftarrow)$

$v^2 = 0 + 2(a_2)(s_2) = 2(7)\left(8 + \frac{16 \times 7}{2 \times 9}\right)$

$\Rightarrow v = \frac{16\sqrt{7}}{3}$ m/s

8. Using equation of continuity $A_1v_1 = A_2v_2$
$(12\ cm^2)v_A = (6\ cm^2)(8.0\ m/s)$
$v_A = 4.0$ m/s

9. Applying Bernoulli's principle between point A and C that are at same horizontal level

$$\frac{1}{2}\rho.V_A{}^2 + p_A = \frac{1}{2}\rho.V_C{}^2 + p_{atm}$$

$\Rightarrow p_A = (1.01 \times 10^5\ N/m^2) + \frac{1}{2} \times 13{,}600\ (8^2 - 4^2)$

$= 4.27 \times 10^5\ N/m^2$

10. By applying Bernoulli's equation between point B and C and using equation of continuity
$v_B = 8.57$ m/s
and $p_B = 3.70 \times 10^4$ Pascal
$\rho gh = 3.70 \times 10^4$

$h = \frac{3.70 \times 10^4}{10 \times 13{,}600} = 272$ mm

DPP NO. - 26

1. V = KT + C

$P = \frac{nRT}{V}$

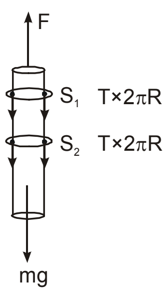
$\Rightarrow P = \frac{nRT}{KT + C} \Rightarrow \frac{dP}{dT} = \frac{nRC}{(KT+C)^2}$

As C < 0 by diagram

$\Rightarrow \frac{dP}{dT} < 0$ for all T

$\Rightarrow$ P continuously decreases.

2. The free body diagram of the capillary tube is as shown in the figure. Net force F required to hold tube is
F = force due to surface tension at cross-section $(S_1 + S_2)$ + weight of tube.



Free body daigram
of capillary tube

$= (2\pi RT + 2\pi RT) + mg = 4\pi RT + mg$
$= 4\pi \times 2 \times 10^{-3} \times 0.1 + \pi \times 10^{-3} \times 10 = 10.8\ \pi mN$

3. From conservation of energy

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

$$mgh = \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{2}{5}mr^2\right)\omega^2$$

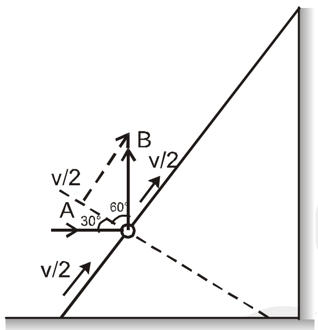
$$gh = \frac{7}{10}(\omega^2 r^2) \qquad \because = wr$$

$$\frac{10gh}{7} = \omega^2 r^2$$

$$KE = \frac{1}{2}\left(\frac{2}{5}mr^2\right)\omega^2 = \frac{2mgh}{7}$$

4. Let 'v' be the initial velocity. Tangential velocity remains same during collision and equal to v cos60° = v/2
Let v′ be the normal component of velocity after impact.

$$\text{In } \Delta\, OAB : \tan 60° = \frac{v/2}{v'} \Rightarrow v' = \frac{v}{2\sqrt{3}}$$



$$\text{Then}: \quad e = \frac{v'}{v\cos 30°} = \frac{(v/2\sqrt{3})}{(\sqrt{3}v/2)} = \frac{1}{3}$$

6. As no. of beats = $\Delta\upsilon$
For option (A) : The frequencies are :
υ_1 = 550 Hz, υ_2 = 552 Hz, υ_3 = 553 Hz, υ_4 = 560 Hz.
The beats produced will be :
$\Delta\upsilon_1 = \upsilon_2 - \upsilon_1 = 2$,
$\Delta\upsilon_2 = \upsilon_3 - \upsilon_1 = 3$,
$\Delta\upsilon_3 = \upsilon_4 - \upsilon_1 = 10$,
$\Delta\upsilon_4 = \upsilon_3 - \upsilon_2 = 1$
$\Delta\upsilon_5 = \upsilon_4 - \upsilon_2 = 8$,
$\Delta\upsilon_6 = \upsilon_4 - \upsilon_3 = 7$
Which doesnot matches with the given set of beat frequencies. Hence (A) is not possible.
Similarly (B) and (C) are also not possible.
For option (D); frequencies were;
$\upsilon_1 = 550$, $\upsilon_2 = 551$, $\upsilon_3 = 553$, $\upsilon_4 = 558$
$\Delta\upsilon_1 = \upsilon_2 - \upsilon_1 = 1$,
$\Delta\upsilon_2 = \upsilon_3 - \upsilon_1 = 3$,
$\Delta\upsilon_3 = \upsilon_4 - \upsilon_1 = 8$,
$\Delta\upsilon_4 = \upsilon_3 - \upsilon_2 = 2$
$\Delta\upsilon_5 = \upsilon_4 - \upsilon_2 = 7$,
$\Delta\upsilon_6 = \upsilon_4 - \upsilon_3 = 5$
which matches with the given set of beat frequencies.
Hence (D).

7. Work done by kinetic friction may be positive when it acts along motion of the body.
Friction on rigid body rolling on inclined plane is along upward because tendency of slipping is downwards.

Sol. 8 to 10
The time taken to reach maximum height and maximum height are

$$t = \frac{u\sin\theta}{g} \quad \text{and } H = \frac{u^2\sin^2\theta}{2g}$$

For remaining half, the time of flight is

$$t' = \sqrt{\frac{2H}{(2g)}} = \sqrt{\frac{u^2\sin^2\theta}{2g^2}} = \frac{t}{\sqrt{2}}$$

$$\therefore \text{ Total time of flight is } t + t' = t\left(1+\frac{1}{\sqrt{2}}\right)$$

$$T = \frac{u\sin\theta}{g}\left(1+\frac{1}{\sqrt{2}}\right)$$

Also horizontal range is = u cosθ × T

$$= \frac{u^2\sin 2\theta}{2g}\left(1+\frac{1}{\sqrt{2}}\right)$$

Let u_y and v_y be initial and final vertical components of velocity.

$\therefore \quad u_y^2 = 2gH \quad$ and $v_y^2 = 4gH$

$\therefore \quad v_y = \sqrt{2}u_y$

Angle (ϕ) final velocity makes with horizontal is

$$\tan\phi = \frac{v_y}{u_x} = \sqrt{2}\frac{u_y}{u_x} = \sqrt{2}\tan\theta$$

DPP NO. - 27

1. If M_0 is molecular mass of the gas then for initial

condition $PV = \frac{M}{M_0} . RT \qquad ...(1)$

After 2M mass has been added

$$P' . \frac{V}{3} = \frac{3M}{M_0} . R . \frac{T}{3} \qquad ...(2)$$

By dividing (2) by (1)
P′ = 3P

2. Snell's law = $\mu_0 \sin(90° - \theta) = \mu_0\left(1-\frac{x}{d}\right)\sin 90°$

$\Rightarrow \left(1-\frac{x}{d}\right) = \cos\theta$

$\Rightarrow x = d(1 - \cos\theta)$

3. The electric field at P shall be zero if q = Q.

4. All energy is transfered to other particles.

5. (A) Absolute velocity of ball = 40 m/s (upwards)

$h_{max} = h_i = f_f$

$= 10 + \frac{(40)^2}{2\times 10}$

h = 90 m

(B) Maximum height from left = $\frac{(30)^2}{2\times 10}$ = 45 m

(C) The ball unless meet the elevator again when displacement of ball = displacement of lift

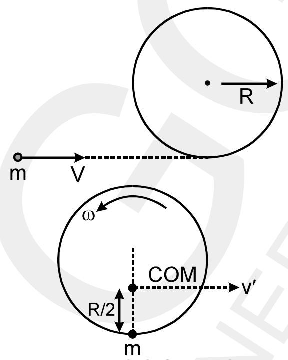
$40t - \frac{1}{2}\times 10\times t^2 = 10\times t \Rightarrow t = 6s.$

(D) Let t_0 be the total time taken by the ball to reach the ground then $-10 = 40\times to - \frac{1}{2}\times 10\times to^2$

$\Rightarrow t_0 = 8.24$ s.

$\therefore$ time taken by the ball for each the ground after crossing the elevator = $t_0 - t = 2.24$ s.

6.



Let velocity of COM after collision is v′ & angular velocity is ω.

conserving linear momentum

$mv = 2mv' \Rightarrow v' = \frac{v}{2}$ ....(1)

conserving angular momentum about COM

$mv.\frac{R}{2} = I.\omega$

$= (I_{Ring\ COM} + I_{mass})$

$\omega = \left[\left(MR^2 + \frac{MR^2}{4}\right) + \frac{MR^2}{2}\right]\omega$

$= \left(MR^2 + \frac{MR^2}{4}\right)\omega = mv.\frac{R}{2} = \frac{3}{2}MR^2\omega$

$\omega = \frac{v}{3R}$

7. As speed of ball is variable, so motion is non uniform circular motion.

8. At the highest position of ball, net tangential force is zero, hence tangential acceleration of ball is zero,

9. Tension in the string is minimum when ball is at the highest position. By conservation of energy

$\frac{1}{2}mv^2 + mg(2\ell) = \frac{1}{2}m(20g\ell)$

$v^2 = 16g\ell$ where v is the velocity of ball at the highest point.

So $T + mg = \frac{mv^2}{\ell}$

$T = \frac{m16g\ell}{\ell} - mg = 15\,mg$

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

(A) The fundamental frequency in the string,

$f_0 = \frac{\sqrt{T/\mu}}{2\ell} = \sqrt{\frac{102.4}{1\times 10^{-3}}}\times\frac{1}{2\times 0.5}$ Hz = 320 Hz.

Other possible resonance frequencies are f_A and f_0 = 320 Hz, 640 Hz, 960 Hz.

(B) The fundamental frequency in the string.

$f_0 = \frac{\sqrt{T/\mu}}{4\ell} = \frac{320}{4\times 0.5}$ = 160 Hz.

Other possible resonance frequencies are f_B = 160 Hz, 480 Hz, 800 Hz.

(C) The fundamental frequency in both ends open organ pipe is

$f_0 = \frac{v}{2\ell} = \frac{320}{2\times 0.5}$ = 320 Hz.

Other possible resonance frequencies are f_c = 320 Hz, 640 Hz, 960 Hz

(D) The fundamental frequency in one end open organ pipe is

$f_0 = \frac{v}{4\ell} = \frac{320}{4\times 0.5}$ = 160 Hz.

Other possible resonance frequencies are f_D = 160 Hz, 480 Hz, 800 Hz.

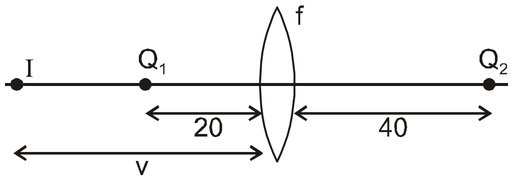
DPP NO. - 28

1. for object O_1O_1

$$\frac{1}{v}+\frac{1}{20}=\frac{1}{f} \quad .... (1)$$

for object O_2O_2

$$\frac{1}{v}-\frac{1}{40}=-\frac{1}{f} \quad .... (2)$$



from equation 1 and 2 we get
f = 80/3

2. As the reflector approaches OS, the beat frequency will decrease to zero. After this, the reflector moves away from OS thereby increasing the beat frequency but after a long time the beat frequency will to become constant. Hence the correct option is (D).

3. Equation of process

$$\Rightarrow \frac{P^2}{\rho} = \text{constant} = C \quad .... (1)$$

Equation of State $\frac{P}{\rho}=\frac{R}{M}T$ .... (2)

From 1 and 2
PT = constant
$\Rightarrow$ C is false, D is true.

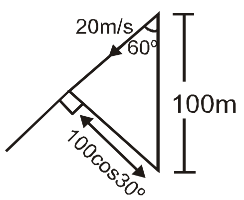
As ρ-changes to $\frac{\rho}{2}$

$\Rightarrow$ P changes to $\frac{P}{\sqrt{2}}$ from equation (1)

$\Rightarrow$ A is false.

Hence T changes to $\sqrt{2}T$. $\Rightarrow$ B is true.

4. w.r.t.



5. From graph (1) : $v_y = 0$ att = $\frac{1}{2}$ sec.

i.e., time taken to reach maximum height H is

$$t = \frac{u_y}{g} = \frac{1}{2}$$

$\Rightarrow u_y = 5$ m/s . **..Ans.(i)**

from graph (2) : $v_y = 0$ at x = 2m

i.e., when the particle is at maximum height, its displacement along horizontal x = 2 m

$x = u_x \times t$

$$\Rightarrow 2 = u_x \times \frac{1}{2}$$

$\Rightarrow u_x = 4$ m/s **....Ans (ii)**

6. **4 py $(y^2 + 4x^2)^{1/2}$**

$$\text{Force} = p\left|\frac{dE}{dx}\right|$$

{y is not changing since $\bar{p}$ is directed along x axis}

$$= p\,|[4y^2\hat{i}+8xy\hat{j}]|$$

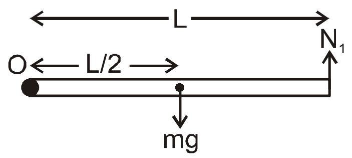
$$= p4y\,|[y\hat{i}+2x\hat{j}]|$$

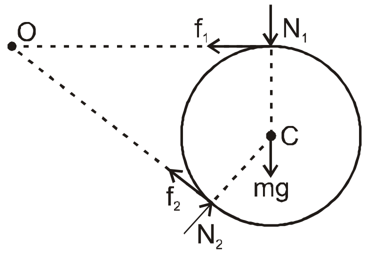
$$= 4py\sqrt{y^2+4x^2}$$

Ans. 4 py $(y^2 + 4x^2)^{1/2}$

Sol.7 to 9.

FBD of rod and cylinder is as shown.





Net torque on rod about hinge 'O' = 0

$$\therefore N_1 \times L = mg \times \frac{L}{2}$$

or $\boxed{N_1 = \frac{mg}{2}}$

Net torque on cylinder about its centre C is zero.

$\therefore f_1R = f_2R$

or $\boxed{f_1 = f_2}$

Net torque on cylinder about hinge O is zero.

$\therefore N_2 \times L = N_1 \times L + mgL$

or $N_2 = \boxed{\frac{3mg}{2}}$

10. (A) p (B) q,s (C) q,s (D) q,s

(A) Work done by an ideal gas during free expansion is zero.

(B) The angle between normal reaction on block and velocity of block is acute (whether the block moves up or down the incline). Hence work done by this force is non-zero and positive.

(C) Net electrostatic potential energy

$$= S_1 + S_2 + M_{12} = \frac{Q^2}{8\pi\epsilon_0 a} + \frac{Q^2}{8\pi\epsilon_0 a} - \frac{Q^2}{4\pi\epsilon_0 b}$$

$$= \frac{Q^2}{4\pi\epsilon_0 a} - \frac{Q^2}{4\pi\epsilon_0 b} = \text{non-zero and positive.}$$

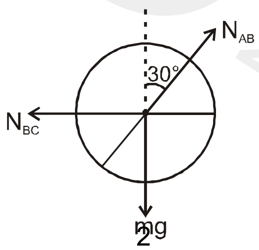
$(\because b >> a)$

(D) The kinetic energy of cylinder is increasing and work is done on cylinder by only force of friction. Therefore work done by force of friction on cylinder is non-zero and positive.

DPP NO. - 29

1. The free body diagram of cylinder is as shown. Since net acceleration of cylinder is horizontal,

$N_{AB} \cos30° = mg$



or $N_{AB} = \frac{2}{\sqrt{3}} mg$ .... (1)

and $N_{BC} - N_{AB} \sin30° = ma$

or $N_{BC} = ma + N_{AB} \sin30°$ .... (2)

Hence N_{AB} remains constant and N_{BC} increases with increase in a.

2. **(B)** The line of impact for duration of collision is parallel to x-axis.

The situation of striker and coin just before the collision is given as

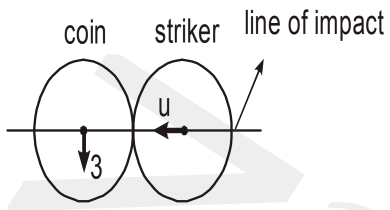


Figure (A)
before collision

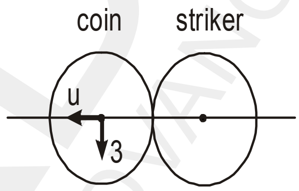
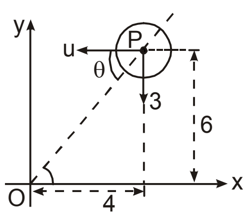


Figure (B)
after collision

Because masses of coin and striker are same, their components of velocities along line of impact shall exchange. Hence the striker comes to rest and the x-y component of velocities of coin are u and 3 m/s as shown in figure.



For coin to enter hole,

its velocity must be along PO

$\therefore \tan\theta = \frac{6}{4} = \frac{3}{u}$ or

$u = 2$ m/s **Ans. (2, 0)**

3. For no ray to emerge out of side PR

$A > 2C \Rightarrow \sin\frac{A}{2} > \sin C$

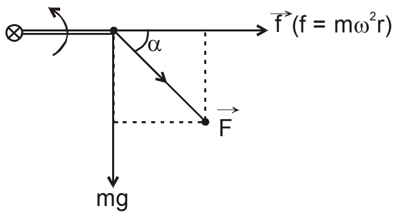
$\Rightarrow \sin\frac{A}{2} > \frac{\sqrt{3}}{2}$

or $A > 120°$

4. $\rho g h \, \pi r^2 = 2\pi r S \cos\theta$

$$\Rightarrow r = \frac{2S\cos\theta}{\rho g h} = \frac{2\times1\times0.5}{10^3\times10\times10} = 10^{-6}\text{ m}$$

5. $F = \sqrt{f^2 + (mg)^2}$



Now when the angular speed of the rod is increasing at const. rate the resultant force will be more inclined towards $\vec{f}$.

Hence the angle between $\vec{F}$ and horizontal plane decreases so as with the rod.

6. Consider a spherical shell of radius r(r > R) and thickness dr. Then potential at centre due to it,

$$dV = \frac{K\,dq}{r} = \int_{r=R}^{r\to\infty} \frac{K(C/r^3)4\pi r^2}{r}dr$$

$$= (\text{const.}) \int_{r=R}^{r\to\infty} \frac{1}{r^2}dr$$

$$= (\text{const.}) \left(\frac{1}{R}\right)$$

7. Using gauss theorem

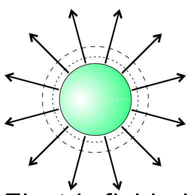
$$\int \vec{E}.d\vec{s} = \frac{q_{in}}{\varepsilon_0}$$

$$E \times 4\pi x^2 = \frac{\int \rho dv}{\varepsilon_0} = \frac{\int_{r=R}^{R=x} \frac{C}{r^3} 4\pi r^2 dr}{\varepsilon_0}$$

$$E \times 4\pi x^2 = \frac{(C)}{\varepsilon_0 x^2} \ell n\left(\frac{x}{R}\right)$$

$$\Rightarrow \quad E = \frac{(C4\pi)}{\varepsilon_0} \ell n\left(\frac{x}{R}\right)$$

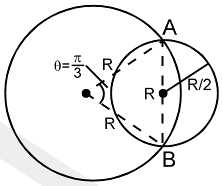
8.



Electric field will be radially outwards.
Electric potential decreases as we move in the direction of electric field.

DPP NO. - 30

1. Flux will be maximum when maximum length of ring is inside the sphere.



This will occur when the chord AB is maximum. Now maximum length of chord AB = diameter of sphere. In this case the arc of ring inside the sphere subtends an angle of $\frac{\pi}{3}$ at the centre of ring.

$\therefore$ charge on this arc = $\frac{R\pi}{3}.\lambda$

$$\therefore \quad \phi = \frac{\frac{R\pi}{3}\lambda}{\epsilon_0} = \frac{R\pi\lambda}{3\,\epsilon_0}$$

2. The change in length of rod due to increase in temperature in absence of walls is

$\Delta\ell = \ell\,\alpha\,\Delta T = 1000 \times 10^{-4} \times 20$ mm = 2 mm

But the rod can expand upto 1001 mm only.

At that temperature its natural length is = 1002 mm.

$\therefore$ compression = 1mm

$\therefore$ mechanical stress = $Y\frac{\Delta\ell}{\ell} = 10^{11} \times \frac{1}{1000}$

$= 10^8$ N/m²

3. $v_1 = 4\cos 53^\circ\,\hat{i} + 4\sin 53^\circ\,\hat{j} = \frac{12}{5}\hat{i} + \frac{16}{5}\hat{j}$

$v_2 = 3\cos 37^\circ\,\hat{i} + 3\sin 37^\circ\,\hat{j} = \frac{12}{5}\hat{i} + \frac{9}{5}\hat{j}$

$v_{12} = \frac{7}{5}\hat{j} = 1.4\,\hat{j}$

Relative velocity in horizontal direction is zero.

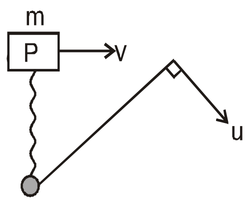
4. 0.3 m

$(\text{Range})_1 = (\text{Range})_2$

$$\sqrt{2g(\ell-0.1)}\sqrt{\frac{2\times0.1}{g}} = \sqrt{2g(\ell-0.2)}\sqrt{\frac{2\times0.2}{g}}$$

$\ell = 0.3$

5. **(a)** 4.5 m/s **(b)** 1.5 m/s **(c)** 3.75 cm



By conservation of angular momentum

$0.5 \times V \times 0.4 = 0.5 \times 4 \times 1.2$

$v = 3u$

also by energy conservation

$$\frac{1}{2} \times 0.5 \times v^2 = \frac{1}{2} \times 100 \times (0.3)^2 + \frac{1}{2} \times 0.5 \times u^2$$

$$\Rightarrow \frac{v^2}{4} = \frac{9}{2} + \frac{u^2}{4}$$

$$\Rightarrow \frac{9u^2}{4} = \frac{9}{2} + \frac{u^2}{4}$$

$$\Rightarrow \frac{8u^2}{4} = \frac{9}{2}$$

$$\Rightarrow u = \sqrt{\frac{9}{4}} = \frac{3}{2}$$

So $v = 3u$

$= 3 \times 1.5$

$= 4.5$

(c) $a_n = \frac{u^2}{r}$

$$\Rightarrow r = \frac{u^2}{a_n} \qquad \left(a_n = \frac{K_h}{m} = \frac{100 \times 0.3}{0.5} = 60 m/s^2\right)$$

$$\Rightarrow r = \frac{(1.5)^2}{(60)} = \frac{2.25}{60} = 0.0375 \text{ m}$$

$= 3.75$ cm

6. $\lambda = 4$m and f = 50 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

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

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

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

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

8. 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 $\phi_0 = -30°$

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