Physics English Classified MCQ Mechanics 1990 - 2016

Mechanics

01. Linear Motion

1) An object is projected upwards with a velocity of 100 ms^{-1} from the ground. If the air resistance is neglected it will strike the ground in,

1) 5s 2) 10 s 3) 15 s 4) 20 s 5) 25 s (1992)

2) Consider the following statements made about the motion of a particle.

A. Velocity of a particle cannot be reversed without changing the direction of its acceleration.

B. When a particle is projected vertically downwards with a very large initial velocity its acceleration will exceed the acceleration due to gravity.

C. when the acceleration of a particle is zero it must necessarily be at rest.

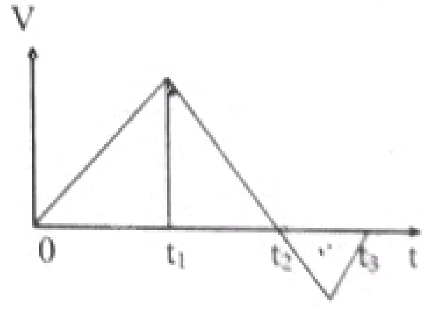
Of the above statements,

1) Only A and B are true 2) Only B and C are true 3) Only A and C are true
4) all A, B and C are true 5) all A, B and C are false (1992)

3) An object is dropped from a helicopter which is moving horizontally at a constant velocity of 45 ms^{-1} 180m above the ground. Time taken for the object to reach the ground is,

1) 3 s 2) 4 s 3) 5s 4) 6s 5) 12 s (1993)

4) The figure shows the velocity – time graph for a particle which starts from rest and moves along X direction. According to this graph.



A) the particle comes to rest only at time $t = t_3$

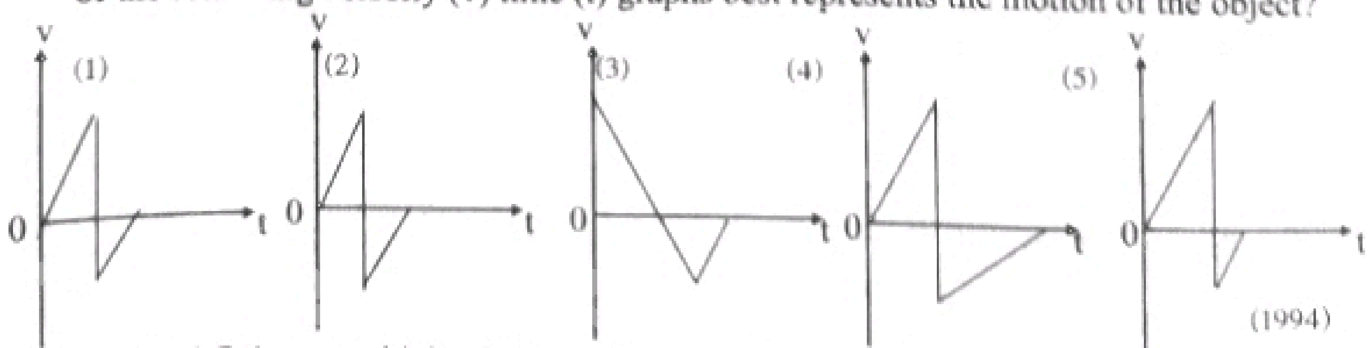
B) the particle returns to its original position at time $t = t_3$

C) the particle accelerates only during the time interval $0 - t_1$

Of the above statements.

1) Only (A) is true 2) Only (B) is true 3) Only (A) and (C) are true
4) Only (A) and (B) are true 5) all (A), (B) and (C) are true (1993)

5) An object dropped from a height h bounces back from the floor to a height $\frac{h}{2}$ which of the following velocity (v) time (t) graphs best represents the motion of the object?



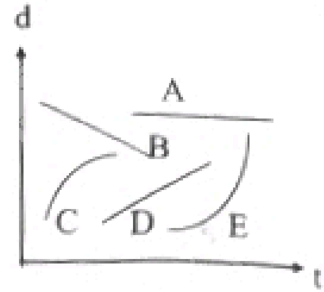
(1994)

6) A bird flying at a high of 40 m with a speed of 10ms^{-1} drops a small fruit from its mouth. If free fall is assumed the speed of the fruit just before it reaches the ground is,

1) 10 ms^{-1} 2) 15 ms^{-1} 3) $20\sqrt{2}$ ms^{-1} 4) 25 ms^{-1} 5) 30 ms^{-1} (1995)

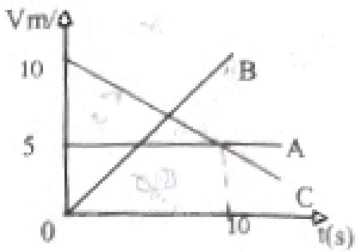
7) Figure shows five displacement (d) time (t) curves for five different objects, the object which has an acceleration in direction of its motion is represented by

1) A   2) B   3) C   4) D   5) E   (1996)



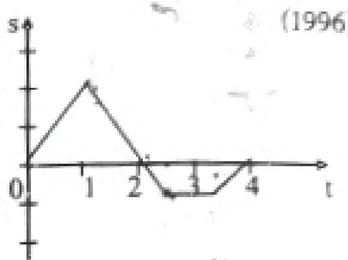
8) Figure shows velocity (V) – time (t) curves of three particles A,B and C moving along a straight line. If at t = 0 all the particles can be found together at a certain point on the straight line then at t = 10 s

1) particles A and B meet again
2) particles B and C meet again
3) particles C and A meet again
4) particles A, B and C all meet again
5) none of the particles meet again

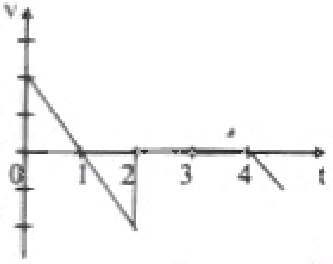


(1996)

9) Which of the following curves correctly represents the corresponding velocity (V) - time (t) curve for the displacement (s) – time (t) curve show in the figure?



1)



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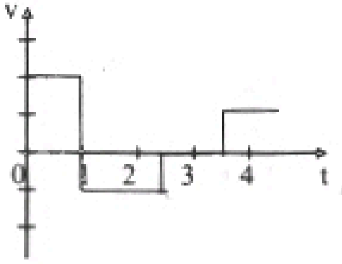

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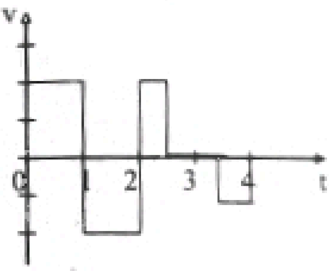

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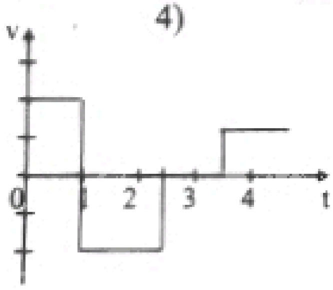
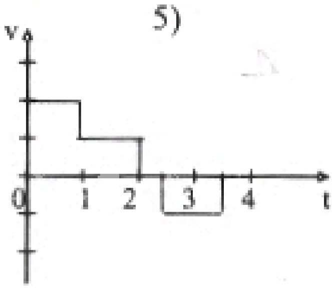
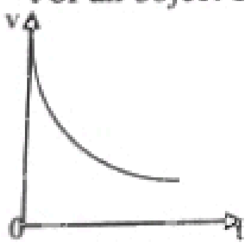


5)

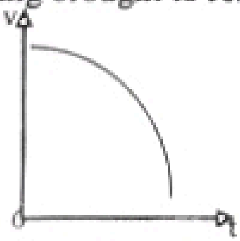


(1997)

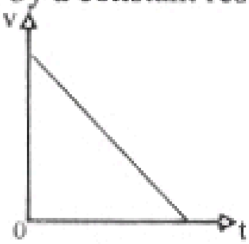
10) Which of the following graphs best represents the variation of velocity, V, with time t of an object being brought to rest by a constant resultant force?



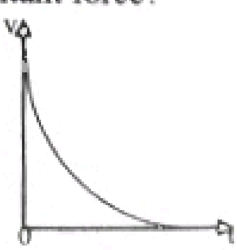
1)



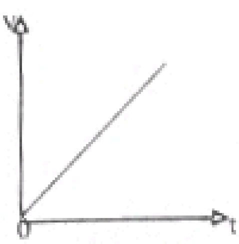
2)



3)



4)



5) (1999)

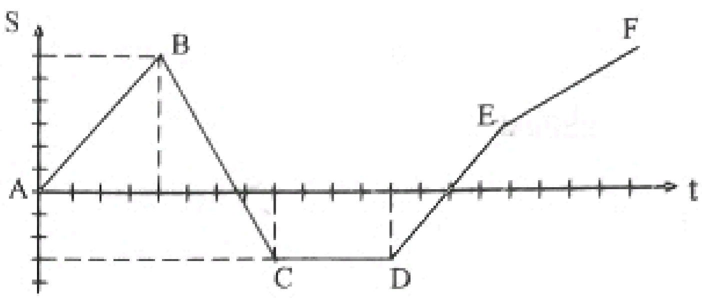
11) The distances traveled by an object falling freely form rest during first, second and third seconds are in the ratio

1) 1 : 2 : 3   2) 1 : 4 : 9   3) 1 : 2 : 9   4) 1 : 1 : 1   5) 1 : 3 : 5   (1999)

12) When two objects A and B move with uniform speeds toward each other along a straight line, they get 5m closer to each other every second. If they move in the same direction along a straight line with the original speeds they get 1m closer, to each other every second. The speeds of A and B are respectively

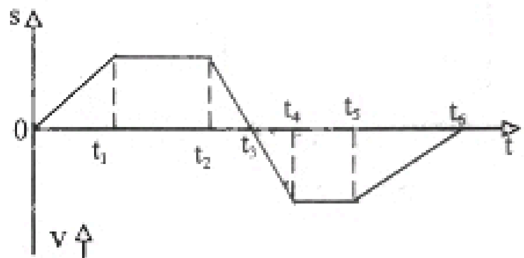
1) $5ms^{-1}$ and $4ms^{-1}$ 2) $5\ ms^{-1}$ and $10ms^{-1}$ 3) $3ms^{-1}$ and $2ms^{-1}$
4) $3ms^{-1}$ and $1ms^{-1}$ 5) $2ms^{-1}$ and $1ms^{-1}$ (1999)

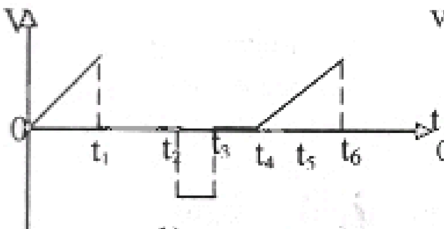
13) Displacement (S) of a particle measured along the x-axis with time (t) is shown in the figure. The magnitude of the velocity of the particle is largest when it travels from,



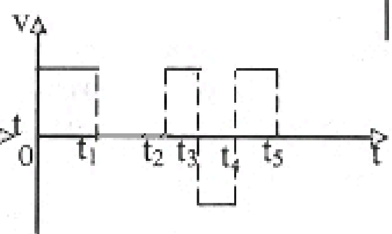
1) A to B 2) B to C 3) C to D 4) D to E 5) E to F (2000)

14) The displacement (s) – time (t) curve of an object is shown in the figure. The corresponding velocity (v) – time (t) curve is best represented by,

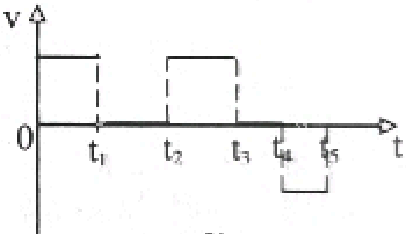




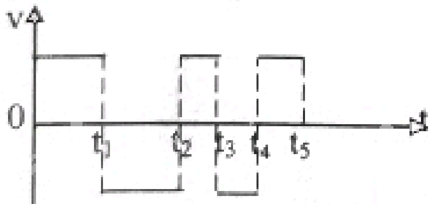
1)



2)



3)



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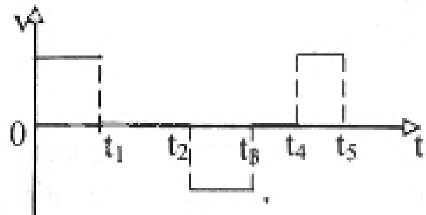
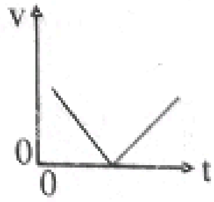
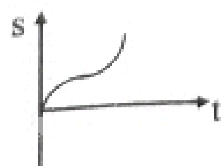


5)

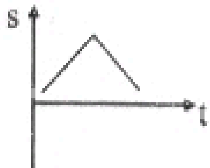
(2001)

15) The graph shown represents the velocity (v) time (t) curve for an object. The corresponding displacement (s) – time (t) curve is best represented by

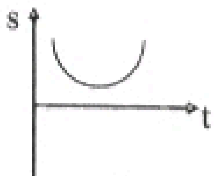




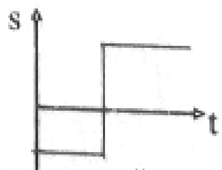
1)



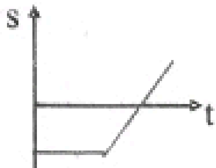
2)



3)

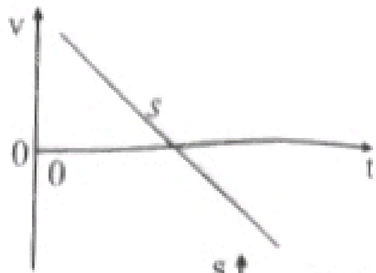


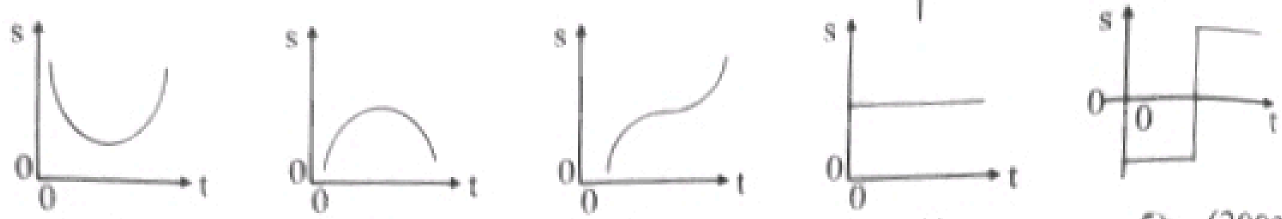
4)



5) (2002)

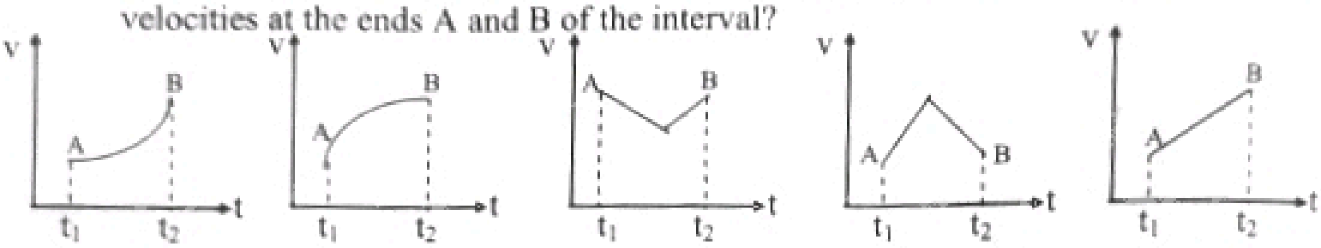
16) The graph shown in the figure represents the velocity (v) time (t) curve for an object. The corresponding displacement (s) – time (t) curve is best represented by,





1) 2) 3) (4) 5) (2003)

17) In Which of velocity (v) time (t) graphs shown below would the average velocity over the entire period between t_1 and t_2 be equal to the average of the two velocities at the ends A and B of the interval?



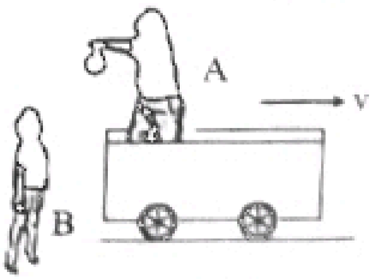
1) 2) 3) 4) 5) (2003)

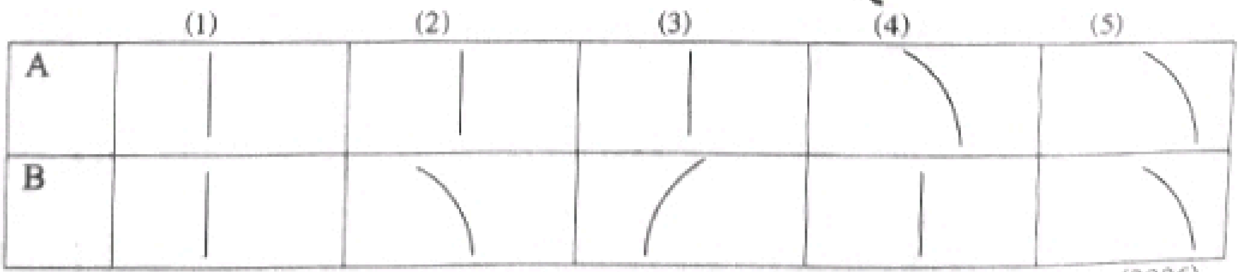
18) A particle P moving with a uniform velocity of 4 ms^{-1} along x-axis passes the origin O at time t = 0.A second particle Q moving along the same direction with a uniform velocity of 5ms^{-1} passes origin O at t= 1s. Particle Q will reach the particle P when they have traveled a distance of

1) 10 m from the origin
2) 16 m from the origin
3) 20 m from the origin
4) 25 m from the origin
5) 30 m from the origin

(2004)

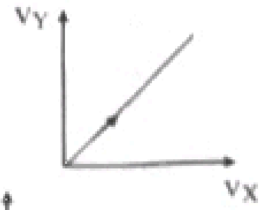
19) A person *A* standing on a trolley moving with a constant speed *V* on a straight horizontal track drops an object an shown in the figure. *B* is not observer standing on the ground. If the air resistance is negligible, the paths of the objects as observed by *A* and *B* are represented by,

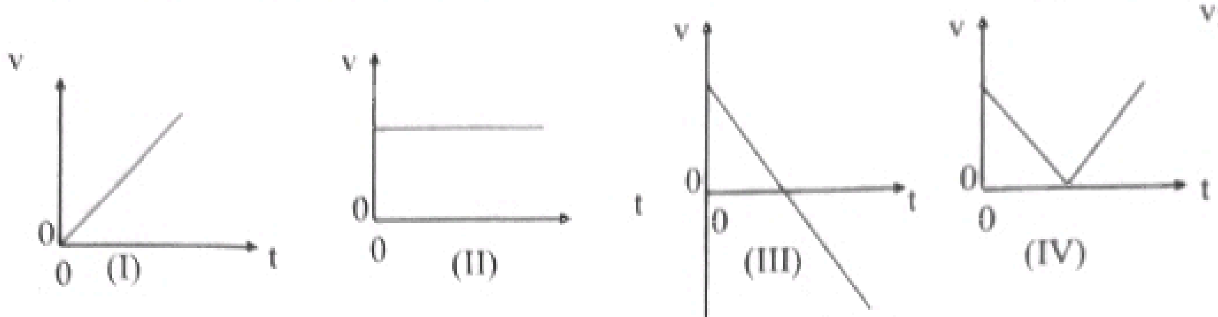




(2006)

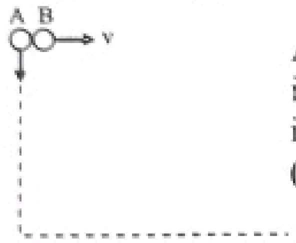
20) A stone is thrown at a certain angle with the horizontal in the direction shown by the arrow. If air resistance is ignored, which of the following velocity (v) – time (t) graphs best represent the variation of v_x with t, and v_y with t ?





	t with v_X	t with v_Y		t with v_X	t with v_Y
1)	II	III	2)	II	I
3)	I	IV	4)	II	IV
5)	II	II			

(2006)

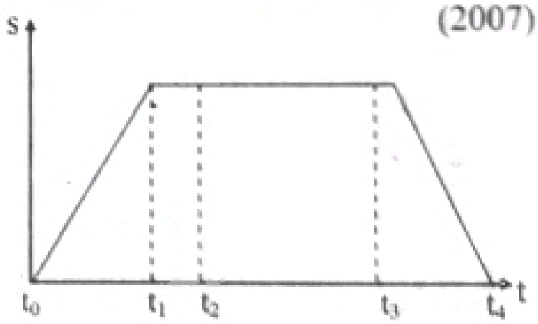
21) 

A ball B is projected horizontally with speed υ and a ball A is dropped vertically from rest at the same instant as shown in the figure. Which of the following statements is true ? (Neglect air resistance)

1) A reaches the ground first with a higher speed than B.
2) B reaches the ground first with a higher speed than A.
3) A reaches the ground first with a lower speed than B.
4) Both A and B reach the ground at the same instant with the same speed.
5) Both A and B reach the ground at the same instant but B with higher speed than A.

(2007)

22) Figure shows displacement (s) versus time (t) curve for a motion of a particle. Consider the following statements made about its motion.

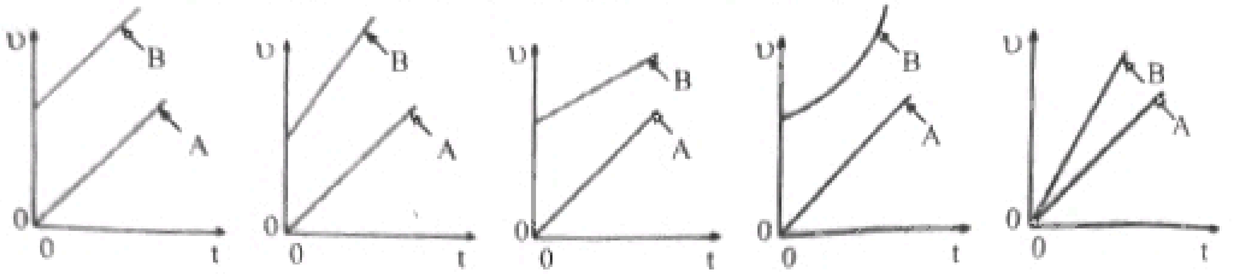


A) During the period t_0 – t_1 the particle moves at a contant acceleration and during t_2 – t_3 it moves at a constant velocity.
B) Particle comes to rest at time t_4
C) During the time period t_0 – t_4 the total distance travelled by the particle is equal to the area under the s – t curve.

Of the above statements,
1) only (A) is true 2) only (A) and (B) are true. 3) only (B) and (C) are true
4) all (A), (B) and (C) are true. 5) all (A), (B) and (C) are false

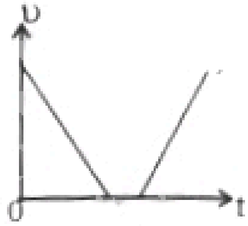
(2008)

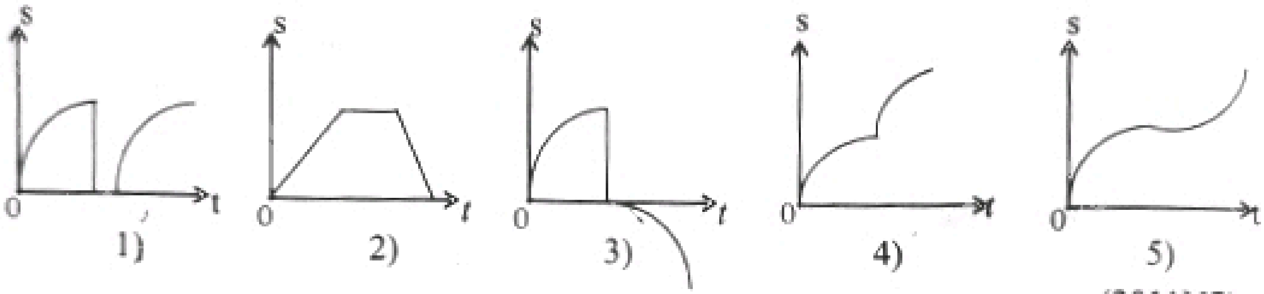
23) A person simultaneously drops an object, and throws another object vertically downwards from a certain height. Which of the following graphs best represents the velocity (υ) – time (t) curves for the two objects? (Curve A represents the dropped object and curve B represents the thrown object)



1) 2) 3) 4) 5)(2009)

24) Velocity (υ) – time (t) curve for the motion of a particle is shown in the figure. The corresponding displacement (s) – time (t) curve would be,

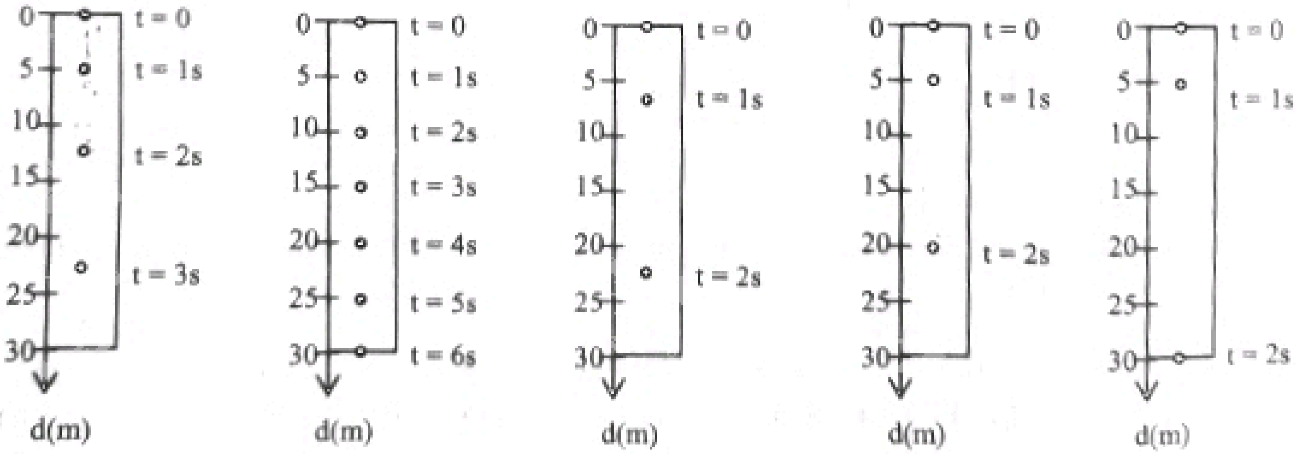




1) 2) 3) 4) 5)

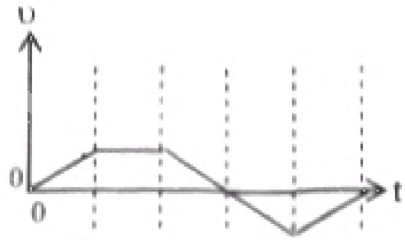
(2011NS)

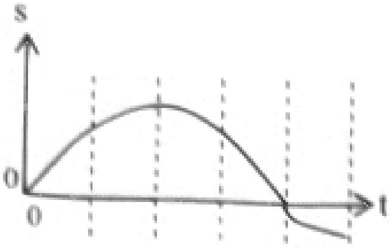
25) Photographs of an object that starts falling freely from rest at t = 0 are taken by a camera, first at t = 0 and thereafter at the end of each second. Which of the following diagram correctly indicate the location of the object at the end of each second ? The vertical axes of the diagrams represent the distance (d) travelled by the object.



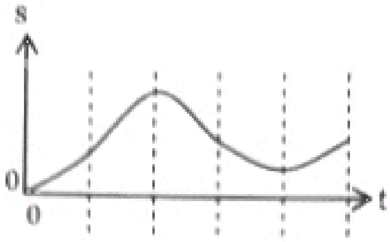
1) 2) 3) 4) 5)

26) The variation of the velocity (υ) with time (t) of a particle is shown in the figure. The corresponding displacement (s) time (t) curve is best represented by,

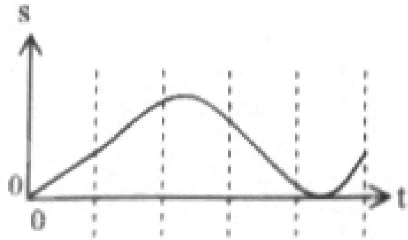




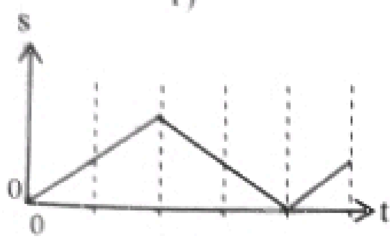
1)



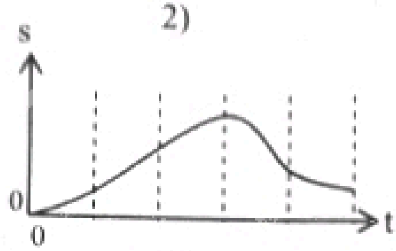
2)



3)



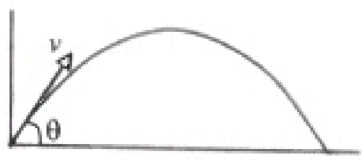
4)

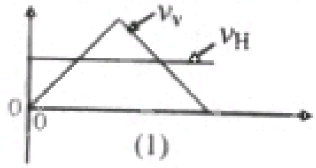


5)

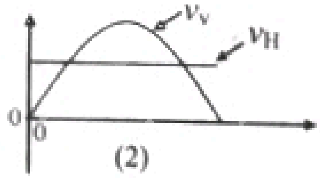
(2012)

27) An object is projected under gravity with velocity v, in a direction which makes an angle θ with the horizontal as shown in the figure. Which of the following graphs correctly indicates the variation of the horizontal (υ_H) and vertical (υ_V) components of the velocity of the object with time (t)?

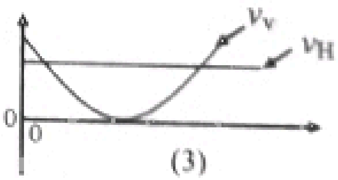




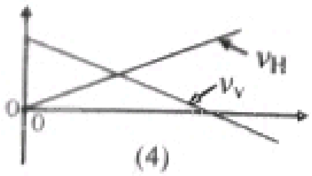
(1)



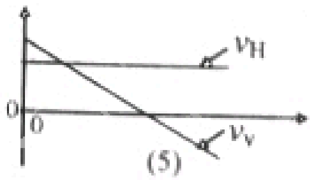
(2)



(3)



(4)



(5)

(2013)

28) A ball is dropped from a height of 1.8 m onto a rigid surface. The collision between the ball and the surface is perfectly elastic. If the ball continues to bounce on the surface, the motion of the ball is,

(1) simple harmonic with a period of 1.2 s.
(2) not simple harmonic but periodic with a period of 0.6 s.
(3) not simple harmonic but periodic with a period of 1.2 s.
(4) simple harmonic with a period of 0.6 s.
(5) simple harmonic with a period of 2.4 s.

(2015)

29) If the velocity (v) of an object varies with time (t) as shown in figure (a), the corresponding variation of the displacement (x) with time (t) is best represented by,

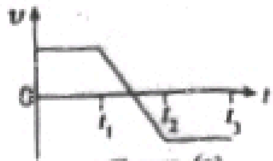
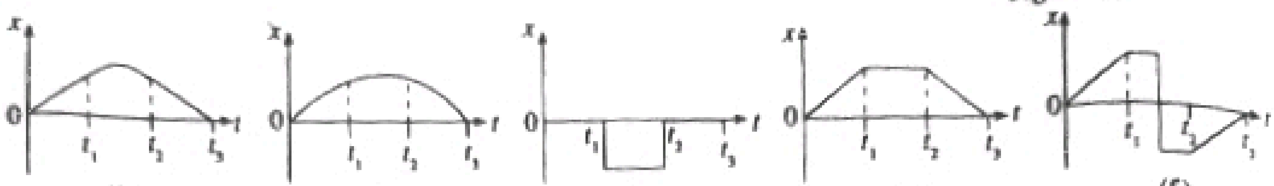


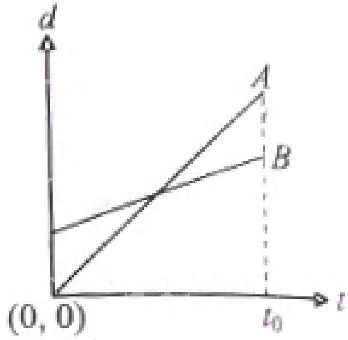
Figure (a)



(1) (2) (3) (4) (5)

(2015)

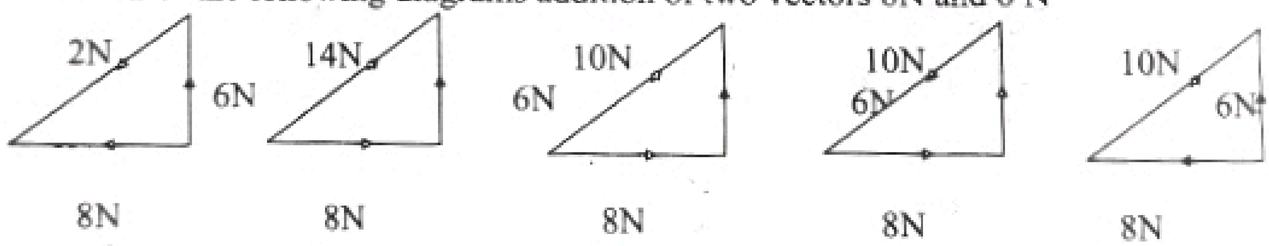
30) The two straight lines shown in the displacement (d) – time (t) graph represent the motions of two objects A and B started from rest at time $t = 0$ and moving along the positive x – direction. Which of the following statements made about the motions of the objects is true?



1) The object A has travelled for a longer time than B.
2) When $t = t_0$ object B has made a displacement greater than B.
3) Object A has a greater velocity than B.
4) Object A has a greater acceleration B.
5) Both objects have the same velocity at the point where the two straight lines cross each other. (2016)

02. Equilibrium of Forces

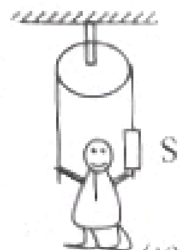
1) Which of the following diagrams addition of two vectors 8N and 6 N



1) 2) 3) 4) 5)(1993)

2) Which of the following sets of forces never produces a zero resultant?
1) 5 N, 5 N, 5 N
2) 5 N, 5 N, 10 N
3) 5 N, 10 N, 10 N
4) 10 N, 10 N, 20 N
5) 5 N, 10 N, 20 N
(1994)

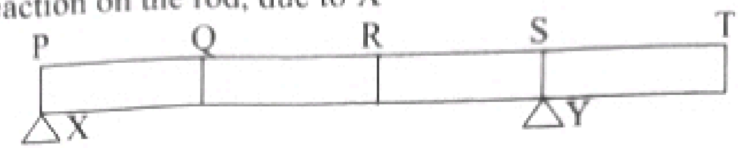
3) A child of weight W hangs at rest from the ends of a light inextensible rope as shown in the figure if the weigh of the spring balance, S is negligible the reading on its scale is,



1) 0 2) $\frac{W}{4}$ 3) $\frac{W}{2}$ 4) W 5) 2W

(1994)

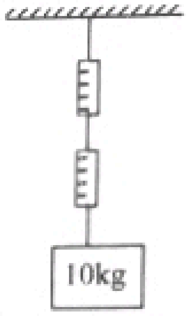
4) The diagram shows a uniform rod resting horizontally on two support s X and Y. The lengths PQ, QR, RS and ST are equal. As Y moves from S to T, keeping XZ stationary, the reaction on the rod, due to X



1) decreases and that due to Y increases
2) increases and that due to Y decreases
3) increases and that due to Y also increases
4) decreases and that due to Y also decreases
5) remains equal to that due to Y

(1994)

5) Two spring scales of negligible mass are connected together and a 10 kg mass is hung as shown in the figure. Which of the following statements is true?



1) Each scale will read 5kg.
2) Each scale will read 10 kg
3) The bottom scale will read 10kg and the top one will read zero
4) The top scale will read 10 kg and the bottom one will read zero
5) Each scale will show a reading between zero and 10 kg such that the sum of the two readings is 10 kg.

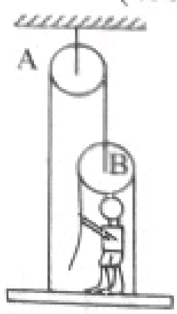
(1995)

6) A system of coplanar forces acts on a rigid body .If the resultant of moments of the forces about a certain point on the body is zero. Consider the following statements
(A) The resultant of the moments of forces about any other point on the body is always zero
(B) The body must be in equilibrium
(C) The resultant force acting on the body must be zero
Of the above statements

1) all A, B and C are false   2) Only A is true   3) Only B is true
4) Only C is true   5) only A and B are true

(1995)

7) A man of weight 500N standing on a platform P supported by two light strings passing over two light smooth pulleys A and B supports himself by pulling the string as shown in the figure. If the weight of the platform is 1000 N, the force exerted by the man on the string to keep the platform.



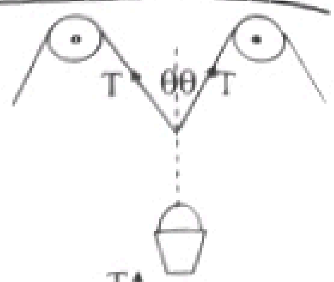
1) 1000 N   2) 800 N   3) 500 N   4) 400 N   5) 375 N   (1995)

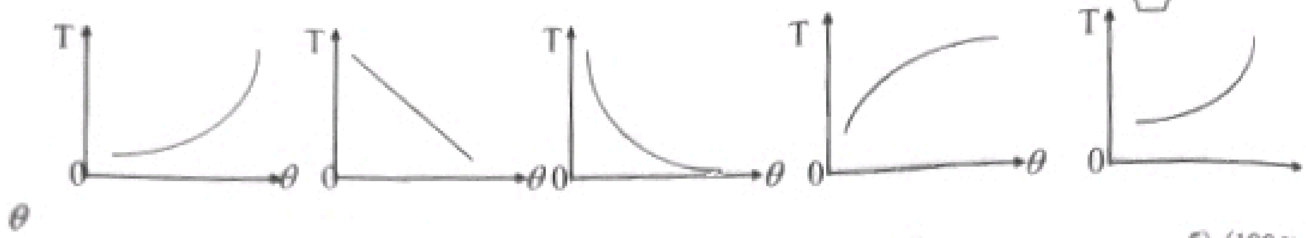
8) Which of the following group of forces acting on a body. Cannot have a zero resultant force?

1) 2N, 2N, 2N   2) 2N, 3N, 4N   3) 1N, 2N, 2N
4) 1N, 1N, 2N   5) 1N, 2N, 4N

(1996)

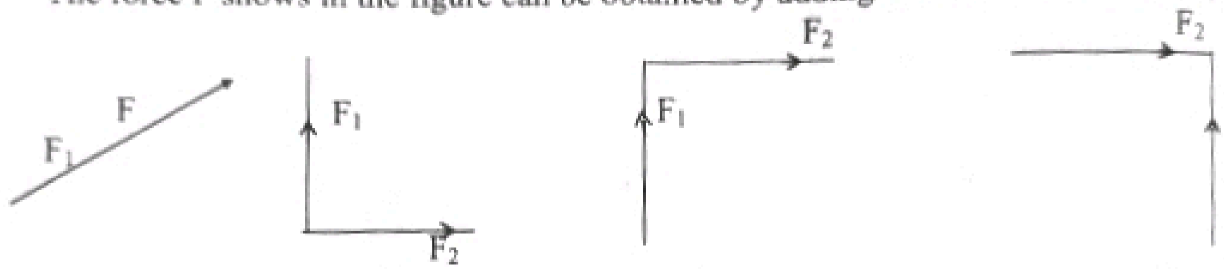
9) The diagram shows tow boys pulling a bucket of water from a well. Which of the following graphs correctly represents the variation of the tension T in the string with the angle θ.





1) 2) 3) 4) 5) (1996)

10) The force F shows in the figure can be obtained by adding the forces F_1 and F_2 in,

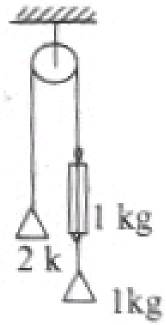


(A) (B) (C)

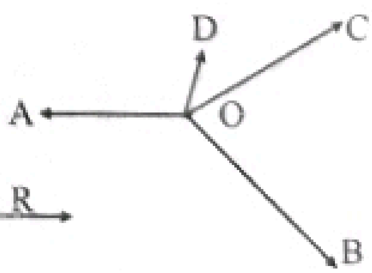
1) A only 2) B Only 3) C only
4) A and B Only 5) all A, B and C (1997)

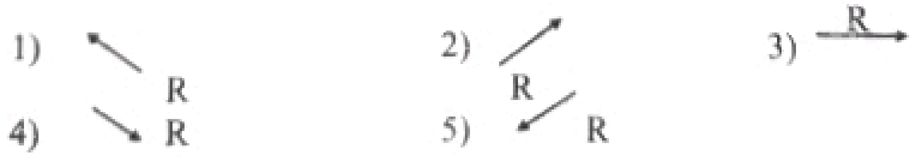
11) A light string passing over a smooth Pulley carries a spring balance of mass 1 kg and two weights of masses 1kg and 2kg as shown in the figure. The reading on the balance will be,

1) zero 2) 1 kg 3) 2 kg
4) 3 kg 5) 4 kg (1997)



12) Figure shows four coplanar forces A,B,C and D (drawn to the scale) acting on a point object O. The resultant force R acting on O will most likely to be along the direction

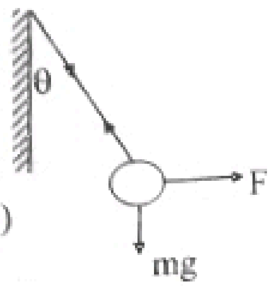




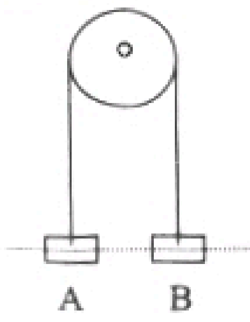
(1998)

13) An object of mass m is hung by a string and is kept in equilibrium as shown in the diagram by a horizontal force F. The magnitude of F is,

1) mg tan θ 2) mg sin θ 3) mg
4) mg cos θ 5) mg / tan θ (2001)



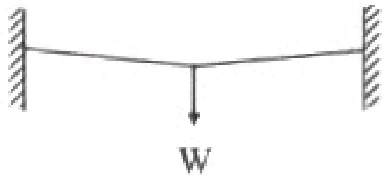
14) Two equal masses A and B are attached to a light inextensible string passing over a smooth light pulley as shown in the diagram. The mass B is moved down, held it stationary and then released it, Which of the following statements is correct for the subsequent motion of B?



1) B will move back to the original position
2) B will move back to the original position
3) B will stay stationary
4) B will start to move downwards
5) B will start to move upwards

(2001)

15) A weight W is hung on a tightly fixed rope as shown in the diagram .The tension in the rope is,

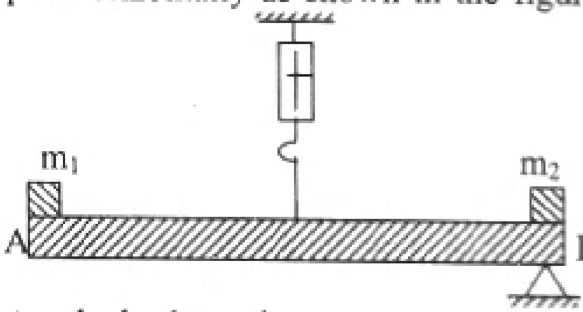


1) approximately W
2) approximately $\frac{W}{2}$
3) less than $\frac{W}{2}$
4) in-between $\frac{W}{2}$ and W
5) much greater than W

(2001)

16) A uniform bar of mass M is suspended form its midpoint by a spring balance two masses m_1, and m_2 ($m_1 > m_2$) are placed at the two ends of the bar. A wedge supports the bar at the end B to keep it horizontally as shown in the figure. The reading of the spring balance is,

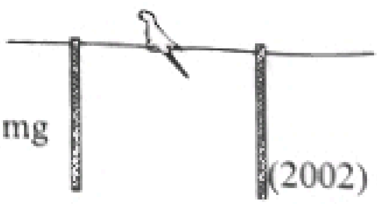
1) 0
2) m_1g
3) $(M + m_1)g$
4) $(M + 2m_1)g$
5) $(M + m_1 + m_2)g$



(2001)

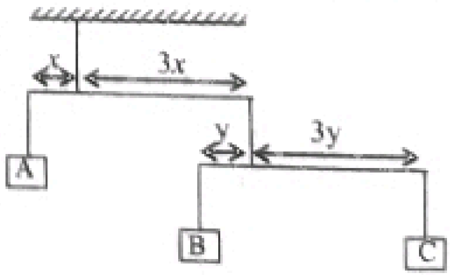
17) A bird of mass m sits on a tightly stretched telegraph wire as shown in the figure. The additional tension produced by the bird in the wire is,

1) zero
2) less than mg
3) more than mg
4) equal to mg
5) equal to 1/2 mg



(2002)

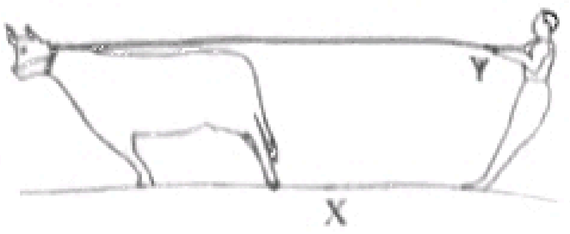
18) Three masses A, B and C are hanging from horizontal crossbars as shown in the figure. Each crossbar has negligible mass. If A has mass 6kg, the masses of B and C respectively are,

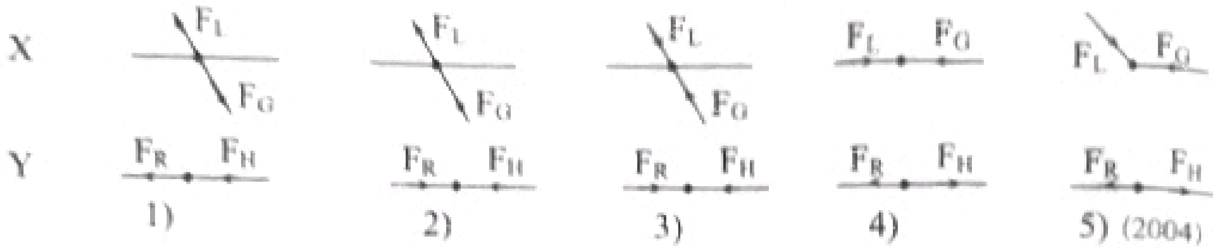


1) 1.0 kg ; 1.0 kg
2) 1.5 kg ; 0.5 kg
3) 3.0 kg ; 1.0 kg
4) 0.5 kg ; 1.5 kg
5) 1.5 kg ; 1.0 kg

(2003)

19) Figure shows an attempt made by a man to hold a bull tied to a rope trying to escape. The force at X acting on the bull's leg is F_L and that on the ground is F_G. The force at Y acting on the rope is F_R and that on the hand of the man is F_H the forces F_L, F_G, F_R are correctly represented by,





(2004)

20) Figure 1 shows a book A placed on top of a box B, which rests on the floor. Figure 2 shows the free body force diagram for the box P, Q and R indicate the forces acting on the box.
Which of the following statements is true?

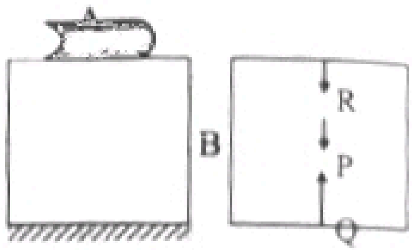
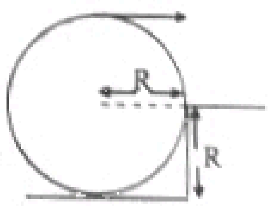


figure 1 figure 2

1) Q > P + R
2) Force on the floor exerted by the box is indicated by *P*.
3 Force on the floor exerted by the box is indicated by *Q*.
4) Force exerted on the box by the book is indicated by *R*.
5) Q < P + R

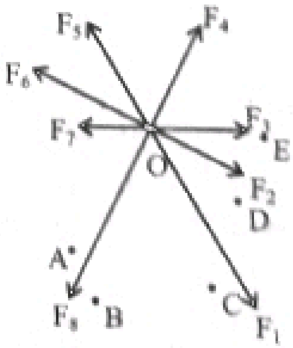
(2005)

21) A circular coin of radius R and mass *M* is placed so that it touches a step height *R* as shows in the figure. The minimum value of the horizontal force *F* required to pull the coin over the step is,



1) $\frac{Mg}{2}$ 2) $\frac{Mg}{\sqrt{2}}$ 3) Mg 4) $\sqrt{2}$ Mg 5) 2Mg (2006)

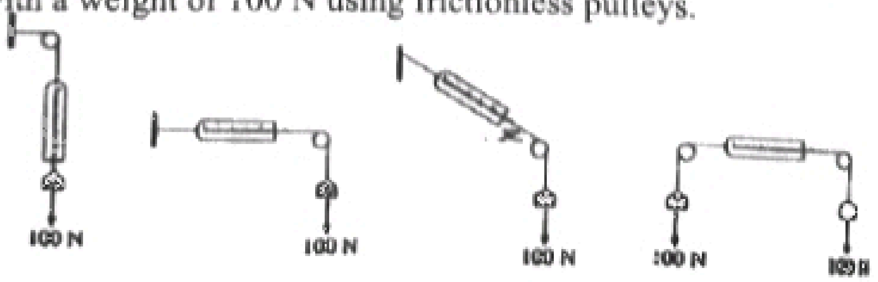
22) A figure F_1 to F_8 drawn to scale act on a point object O as shown,



1) $\overrightarrow{OA}$ 2) $\overrightarrow{OB}$ 3) $\overrightarrow{OC}$
4) $\overrightarrow{OD}$ 5) $\overrightarrow{OE}$

(2006)

23) Figures *A*, *B*, *C* and *D* show four ways in which a light spring balance can be loaded with a weight of 100 N using frictionless pulleys.

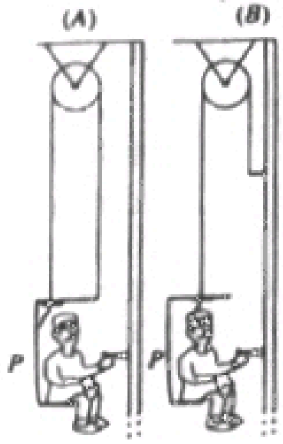


The scale readings of the spring balance in the four cases would be,

	A	B	C	D
1)	100N	100N	100 N	100 N
2)	100 N	0	200 N	100 N
3	100 N	100 N	100 N	200 N
4)	100 N	0	200 N	200 N
5)	100 N	100 N	200 N	200 N

(2007)

24) Figures *A* and *B* show two ways in which a painter could use a system consisting of a platform *P*, a pulley and a rope in painting tall buildings. The total weight of the painter and the platform is 400 N. If the rope is light then the tension of the rope in the two cases are,

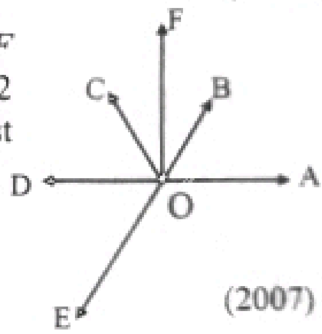


	A	B
1)	400 N	400 N
2)	400 N	200 N
3)	200 N	400 N
4)	200 N	200 N
5)	100 N	200 N

(2007)

25) A system of coplanar forces *OA*, *OB*, *OC*, *OD*, *OE* and *OF* acts on an object as shown in the figure. Magnitude of *OA*=2 *OD* and *OE*=2 *OB*. The resultant force on the object is most likely to be,

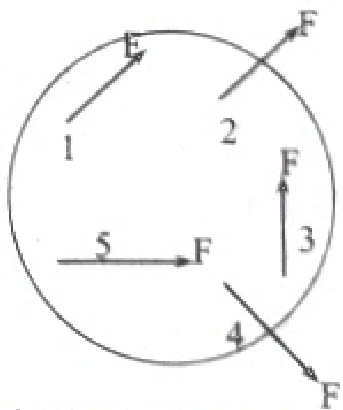
1) along the direction of *OC*. 2) along the direction of *OE*.
3) along the direction of *OF*. 4) along the direction of *OA*.
5) zero



(2007)

26) A thin disc has freedom to rotate around art axis passing through its centre O perpendicular to the plane of the disc. The disc is acted upon by five coplanar force (1 – 5) equal in magnitude, as shown in the figure.

Consider the following statements made about the torques produced by the forces.



(A) Maximum torque is produced by the force 2.

(B) Rotation of the disc due to the resultant torque will be in clockwise direction.

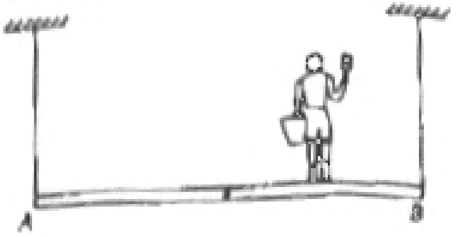
(C) When the magnitude of the forces are doubled the magnitude of the torque will also be doubled.

Of the above statements,

1) only (A) is true 2) only (B) is true 3) only (C) is true
4) only (B) and (C) is true 5) All (A), (B) and (C) are true.

(2011)

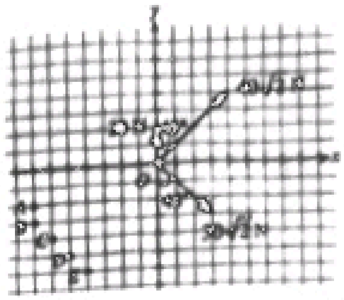
27) A man of mass 60 kg standing on a uniform wooden rafter hung horizontally by two identical ropes is painting a wall. The mass of the rafter is 20 kg. What is the minimum tension that should be withheld by each rope so that the man can move safely between A and B?



1) 100N 2) 400N 3) 600N
4) 700N 5) 800N

(2013)

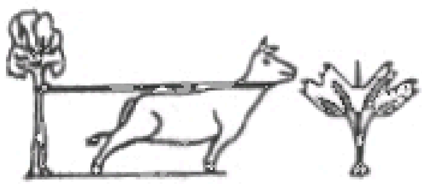
28) If three coplanar forces of 20 N, $40\sqrt{2}$ N and $30\sqrt{2}$ N act on a particle situated at the origin O of a x – y coordinate system as shown in figure, the vector that represents the force necessary to keep the particle stationary is

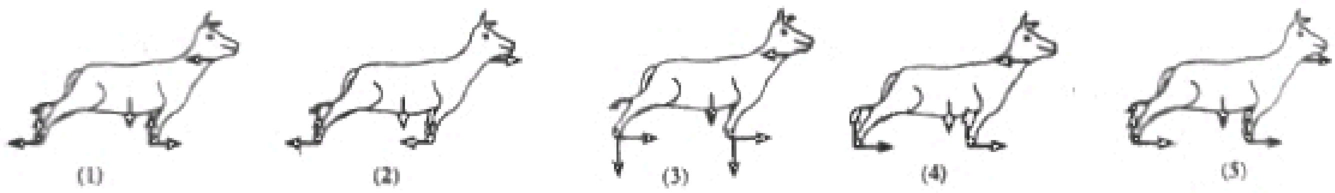


1) OA 2) OB 3) OC
4) OD 5) OE

(2014)

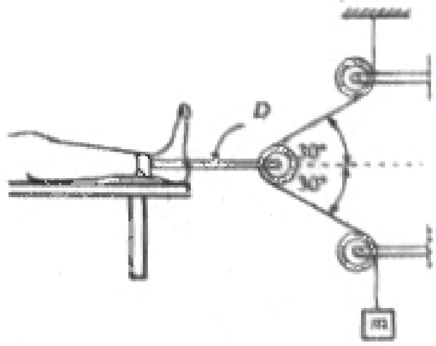
29) A bull fastened to a strong tree with a rope attempting to eat a nearby coconut plant is shown in figure (a). The free-body diagram for the bull is correctly represented by,





(2015)

30) The pulley arrangement shown in the figure exerts a force on a leg of a patient connected to a traction device D. The pulleys are frictionless and the system is at equilibrium. If the horizontal force acting on the leg by D is 80 N, then the value of the hanging mass m will be ($\cos 30° = \frac{\sqrt{3}}{2}$)



(1) $\frac{4}{\sqrt{3}}$ kg (2) 4 kg (3) $\frac{8}{\sqrt{3}}$ kg
(4) 8 kg (5) $8\sqrt{2}$ kg

(2015)

03. Centre of Gravity

1) A thin plate of irregular shape is suspended freely by a cord from a point A as shown in figure (i) Next, the plate is suspended freely from another point B as shown in figure (ii) , The centre of gravity of the plate is most likely to be found at,

1) P
2) Q
3) R
4) S
5) T

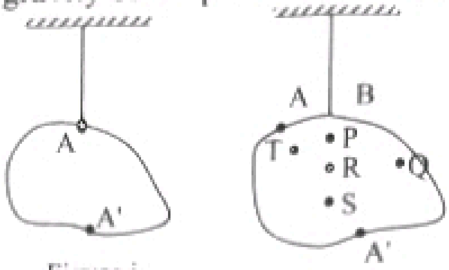
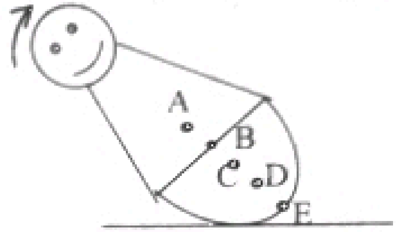


Figure i   Figure 2

(1992)

2) The diagram given is a cross – section of a toy placed on a horizontal table which always returns to the upright vertical position when released. The centre of gravity of this toy is most likely to be at,

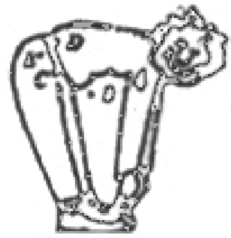


1) A   2) B   3) C   4) D   5) E

(1993)

3) A person bends over and touches his toes as shown in the figure the center of gravity of the person is most likely to be found at,

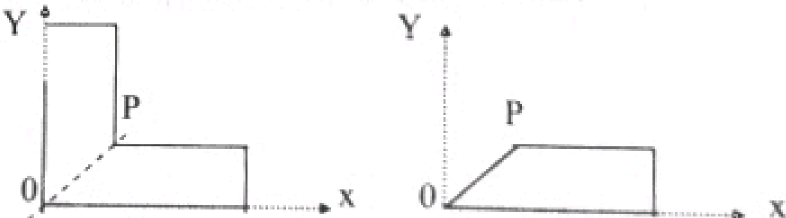
1) A   2) B   3) C
4) D   5) E



(1994)

4) The co–ordinates of the centre of gravity of a uniform sheet of cardboard shown in fig(a) are (x_0, y_o). The cardboard is now folded along OP as shown in fig (b). The center of gravity of the (x,y) folded cardboard has co–ordinates where

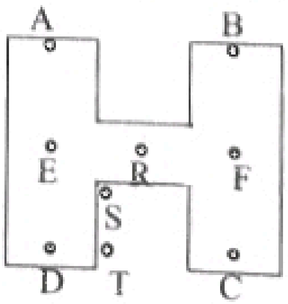
1) $x = x_0 ; y = y_0$
2) $x < x_0 ; y < y_0$
3) $x > x_0 ; y > y_0$
4) $x > x_0 ; y < y_0$
5) $x < x_0 ; y > y_0$



(a)   (b)   (1995)

5) When a H shaped body shown in the figure is hung from point B, it hangs with point D directly below B. When the body is hung from point E. it hangs so that the point C is directly below E. The centre of gravity of the body is more likely to be at,

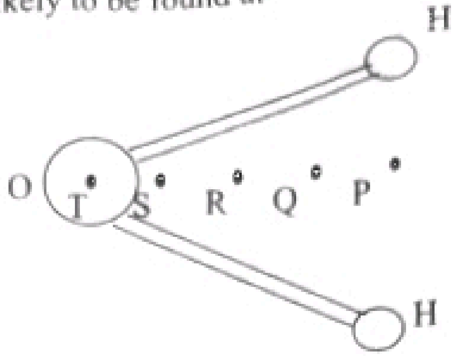
1) E
2) Q
3) R
4) S
5) T



(1996)

6) The water (H_2O) molecule has the shape shown in the figure. The centre of gravity of the molecule is most likely to be found at

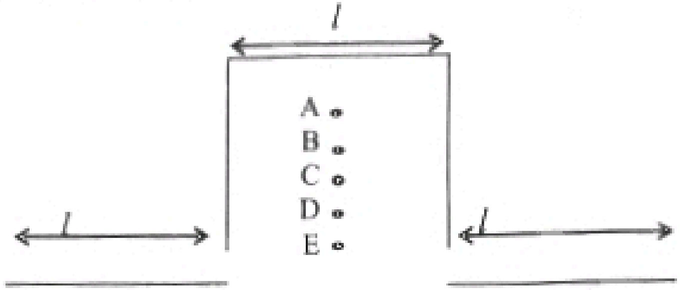
1) P
2) Q
3) R
4) S
5) T



(1997)

7) A uniform wire is bent as shown in the figure. The center of gravity of the whole wire is most likely to be found at,

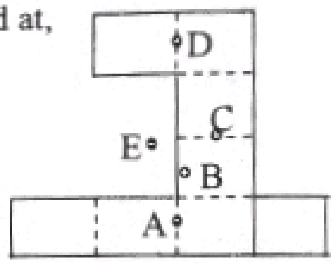
1) A
2) B
3) C
4) D
5) E



(1998)

8) The center of gravity object is most likely to be found at,

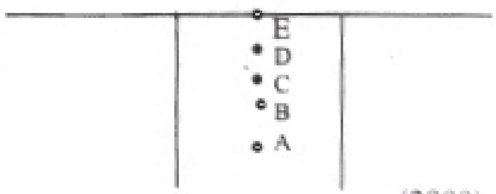
1) A 2) B
3) C 4) D
5) E



(1999)

9) The frame shown in the figure is made from a uniform wire. The centre of gravity of the frame is most likely to be found at,

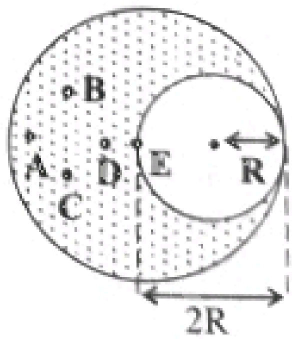
(1) A (2) B (3) C
(4) D (5) E



(2000)

10) A uniform circular plate of radius 2R has a circular hole of radius R cut out of is as shown in the figure. The center of gravity of the plate with the hole is most likely to be found at,

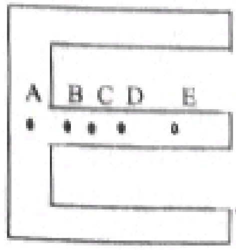
(1) A (2) B (3) C
(4) D (5) E



(2001)

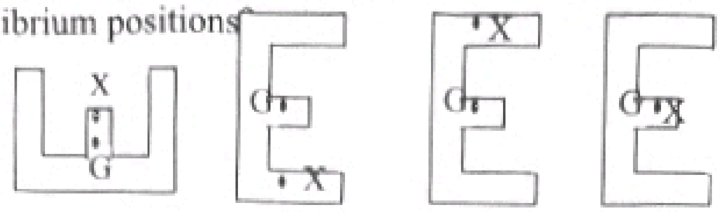
11) Figure shows a piece of metal in the shape of the letter 'E' cut form a uniform sheet. The centre of gravity is most likely to be found at.

1) A 2) B 3) C 4) D 5) E



J02)

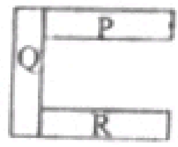
12) Identical laminate cut into the form of the letter E are pivoted vertically at X. If G is the centre of gravity of the laminate , which of the states shown in the figure are at stable equilibrium positions?

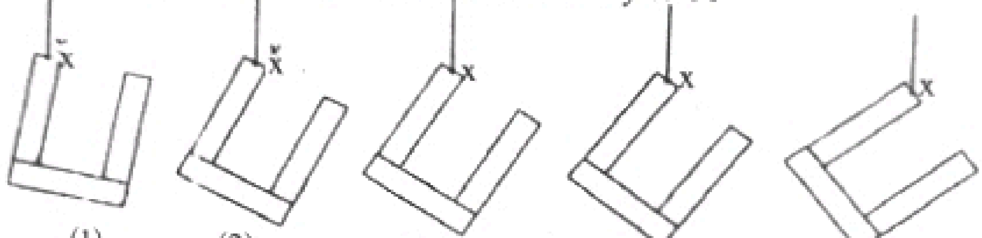


(A) (B) (C) (D)

(1) (A) and (C) only (2) (A) and (B) only (3) (C) and (D) only
(4) (B) , (C) and (D) only (5) (B) , (C) and (D) only (2003)

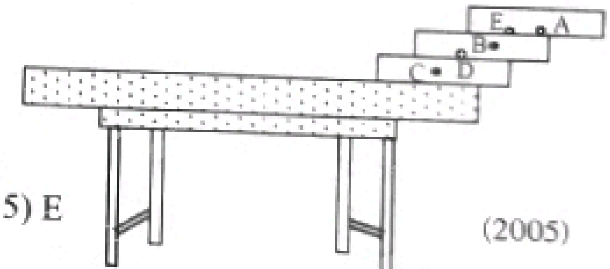
13) A frame is made by joining there uniform rods P, Q and R having identical geometrical dimensions as shown in the figure. Rods P and R are of the same mass, but the rod Q is twice as heavy as P or R. When the frame is suspended freely from the point X, its equilibrium position is most likely to be





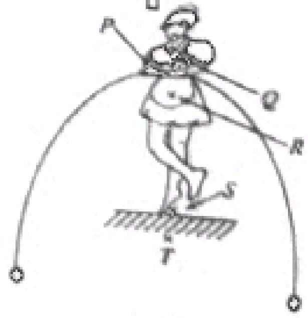
(1) (2) (3) (4) (5) (2004)

14) Three identical uniform books are placed on each other as shown in the figure. The centre of gravity of the set of books is likely to be found at,



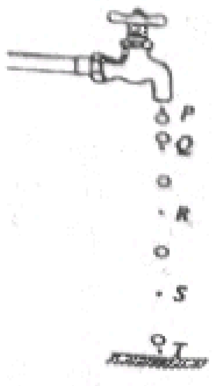
1) A 2) B 3) C 4) D 5) E (2005)

15) A toy in the form of a child – figure holding a section of a thin ring, which carries two identical heavy metal balls, is made from a thin metal sheet as shown in the figure. If the toy can be balanced in stable equilibrium from the toe of the child – figure, most probably the centre of gravity of the system can be found close as a point.



1) P 2) Q 3) R 4) S 5) T (2007)

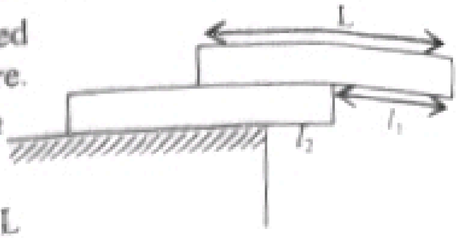
16) Water droplets drip at a constant rate from a tap as shown in the figure. The centre of gravity of the system of drops in the air is most likely to be found at,



1) P 2) Q 3) R
4) S 5) T

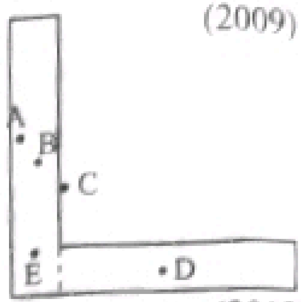
(2008)

17) Two identical uniform bricks of length L are stocked without bring toppled on a table as shown in figure. The respective maximum possible values for l_1 and l_2



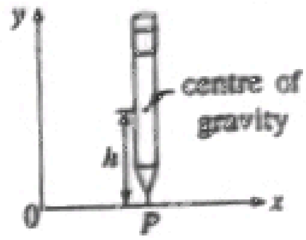
1) $\frac{L}{2}, \frac{L}{4}$ 2) $\frac{L}{2}, \frac{L}{6}$ 3) $\frac{L}{2}, \frac{L}{8}$
4) $\frac{L}{4}, \frac{L}{4}$ 5) $\frac{L}{4}, \frac{L}{6}$ (2009)

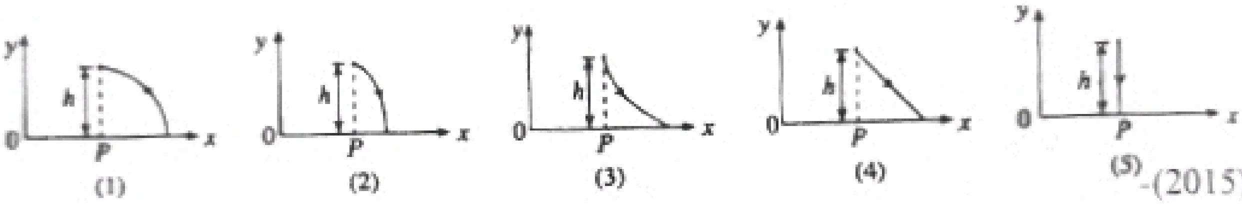
18) Figure shows a thin uniform L shaped metal sheet. The centre of gravity of the sheet is most likely to be found at the point



1) A 2) B 3) C 4) D 5) E (2012)

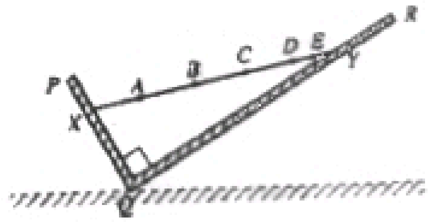
19) A pencil is held vertical on its tip on a frictionless table as shown in the figure. When it is allowed to fall freely towards the +x – direction, the path of the centre of gravity of the pencil is best represented by,





(2015)

20) A rod XY rests between two smooth boards PQ and QR kept inclined to the horizontal as shown in the figure. Angle PQR is 90° and the surfaces of the boards are normal to the plane of the paper. The centre of gravity of the rod is most likely to be situated at the point,



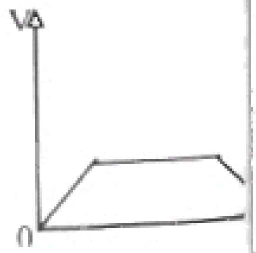
1) A 2) B 3) C 4) D 5) E (2016)

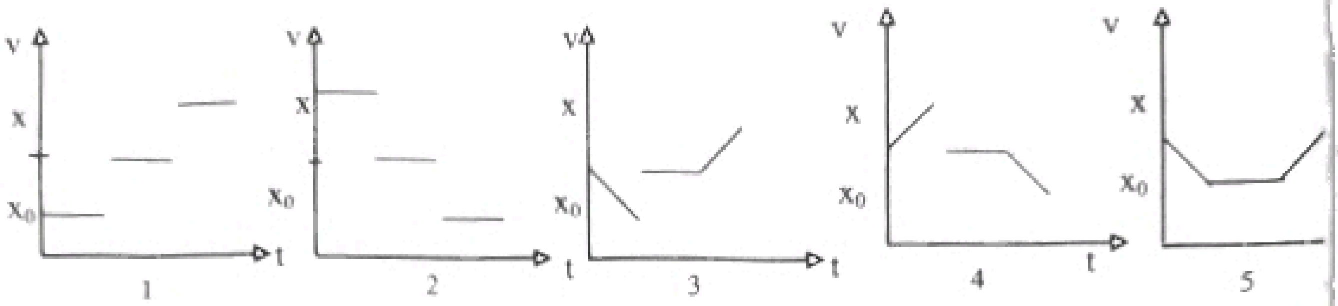
04. Newton's Laws and Momentum

1) A rail car of mass 5 M rests on a smooth horizontal track, an engine of mass 3M moving at 8 ms^{-1} collides and couples with the rail car. The speed of the engine after the impact is,
1) 1.6 $m\,s^{-1}$ 2) 3 ms^{-1} 3) 4.8 ms^{-1} 4) 5 ms^{-1} 5) 8 ms^{-1} (1992)

2) An astronaut of mass m is launched from the surface of the moon in a space craft having an initial vertical acceleration of 5g', where g' is the acceleration of free fall in moon. The vertical reaction of the space craft on the astronaut is,
1) zero 2) mg' 3) 4 mg' 4) 5 mg' 5) 6 mg' (1992)

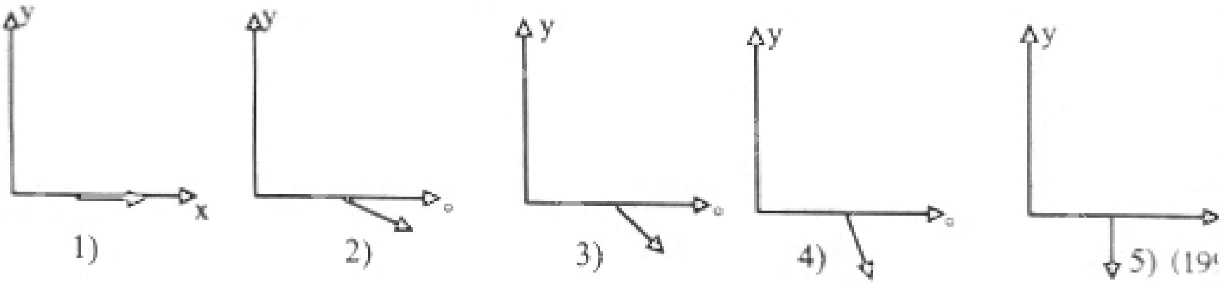
3) When a mass is suspended vertically by a light spring from the ceiling of a stationary lift, the extension of the spring is found to be x_0. If the lift is then set in motion in the vertically downward direction so that its velocity (V) varies with time (t) according to the graph shown in the figure, the variation of the extension (x) of the spring with time (t) is best, represented by,





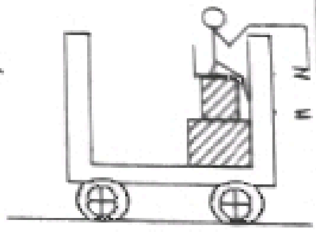
(19

4) An object of mass m, moving with speed V along the x-axis, suddenly breaks ir two identical pieces, if one of the broken pieces moves parallel to the y-axis alo its positive direction with speed V which of the following diagrams best indica the direction of motion of the other piece?



(19

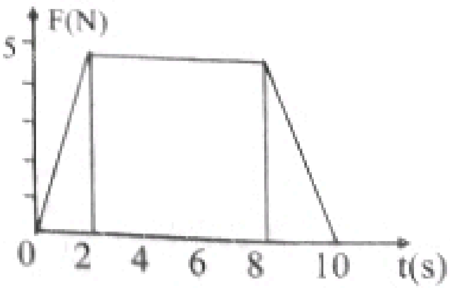
5) As shown in the figure a child is holding a strong magnet in front of an iron trolley plcced on a smooth track, which of the following statements made about the trolley is true,



1) it moves with a uniform speed
2) it moves with a uniform acceleration
3) it accelerates initially and then moves with a uniform speed
4) on viewing, stars will appear brighter on the moon than on the earth
5) Surface of the moon is bound to get more hits due to meteorites wh compared to the number of hits received by the earth.

(19

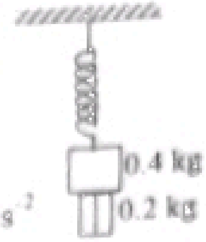
6) An object of mass 5 kg is subjected to a resultant force F which varies with time t as shown in the graph the momentum gained by the object in the 10 s is



1) 0 2) 5 N s 3) 40 N s
4) 50 N s 5) 60 N s

(19

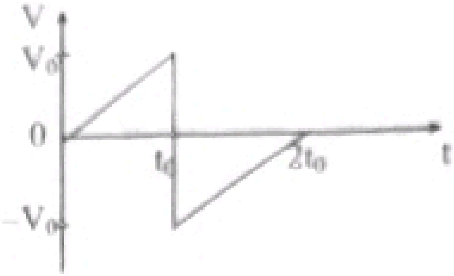
A mass of 0.4 kg is suspended from a light spring as shown. A second mass of 0.2 kg is suspended from the first by a thread. When the system is in equilibrium the thread is burnt. The initial acceleration of the 0.4 kg mass will be,



1) $\frac{10}{3}$ ms^{-2} 2) 5m s^{-2} 3) $\frac{20}{3}$ m s^{-2} 4) 10 m s^{-2} 5) 20 m s^{-2}

(1994)

The velocity (V) time (t) curve of a particle of mass m moving along a straight line is shown in the figure

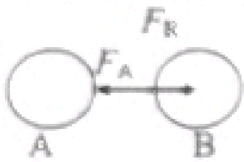


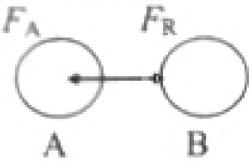
(A) The particle returns to the motion
(B) Acceleration of the particle does not change directions during the motion
(C) At $t = t_0$ the impulse acting on the particle is infinite

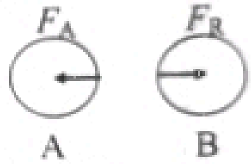
Of the above statements

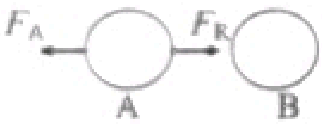
1) Only A is true 2) only B is true
3) Only C is true 4) Only A and B are true 5) all A, B and C are true (1995)

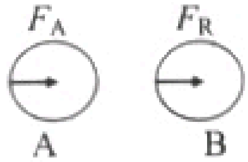
When two objects A and B collide with each other, in which of the following the action (F_A) and reaction (F_R) forces are correctly marked on objects?

1)


2)


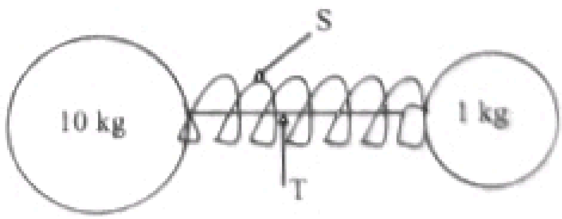
3)


4)


5)


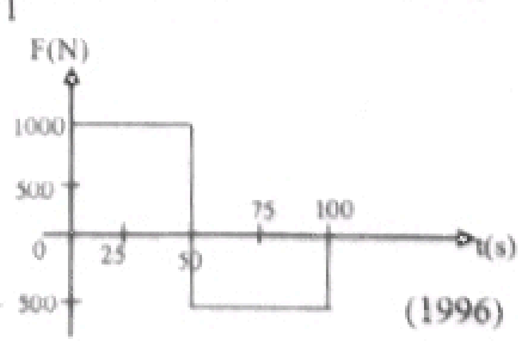
(1996)

S is a light spring compressed between two masses and the masses are held together by a string is cut, the 1 kg mass moves off with a velocity of 20ms^{-1} Then the 10 kg mass will move with a velocity of



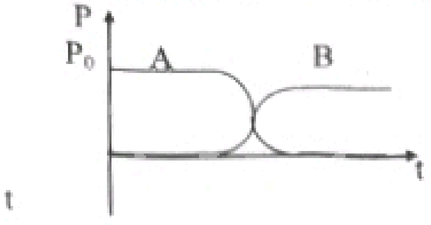
1) 20 m s^{-1} 2) 10 m s^{-1} 3) 2 m s^{-1} 4) $\frac{20}{11}$ m s^{-1} 5) 1 m s^{-1} (1996)

A force F varying with time as indicated in the figure is applied to a wagon of mass 10 000 kg, which is initially at rest on frictionless horizontal rails, After 100 s the speed of the wagon in ms^{-1} is,

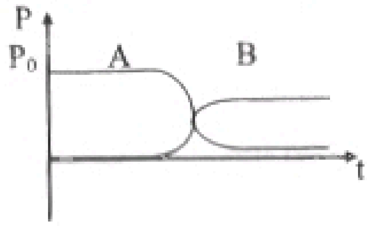


1) 1.25 2) 5 3) 7.5 4) 10 5) 15 (1996)

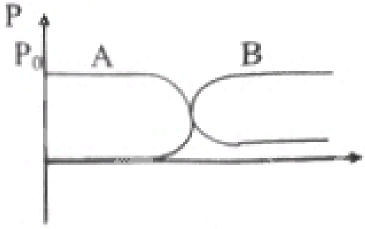
12) A particle A moving on a smooth horizontal table collides with another particle B which is at rest. If the magnitude of the initial momentum of A is p_0 which of the following curves best represents the moment a (p) of particles with time



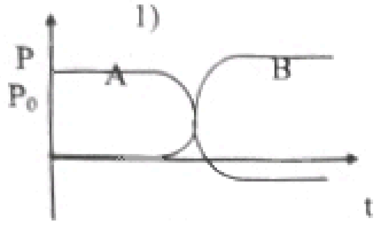
1)



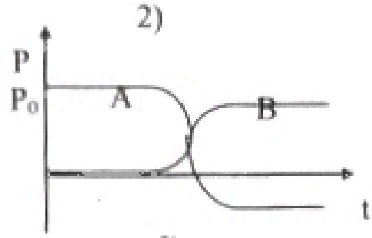
2)



3)



4)



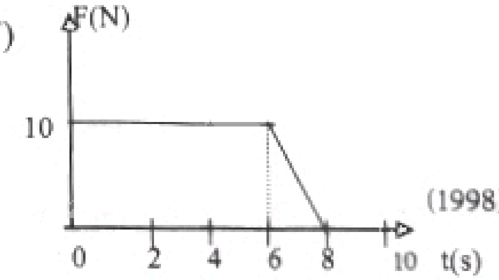
5) (1996)

13) A 5×10^{-2} kg lump of clay that is moving at a velocity of $10 ms^{-1}$ in a horizontal direction to the left strikes a 6×10^{-2} kg lump of clay moving in the same horizontal direction to the right at a velocity of $12\ ms^{-1}$. The two lumps stick together after they collide. The composite object will move at a velocity of,

1) 0 2) $1\ m\ s^{-1}$ 3) $2\ m\ s^{-1}$ 4) $11\ m\ s^{-1}$ 5) $22\ m\ s^{-1}$ (1997)

14) A body of mass 5kg is subjected to a force (F) which varies with time(t) as shown in the graph

1) 350 Ns 2) 80 Ns 3) 70 Ns
4) 40 Ns 5) 0

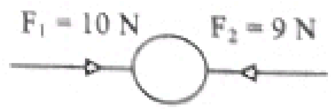


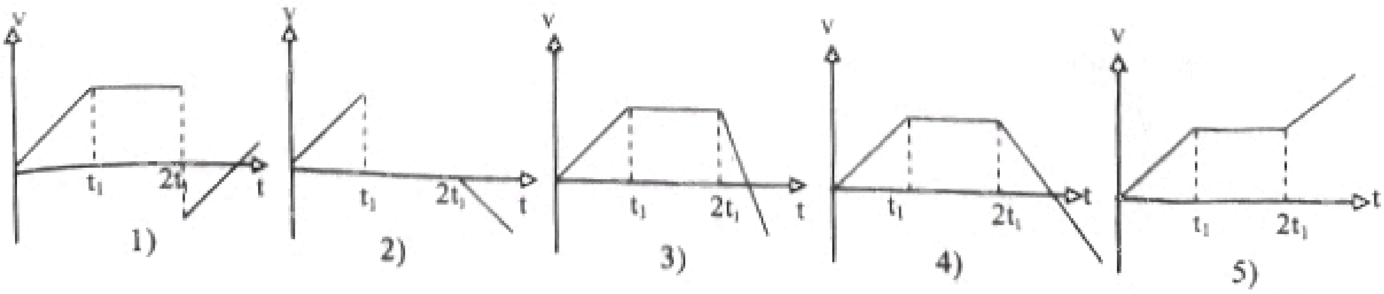
(1998)

15) A railway wagon of mass 1000 kg and length 11 m is at rest on a frictionless straight horizontal track. A man of mass 100 kg staying in the wagon walks straight from one end of the wagon to the other. If the wagon is free to move the distance through which it will move is,

1) 0 2) $\frac{1}{10}$ m 3) $\frac{1}{11}$ m 4) 1 m 5) 11 m (1998)

16) Two forces F_1 (=10 N) and F_2 (=9 N) are applied simultaneously to a stationary object at time t = as shown in the figure. The force F_2 is then increased suddenly to 10N at $t = t_1$ and the force F_1 is completely removed at time $t = 2t$, which of the following graphs best represents the variation of the velocity (v) of the object with time (t)?

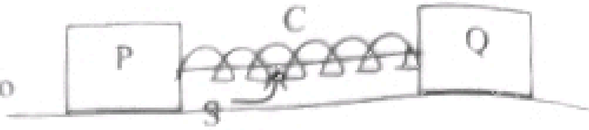




1) 2) 3) 4) 5)

(1998)

17) Two blocks P and Q of masses m_1 and m_2 ($m_2 > m_1$) are kept on a smooth horizontal table. The blocks are attached to the ends compressed light spring C, and are hold stationary - by a string



When the string is cut,

A) the total momentum of the system is zero

B) the forces on the blocks exert spring are equal in magnitude

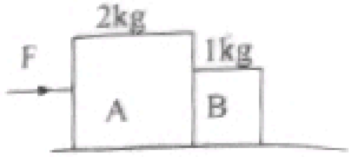
C) initially the block P moves better than Q

Of the above statements,

1) Only (A) is true 2) Only (B) is true 3) Only (A) and (B) are true

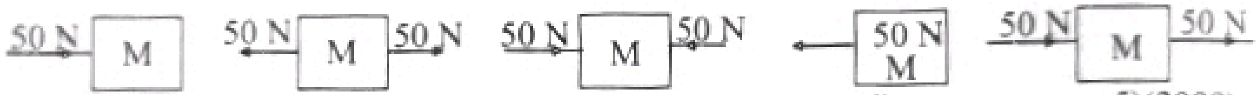
4) only (B) and (C) are true 5) all (A), (B) and (C) are true (1999)

18) Two blocks A and B of masses 2 kg and 1kg respectively are in contact on a frictionless table when a horizontal force F is applied on A as shown in the figure. The force exerted by B on A is 1N. If instead the same force is applied to B in the opposite direction, the force exerted by A on B is,



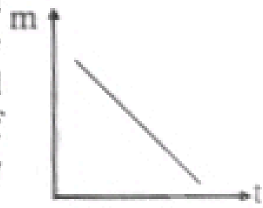
1) 0.5 N 2) 1 N 3) 2 N 4) 4N 5) 5N (1999)

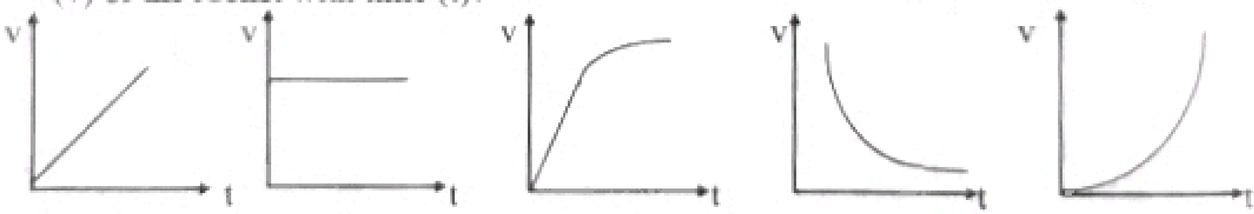
19) Which of the following objects of mass M has the greatest acceleration?



1) 2) 3) 4) 5)(2000)

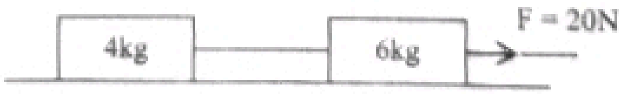
20) Figure shows haw the mass (m) of fuel in a rocket decreases with time (t) when it moves away from the earth perpendicular to the earth surface. If the atmospheric resistance is disregarded and the thrust producel by the fuel is constant throughout, which of the following graphs best represents the variation of the velocity (v) of the rocket with time (t)?





1) 2) 3) 4) 5)(2000)

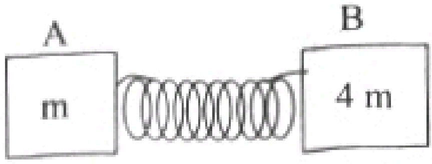
21) Two masses joined by a light string are pulled along a smooth horizontal table as shown in the diagram .



What is the tension in the string joining the masses?

1) 4 N 2) 8 N 3) 12 N 4) 20 N 5) 30 N (2001)

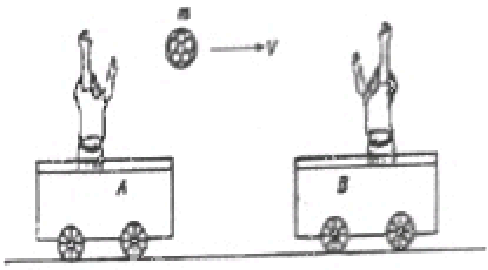
22) Two masses m and 4m lying on a smooth table are compressed against a spring as shown in the figure. As the masses are released the speeds of masses, V_A and V_B are related by



1) $V_A = V_B$
2) $V_A = 2V_B$
3) $V_A = 4V_B$
4) $2V_A = V_B$
5) $4V_A = V_B$ (2002)

23) A golf ball or mass 0.05kg leaves with a velocity of $70 ms^{-1}$ after being struck by a golf club. If the time of contact or the ball with the golf club is 5×10^{-4} s, the mean force applied by the golf club on the ball is,
1) 5.0×10^5 N
2) 2.5×10^5 N
3) 7.0×10^3 N
4) 1.4×10^3 N
5) 1.2×10^3 N (2003)

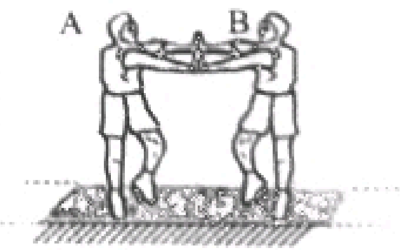
24) Two boys of identical masses are standing on two identical trolleys A and B which are at rest on a frictionless horizontal surface. The boy on trolley A then throws a ball of mass m horizontally with velocity V with respect to the earth and the boy on trolley B boy is M, the respective final velocities of trolleys A and B are,



1) $\frac{-mV}{M}$ and $\frac{-mV}{M+m}$
2) $\frac{-mV}{M+m}$ and $\frac{mV}{M+m}$
3) $\frac{-mV}{M}$ and $\frac{mV}{M+m}$
4) $\frac{-mV}{M-m}$ and $\frac{mV}{M+m}$
5) – v and v (2003)

25) A horizontal force of 10N is applied for a period of 10 ms on a body placed on a smooth horizontal table. The change in momentum of the body in SI units will be,
1) 10^{-3} 2) 0.1 3) 1.0 4) 10^2 5) 10^3 (2004)

26) Two boys, *A* and *B*, standing on a horizontal ice surface move apart by pushing each other. The weight of *A* is twice taht of *B*. By the time *A* has moved 4 m the distance moved by *B* is,



1) 0
2) 2 m
3) 4m
4) 8m
5) 12 m (2006)

27) Suppose the times taken for a large airplane to accelerate uniformly from 500 km hr^{-1} to 505 km hr^{-1} a car from 50 km hr^{-1} to 55kmhr^{-1} and bicycle from 5 km hr^{-1} to 10 km hr^{-1} are same. Consider the following statements.
A) All forward with the same accelaration.
B) All travel the same distance during the above time period.
C) The accelerating force on each is the same.
Of the above statements.
1) only (A) is true
2) only (B) is true.
3) only (A) and (B) are true
4) only (A) and (C) are true
5) all (A), (B) and (C) are true. (2006)

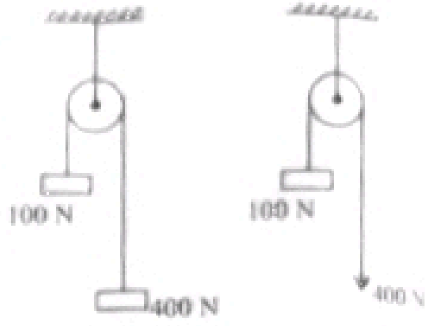
28) Consider the following statements made ragarding the action force and the reaction force

1) They are equal in magnitude
2) They act on the same object
3) They are opposite in direction to each other

Of the above statements,

1) only (A) is true 2) only (A) and (B) are true 3) only (A) and (C) are true
4) only (B) and (C) are true 5) all (A), (B) and (C) are true (2008)

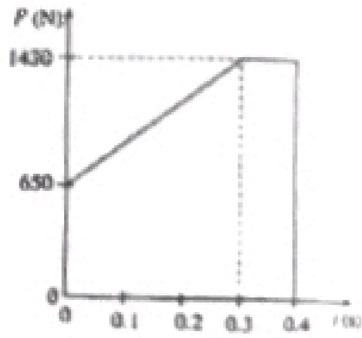
29) Figure (A) shows two blocks of height 100 N and 400 N which are connected by a light string that passes over a frictionless pulley. Figure (B) shows a situation when the heavier block in the system, is removed and the string is pulled by a downward force of 400 N. The repective accelerations of the 100 N block in the two situations are given by,



(A) (B)

1) 0.6 ms^{-2} and 3 ms^{-2} 2) 6 ms^{-2} and 6 ms^{-2}
3) 10 ms^{-2} and 10 ms^{-2} 4) 6 ms^{-2} and 40 ms^{-2}
5) 6 ms^{-2} and 30 ms^{-2} (2008)

30) Figure shows the variation of the force (F) exerted by the floor on the feet with time (t) when a person jumps vertically upwards. The force (F) increases from a value which is equal to the person's normal weight of 650 N to 1430 N in 0.3s, stays constant for 0.1s, and then drop to zero as the feet lose contact with the floor. At what speed did the person leave the floor ?

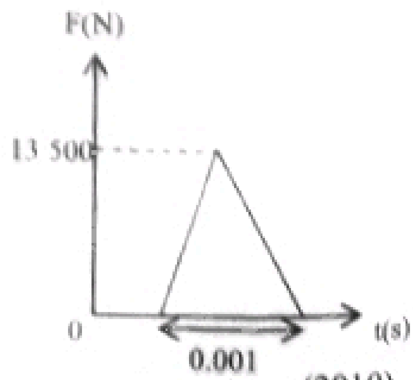


1) 1 ms^{-1} 2) 1.5 ms^{-1} 3) 2 ms^{-1}
4) 3 ms^{-1} 5) 10 ms^{-1} (2008)

31) Two massed M and m, placed on a frictionless horizontal are connected together as shown in figure using a spring whose mass is negligible. Two masses are first pressed together so that the spring is compressed, and the released. If the initial acceleration of mass m is a, what would be the magnitude of acceleration of mass M at that moment ?

1) $\frac{ma}{M+m}$ 2) $\frac{Ma}{M+m}$ 3) $\frac{ma}{M}$ 4) $\frac{Ma}{m}$ 5) $\frac{(M+m)a}{m}$ (2009)

32) A cricket ball of mass 0.15 kg travels with a speed of 20 ms^{-1} just before batted by a batsman. When he batted, the variation of the force (F) exerted by the hat on the ball with time(t) is shown in the graph. If the half bounces back in the opposite direction the speed of the cricket ball just after batting is,

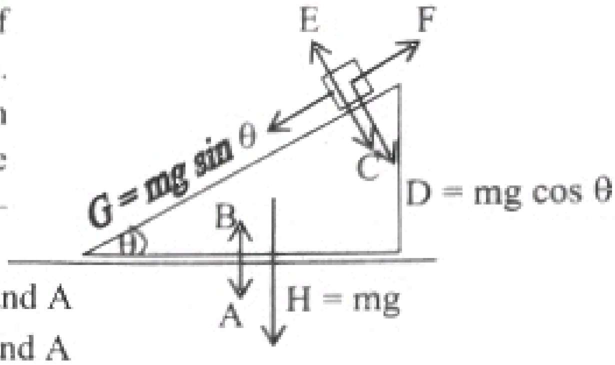


1) 20 ms^{-1} 2) 25 ms^{-1} 3) 65 ms^{-1}
4) 70 ms^{-1} 5) 110 ms^{-1} (2010)

33) An artillery gun is positioned on a horizontal ground and an artillery shell is fired from it so that the shell would land at a target, which is located at a distance 2000 m from the position of the gun. Accidentally the shell explodes into two pieces A and B at a certain point of its trajectory. The mass of A is twice that of B, and both pieces land at the **same moment**, after travelling in the same vertical plane. If A lands at a distance 1800 m in the direction of the target from the gun, the distance to the landing point of B from the gun is,

1) 1600 m 2) 2200 m 3) 2400 m 4) 2600 m 5) 2800m (2010)

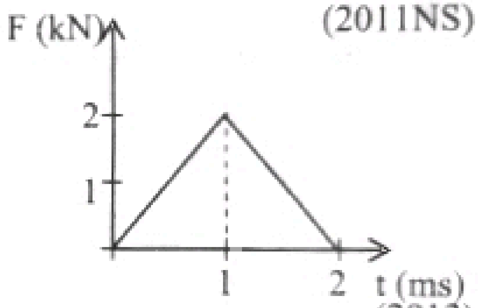
34) A block of mass m is placed on a wedge of mass M which is placed on a horizontal plane. The free body diagram of the system is shown in figure. Out of the forces marked on the diagram what could be considered as action – reaction pairs ?



1) E and C, F and G 2) E and D, B and A
3) E and D, B and H 4) E and C, B and A
5) E and C, B and H

(2011NS)

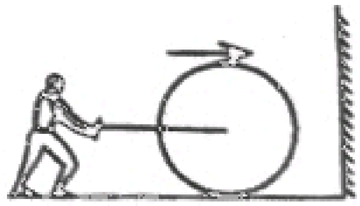
35) A ball of mass 0.5kg which is initially at rest, is struck by a bat. The variation of the force (F) on the ball with time (t) is shown in the figure. The speed of the ball when it leaves the bat is,



1) 10 ms^{-1} 2) 8 ms^{-1} 3) 6 ms^{-1}
4) 4 ms^{-1} 5) 2 ms^{-1}

(2012)

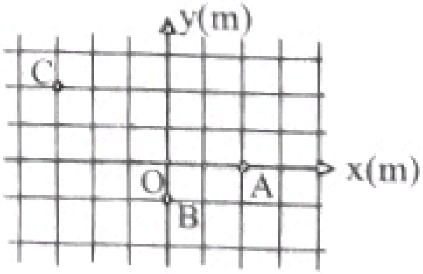
36) A heavy roller of mass 500 kg, moving on a horizontal surface at a constant velocity of 1 ms^{-1} as shown in figure is stopped in 0.5 s on hitting a smooth vertical wall. the horizontal force exerted by the roller on the wall is,



1) 5 000 N 2) 3 000 N 3) 2 000 N
4) 1 000 N 5) 500 N

(2014)

37) A small object is initially at rest at point O, and due to an internal explosion it breaks into three parts and move away. At a certain instant after the explosion, the location of three moving parts are shown by the points A, B and C in figure. If the mass of the part which is at point A is 6 grams, what is the mass of the object (in grams) before explosion?

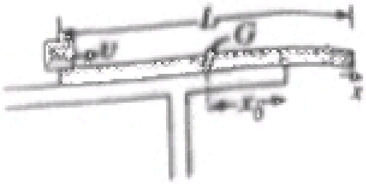


1) 6 2) 9 3) 12 4) 15 5) 18 (2014)

38) A gymnastic player of mass 50 kg lands on the ground vertically with a velocity of 6 ms^{-1} and with his body straight. As his feet touches the ground he bends his knees while keeping rest of the body vertical, and brings his body to a complete stop in 0.2 s. The average value of the force exerted on the player by the ground during the period of 0.2 s is,

1) 30 N 2) 300 N 3) 1500 N 4) 1800 N 5) 3000 N (2015)

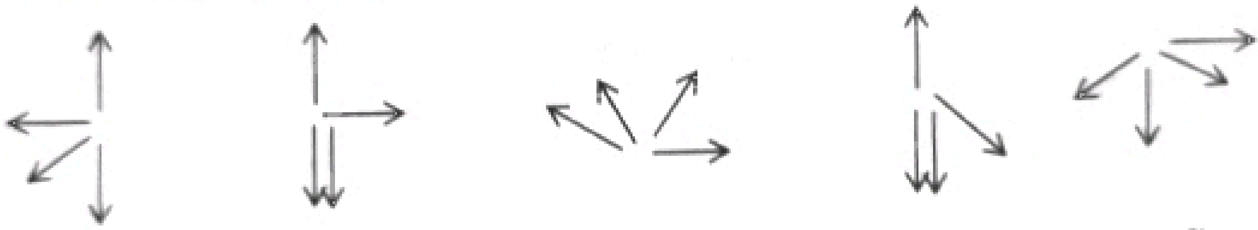
39) A uniform rectangular wooden strip of length L and mass M is placed on a table along the x direction and parallel to one of its edges so that a part of the strip is extended out as shown in the figure. Distance from the centre of gravity G of the strip to edge of the table is x_0. Now a small block of mass m is placed at the left edge of the strip, and an initial speed of v is given to it along the strip in the x direction. If the coefficient of kinetic friction between the strip and the block is μ, the minimum speed that can be given to the block to topple the strip is,



1) $\sqrt{2\mu g\left(x_0+\frac{L}{2}+\frac{Mx_0}{m}\right)}$ 2) $\sqrt{\mu g\left(\frac{L}{4}+\frac{Mx_0}{m}\right)}$

3) $\sqrt{2\mu g\left(x_0+\frac{L}{2}+\frac{mx_0}{M}\right)}$ 4) $\sqrt{\frac{\mu g M x_0 L}{\left(\frac{L}{2}+x_0\right)}}$ 5) $\sqrt{2\mu g\left(\frac{x_0}{2}+\frac{ML}{m}\right)}$ (2015)

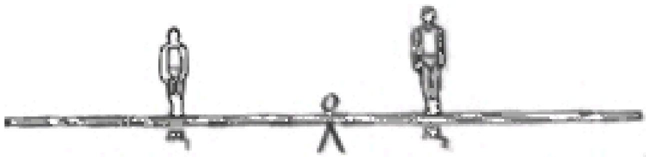
40) An object falling down vertically in air suddenly explodes into four pieces. Which of the following diagrams shows the possible **directions** of motion of the pieces immediately after the explosion? (↓ – direction of the object before explosion.)



1) 2) 3) 4) 5)

(2016)

41) Two children of masses m_1 and m_2 are standing in equilibrium as shown in figure, on a uniform rod which is balanced at its centre of gravity *O*. Then they start moving simultaneously on the rod at constant speeds υ_1 and υ_2 respectively while maintaining the horizontal equilibrium of the rod. Consider the following statements made about the motion of the two children. For the equilibrium to be maintained at any time *t*,

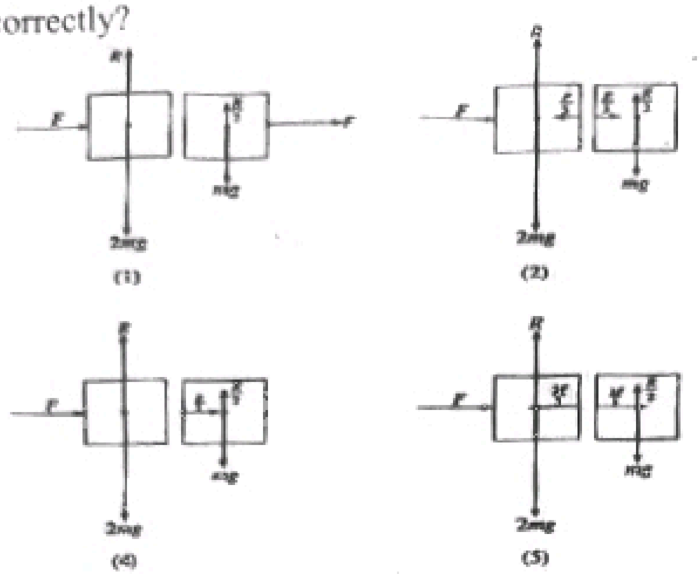


(A) They should always move in opposite directions.
(B) They should move keeping their total linear momentum always equal to zero.
(C) They should move so that the moment produced by one child about *O* is always equal and opposite to the moment produced by other child about *O*.

Of the above statements,

1) Only A is true. 2) Only B is true. 3) Only A and B are true.
4) Only B and C are true. 5) All A, B and C are true. (2016)

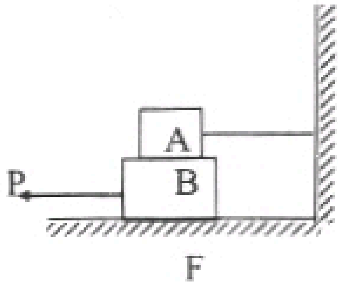
42) Two blocks of mass 2 m and m are placed in contact on a smooth surface as shown in the figure (a). If an external horizontal force F is applied on the block of mass 2 m, which of the following figures shows the forces acting on the two blocks correctly?



(2016)

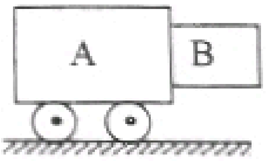
05. Friction

01) A block A of weight 4 N is kept on another block, B, of weight 12 N which rests on floor F as shown in the figure. A is connected to the wall by an inextensible light rod, if the coefficient of static friction between A and B and B and F are the same and is equal to 1/4 , the minimum force P required to drag B to the left is,



1) 1 N 2) 2 N 3) 3 N 4) 4 N 5) 5 N (1994)

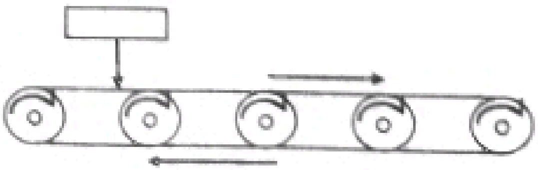
02) A trolley A is on a horizontal track B is a wooden block of mass m. If the coefficient of static friction between the trolley and the block is μ ,the minimum acceleration of the trolley that is required prevent the block from sliding down is

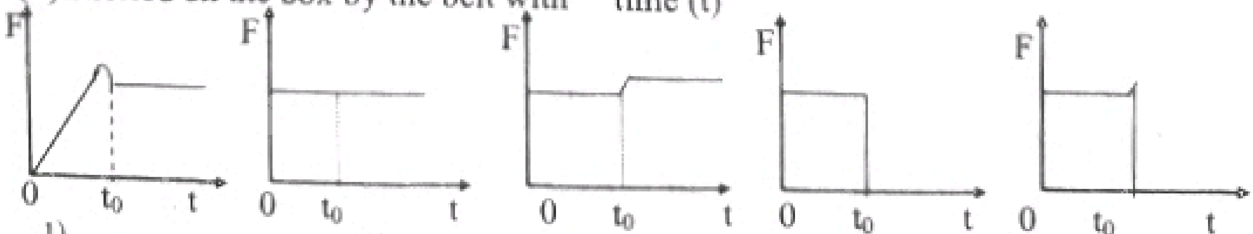


1) $\frac{g}{\mu}$, to the right 2) g, to the right 3) $\frac{g}{\mu}$, to the left

4) μg, to the right 5) $\frac{mg}{\mu}$,to the right (1995)

03) A box is dropped at time t = 0 vertically on to a conveyer belt moving at a constant speed in the horizontal direction as shown in the figure. If the box attains the velocity of the belt at time to which of the following curves best represents the variation of the magnitude of the frictional force (F) exerted on the box by the belt with time (t)



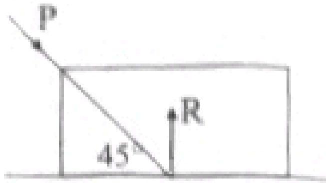


1) 2) 3) 4) 5) (1996)

04) A block rests on an inclined plane whose angle of inclination (θ) to the horizontal can be varied, which of the following graphs the variation of the frictional force F between the block and the plane with θ.

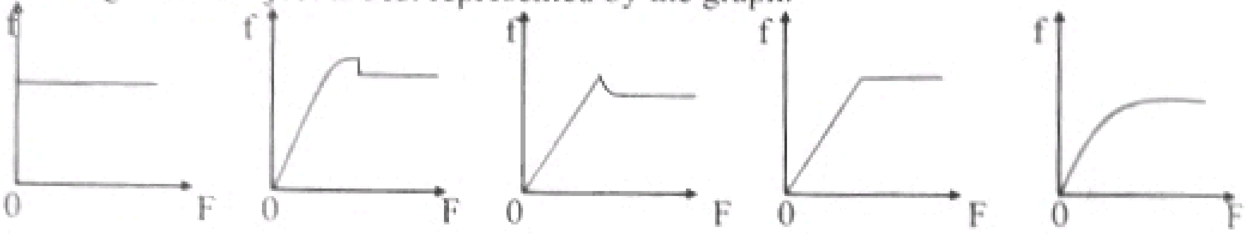
1) 2) 3) 4) 5) (1998)

05) As shown in figure a force P is applied on an object of mass 2 kg lying on a horizontal surface. The coefficient of kinetic friction between the two surfaces is 0.5. If the object moves with uniform velocity the normal force R acting on the object is,



1) 10 N 2) $10\sqrt{2}$ N 3) 20 N 4) $20\sqrt{2}$ N 5) 40 N (2000)

06) An object lies on a horizontal table. When the object is pulled by a horizontal force F that increases uniformly from zero, the variation of the frictional force f acting on the object is best represented by the graph.



1) 2) 3) 4) 5) (2004)

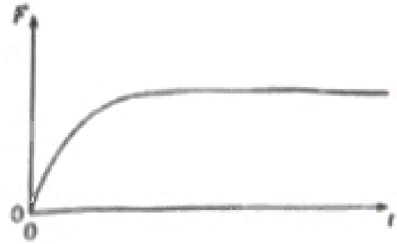
07) Which of the following figure shows the direction of the frictional forces acting on the two tyres of a bicycle when it is paddled by a rider on a surface with friction?

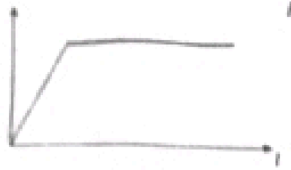
1) 2) 3) 4) 5) (2005)

08) A box of mass 5 kg is placed on a horizontal surface. The coefficient of static friction between the box and the surface is 0.3. If a horizontal force of 10 N is applied to the box, the magnitude of the frictional force acting on the box will be,
1) 1.5 N 2) 3N 3) 4.5 N 4) 10 N 5) 15 N (2008)

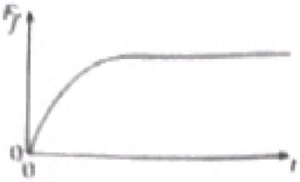
09) A box rests on the floor of an elevator. If the magnitude of the minimum force required to slide the box on the floor when the elevator is stationary, accelerating upward, and accelerating downward are F_1, F_2 and F_3 respectively then,
1) $F_2 > F_1 > F_3$ 2) $F_1 > F_2 > F_3$ 3) $F_3 > F_2 > F_1$
4) $F_1 > F_3 > F_2$ 5) $F_1 = F_2 = F_3$
(2008)

10) A box is placed on a horizontal surface and a horizontal force F is applied on the box. Variation of the magnitude of F with time is shown in the graph. Which of the following graphs shows the possible variations of the magnitude of the frictional force F_f acting on the box with time ?

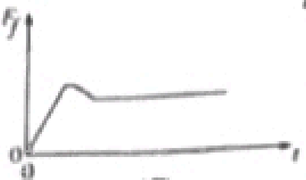




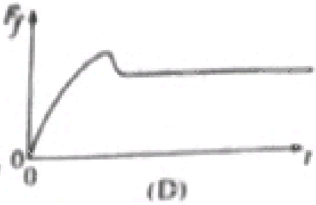
(A)



(B)



(C)

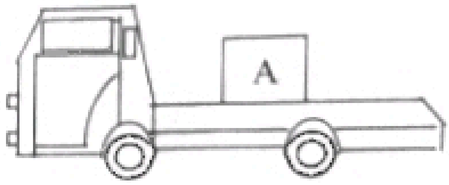


(D)

1) (A) only
2) (B) only
3) (D) only
4) (B) and(D) only
5) (A) and (C) only

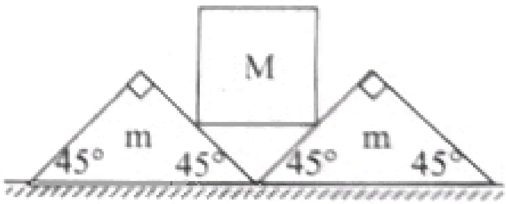
(2009)

11) A box (A) of mass 50 kg is placed on the horizontal floor – bed of a lorry as shown in the figure. The coefficient of static friction between the box and the floor – bed is 0.8 and the lorry accerlerates along straight horizontal road. The maximum acceleration the lorry can have so that the box will not lside over the floor – bed is,



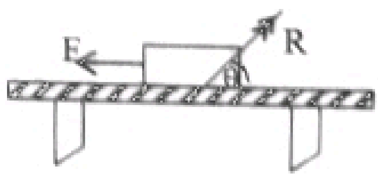
1) $2\ ms^{-2}$ 2) $4\ ms^{-2}$ 3) $8\ ms^{-2}$ 4) $10\ ms^{-2}$ 5) $12\ ms^{-2}$ (2010)

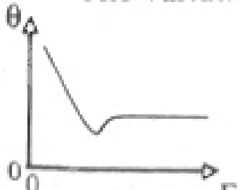
12) Two identical wedges each of mass m are placed next to each other on a float floor. A cube of mass M is placed on the wedges as shown in the figure. Assume that here is no friction between the cube and the wedges. The coefficient of static friction between the wedges and the floor is μ. The largest M that can be balanced without moving the wedges is given by,



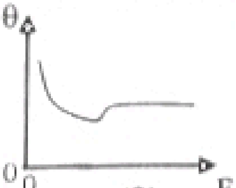
1) $\frac{\mu m}{\sqrt{2}}$ 2) $\frac{\mu m}{1-\mu}$ 3) $\frac{2\mu m}{1-\mu}$ 4) $(1-\mu)m$ 5) $\sqrt{2}(1-\mu)m$ (2011)

13) A box, which is placed on a rough, horizontal surface of a table is pulled by a variable, horizontal force of magnitude F. For a given value of F the resultant force R exerted by the surface on the box makes an angle θ with the horizontal direction as shown in the figure. The variation of θ with F is best represented by,

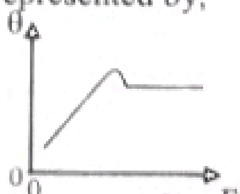




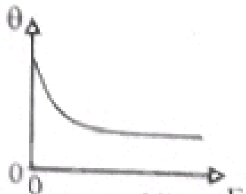
(1)



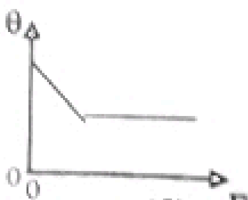
(2)



(3)



(4)



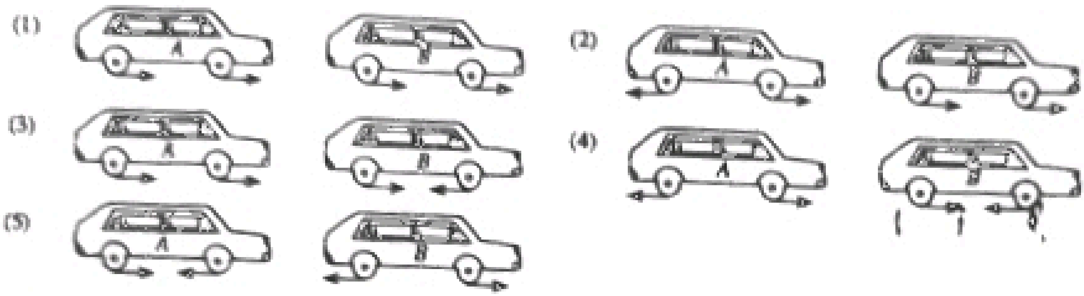
(5)

(2013)

14) A block of mass m, kept on the horizontal truck-bed, is at rest with respect to the truck when it is moving horizontally with a constant acceleration a. The coefficient of static friction between the truck – bed and the mass is μ. The frictional force acting on the mass is given by

1) ma 2) μ ma 3) μm (g + a) 4) μm (g – a) 5) mg (2013)

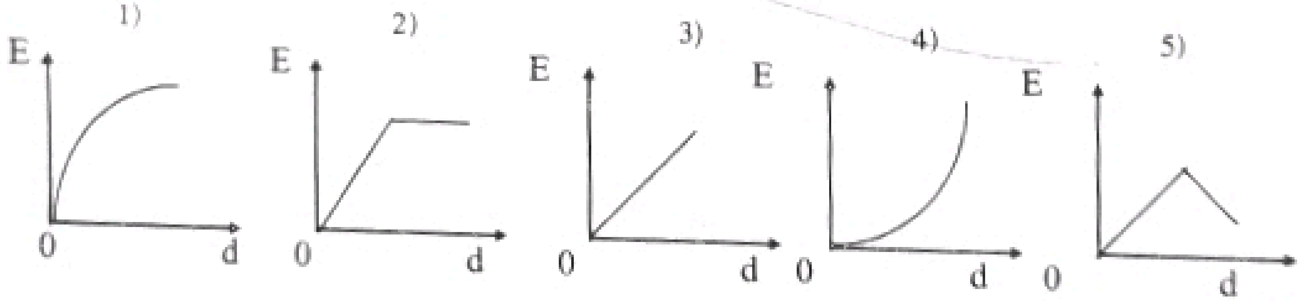
15) Consider two motor vehicles, A and B. In motor vehicle A only the front wheels are coupled to the engine and rotated, and in vehicle B only the rear wheels are coupled to the engine and rotated. Which of the following diagrams correctly shows the directions of the frictional forces acting on the front an drear wheels of motor vehicles A and B by the ground, when they are travelling in the forward direction?



(2014)

06. Work Power and Energy

01) An object starts from rest and moves with a constant acceleration, which of the following graphs best represents the variation of its kinetic energy E with distance traveled d?



(1994)

02) If two objects collide in the absence of external forces, which one of the following statements is always true?

1) The momentum of each object remains unchanged
2) The kinetic energy of each object remains unchanged
3) The total momentum of object remains unchanged
4) The total momentum of objects remains unchanged
5) Direction of motion of each object remains unchanged

(1995)

03) An electric motor pulls a 100kg mass to a height of 30 m in 2s. The minimum power needed for this is

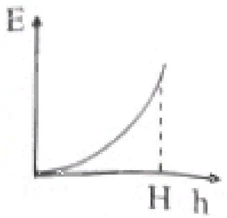
1) 2000 kW 2) 1000 kW 3) 200 kW 4) 100 kW 5) 10 kW (1996)

04) Two small objects of masses M and 2M are release from rest at heights 2h and h respectively above the ground level. Which of the following is same for both masses just before hitting the ground (Neglect the air resistance)

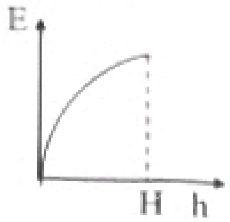
1) Speed 2) Kinetic energy 3) Time of travel
4) gravitational force acting on masses 5) Momentum

(1997)

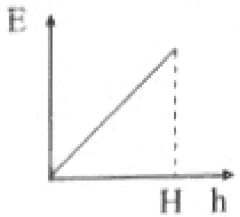
05) A particle falls freely from a height H above the ground. Which of the following graphs represents the variation of its total energy (E) with the height (h) ?



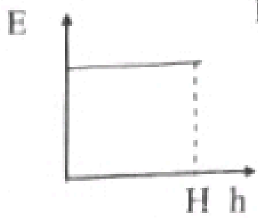
1)



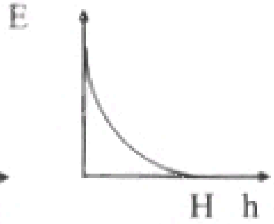
2)



3)



4)



5)(1998)

06) Two particles A and B have equal kinetic energies. But the velocity of the particle B is four times that of a the ratio $\frac{\text{momentum of A}}{\text{momentum of B}}$ is,

1) 1 2) 2 3) 4 4) 8 5) 16 (2000)

07) Two particles A and B have equal momenta, but the velocity of the particle B is four times that of A. The ratio $\frac{\text{kinetic energy of A}}{\text{kinetic energy of B}}$ is,

1) 1/4 2) 1/2 3) 1 4) 2 5) 4 (2001)

08) A cricket ball is hit for a six. It leaves the bat at an upward angle of 45^0 to the horizontal with kinetic energy k. Kinetic energy of the ball at the top of its flight is (neglect air resistance)

1) 0 2) $\frac{k}{4}$ 3) $\frac{k}{2}$ 4) $\frac{k}{\sqrt{2}}$ 5) k (2003)

09) Consider the following statements

(A) If the kinetic energy of a particle is constant with time ,its momentum should also be constant with time

(B) If the momentum of a particle is constant with time, its kinetic energy should also be constant with time

(C) If the momentum of a particle varies linearly with time, its kinetic energy should also vary linearly with time

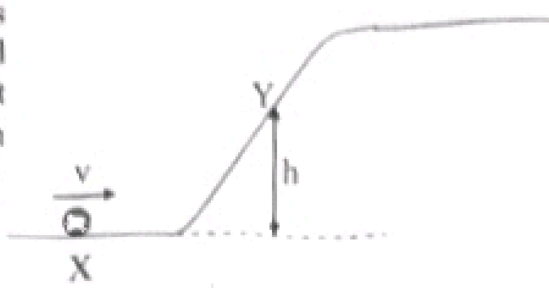
Of the above statements

1) Only (A) is true 2) Only (B) is true 3) Only (C) is true
4) Only (A) and (B) are true 5) Only (A) and (C) are true (2003)

10) Total electric power generation capacity of Sri Lanka is approximately 2.1 GW. If this power is to be generated by converting mass into energy , how much mass per second should be converted into energy? (Velocity of light = 3×10^8 ms^{-1})

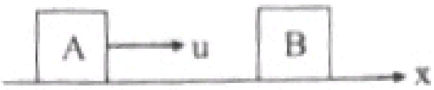
1) 0.023 mg/s 2) 23 g/s 3) 2.3 kg/s 4) 6.9 kg/s 5) 47.61 kg/s (2004)

11) As object of mass m moving on a frictionless plane passes a point X with a velocity v and rises up a frictionless inclined plane to a point Y that is at a height is above X as shown in the figure. If a second object of mass $\frac{m}{2}$ passes the point X with a velocity $\frac{v}{2}$ the height to which the second object will rise is,

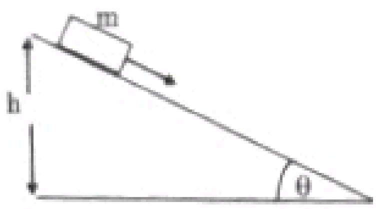


1) $\frac{h}{8}$ 2) $\frac{h}{4}$ 3) $\frac{h}{2}$ 4) h 5) 2h (2005)

12) The object A of mass m and velocity u moving on a smooth horizontal surface along positive x direction makes a perfectly elastic collision with an identical object B which is at rest as shown in the figure. After the collision ,the velocities of A and B are,

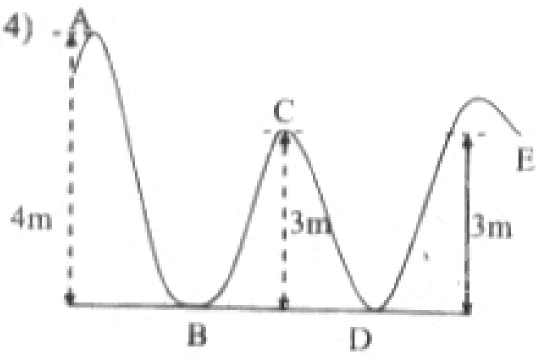


1) 0, and u along positive x direction respectively
2) $\frac{u}{2}$ along positive x direction, and $\frac{u}{2}$ along positive x direction respectively
3) $\frac{u}{2}$ along negative x direction, and $\frac{u}{2}$ along positive x direction respectively
4) u along negative x direction, and 0 respectively
5) 0, and $\frac{u}{2}$ along positive x direction respectively (2005)

13) 

A wooden block of mass m is sliding down an inclined plane at **constant speed** from a height h above the ground as shown in the figure. The total energy dissipated due to friction by the time the block reaches the bottom of the plane is,

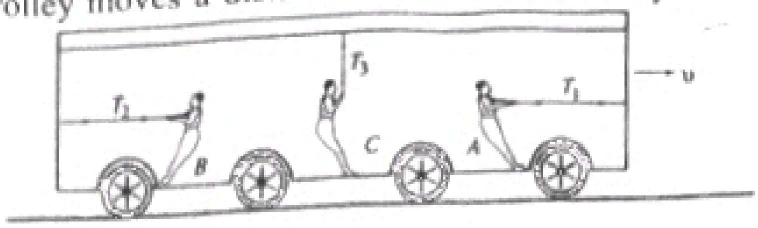
1) $\frac{mgh}{\cos\theta}$ 2) $\frac{mgh}{\sin\theta}$ 3) mgh tan θ 4) mgh 5) 0 (2006)

14) 

As shown in the figure a ball of mass 6 kg released from rest at point *A* on a smooth track *ABCD* slips without rolling. The portion *DE* of the track is rough. If the ball climbs units a vertical height of 3 m along the rough surface, the energy lost due to friction is,

1) 240J 2) 180 J 3) 120J
4) 60J 5) 0 (2007)

15) A trolley is moving with a constant velocity υ. Three men A, B and C are pulling three strings in such a way that their tensions are T_1, T_2 and T_3 respectively, as shown in the figure. When the trolley moves a distance L, the work done by the men are,



	A	B	C
1)	T_1L	T_2L	T_3L
2)	$-T_1L$	T_2L	0
3)	T_1L	$-T_2L$	0
4)	T_1L	T_2L	0
5)	0	0	0

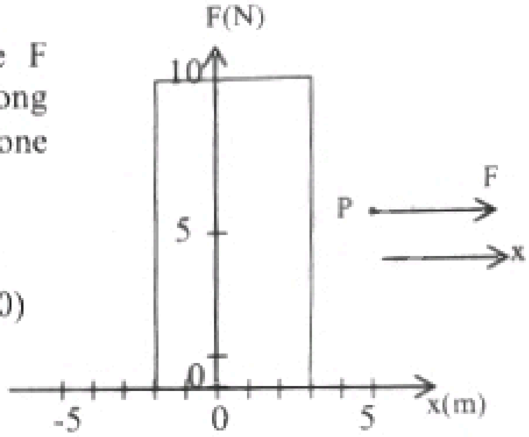
(2007)

16) When a ball of mass 0.1 kg is thrown vertically upward in a a vacuum, it reaches a maximum height of 5.0m. When the ball is thrown upward with the same velocity in air it reaches a maximum height of 2.0m. The average resistive force exerted on the ball by the air is,

1) 1.5N 2) 1.25 N 3) 1.0 N 4) 0.75 N 5) 0.5 N (2008)

17) The graph shows the variation of a force F exerted on an object P when it is moving along the x axis from x = – 5 to x = 5 . The work done on the object by the force is,

1) 10 J 2) 30 J 3) 40 J
4) 50 J 5) 100 J (2010)



18) A particle of mass m_1 moving with speed υ along positive (+) x direction collides elastically with another particle of mass m_2 at rest. Which of the following statements made regarding the motion of the particles after the collision is **incorrect** ?

(A) If $m_1 < m_2$ then m_1 and m_2 would move in –x and +x directions respectively.

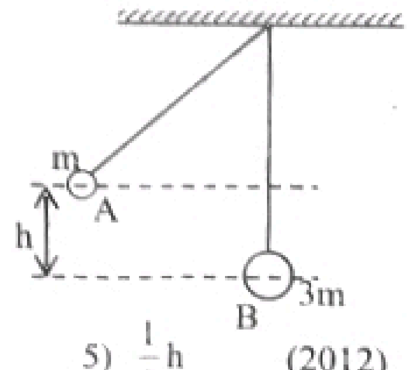
(B) If $m_1 > m_2$ then both m_1 and m_2 would move in +x direction.

(C) m_1 and m_2 would move together as a single mass with a speed lower that υ in the +x direction.

(D) The speed of m_1 would be lower than υ unless m_2 is infinitely large.

(E) If $m_1 = m_2$ then the speed of m_2 would be υ. (2011)

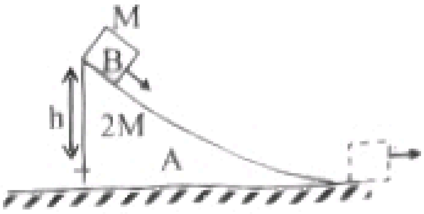
19) Two small spheres A and B of pully of mass m and 3m respectively are suspended from a ceiling by means of strings of equal length. Sphere A is drawn aside so that it is raised to a height h as shown and then released. Sphere A collides with sphere B which is at rest, and they stick together. The maximum height to which the composite body swings is,



1) $\frac{1}{16}h$ 2) $\frac{1}{8}h$ 3) $\frac{1}{4}h$ 4) $\frac{1}{3}h$ 5) $\frac{1}{2}h$ (2012)

20) If the mean output pressure of the heat is 1.2×10^4 Pa and the mean blood flow rate is 5.0×10^{-3} m^3 per minute, the mean output of the heat is
1) 0.5W 2) 1.0W 3) 1.5W 4) 2.0W 5) 2.5W (2013)

21) A body A of mass 2M shown in figure is place on a smooth horizontal surface, and a small block B of mass M is placed at the top of the body. Starting from rest, block B slides down on the smooth surface of A. At the instant when block B leaves A the speed v of A is given by

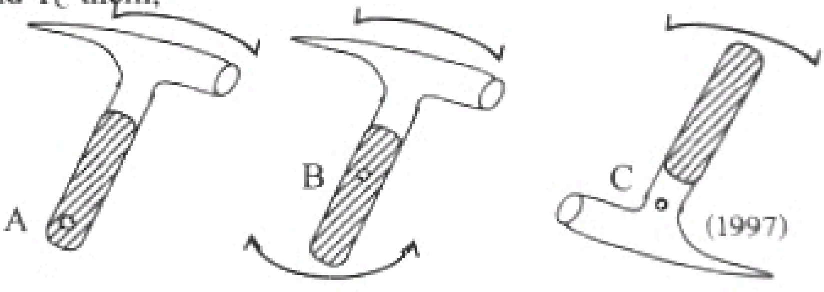


1) $\upsilon = \sqrt{2gh}$ 2) $\upsilon = \sqrt{gh}$ 3) $\upsilon = \sqrt{\frac{gh}{2}}$ 4) $\upsilon = \sqrt{\frac{gh}{3}}$ 5) $\upsilon = \sqrt{\frac{gh}{5}}$ (2013)

22) An elevator of weight 5000 N carries a load of 5000 N. White moving vertically upwards in a building, it travels at constant velocity from 2^{nd} floor to 12^{th} floor in 20 seconds. The height of each floor is 4 m. If only 80% of the power generated by the motor is consumed to lift the elevator and the load against gravity while moving at constant velocity, the power f the motor is,
1) 20 kW 2) 25 kW 3) 40 kW 4) 60 kW 5) 1 000 kW (2016)

07. Rotational Motion

01) A hammer is made to swing with the same angular acceleration about the points A, B and C as shown in the figure. If the respective torques required. If the respective torques required are $T_A T_B$ and T_C them,
1) $\Gamma_A > \Gamma_B > \Gamma_C$
2) $\Gamma_A > \Gamma_C > \Gamma_B$
3) $\Gamma_C > \Gamma_B > \Gamma_A$
4) $\Gamma_A = \Gamma_C < \Gamma_B$
5) $\Gamma_A = \Gamma_B = \Gamma_C$



(1997)

02) A rotating fly wheel of moment of inertia 2 kgm^2 about its axis brought to rest in 20s by a constant couple of 20 Nm acting on the wheel. The initial angular velocity of the wheel in rad s^{-1} is,
1) 50 2) 100 3) 200 4) 400 5) 800 (1997)

03) The product, angular acceleration X time, has the dimensions of,
1) angular displacement 2) angular velocity 3) torque
4) moment of inertia 5) work (1998)

04) Stars may be formed when a huge rotating masses contract to small volumes. In such a contraction how will the moment of inertia and the angular velocity of the rotating mass change?

	Moment of inertia	Angular velocity.
1)	decreases	decreases
2)	decreases	increases
3)	increases	decreases
4)	increases	increases
5)	decreases	unchanged

(1998)

05) A wheel rotating at a speed of 600 revolutions per minute about its axis comes to rest in 20 s. the angular retardation in rad s^{-2} is,
1) 60π 2) 30π 3) 10π 4) π 5) $\pi/2$ (1998)

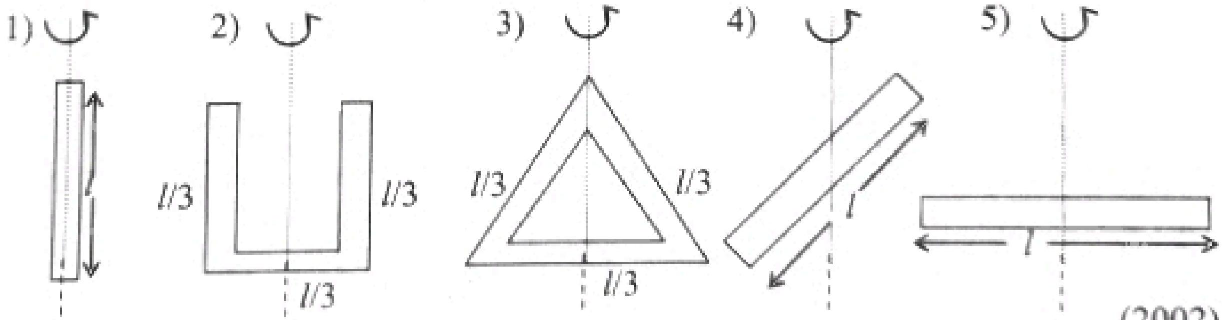
06) Angular velocity has the dimensions of ,
1) LT^{-1} 2) T^{-1} 3) LT^{-2} 4) T 5) $L^{-1}T^{-1}$ (1999)

07) Angular momentum of a system is,
(A) Conserved only when the resultant force on it is zero
(B) In the same direction as its angular velocity
(C) Independent of the mass distribution of the system
Of the above statements,
1) Only (A) is true 2) Only (B) is true 3) Only (C) is true
4) Only (B) and (C) are true 5) all (A), (B)and (C) are true. (1999)

08) A ring a disc and a sphere all of the same mass and radius, with moments of inertia I_R, I_D and Is ($I_R > I_D > I_s$)respectively about their axes, roll down without slipping on an inclined plane from a given height. If the times taken for the ring, disc and sphere to reach the bottom of the plane are t_r, t_d and t_s respectively, then.
1) $t_r < t_d < t_s$ 2) $t_r = t_d = t_s$ 3) $t_r > t_d > t$ 4) $t_r > t_d = t_s$ 5) $t_r > t_d < t_s$ (1999)

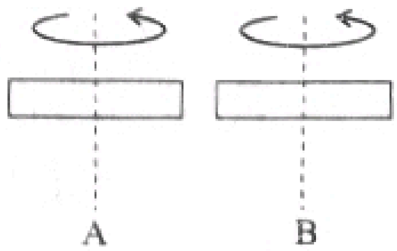
09) A flywheel of moment of inertia $9 kgm^2$ about its perpendicular axis through the centre, is connected to a motor. The motor accelerates the flywheel from rest to 600 revolutions per minute. Neglecting friction the work done on the flywheel is,
1) $900\pi^2 J$ 2) $1800\pi^2 J$ 3) $3600\pi^2 J$ 4) $4000\pi^2 J$ 5) $6000\pi^2 J$ (2000)

10) Five identical uniform rods of length l and mass m, some of which are bent as shown , are rotated form rest about a vertical axis, Rods are accelerated until they reach a final angular speed of ω_0. Which of the following arrangements requires the highest energy to attain its final angular speed (ω_0)?



(2002)

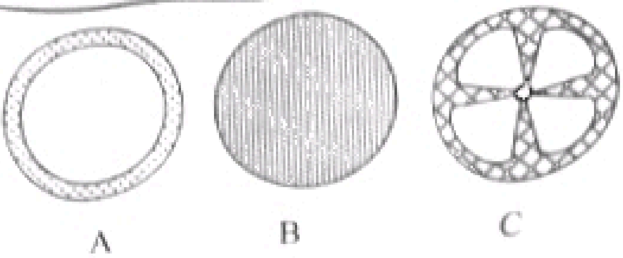
11) Two uniform rods A and B having same dimension but made of different materials of densities d_A and d_B rotate as shown in the figure. If the rotational kinetic energies of the rods are same, then the ratio,



$\frac{\text{Angular momentum of A}}{\text{Angular momentum of B}}$ is given by

1) 1 2) $\frac{d_A}{d_B}$ 3) $\left(\frac{d_A}{d_B}\right)^2$ 4) $\left(\frac{d_A}{d_B}\right)^{\frac{1}{2}}$ 5) $\left(\frac{d_A}{d_B}\right)^{\frac{3}{2}}$ (2003)

12) Three wheels A, B and C of the same mass and same external radius are made out of uniform sheets of different materials as shown in the figure. These wheels are released simultaneously from rest from the same height at the top of an inclined plane. the wheels roll down without slipping. The order that they will reach the bottom of the inclined plane as first, second and third respectively is,



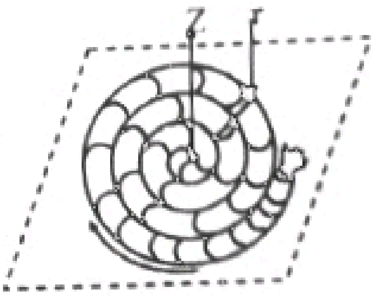
1) A, B, C 2) B, C, A 3) C, A, B 4) B, A, C 5) A, C, B (2004)

13) A uniform circular disk of radius R and M rotates with a uniform angular speed ω in a horizontal plane about an axis passing through its centre perpendicular to its plane. The moment of inertia of the disk about the axis described above is $\frac{1}{2}MR^2$.

When a ball of clay mass $\frac{M}{8}$ is placed gently on the edge of the disk and if it sticks, the new angular speed of the system is,

1) $\frac{2}{5}\omega$ 2) $\frac{8}{9}\omega$ 3) $\frac{4\omega}{5}$ 4) ω 5) $\frac{\omega}{5}$ (2005)

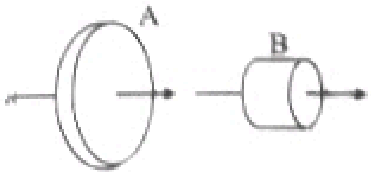
14) A circular disk shaped pin wheel type firework shown in the figure performs a rotational motion about the Z – axis on a horizontal smooth floor, due to a constant reaction force generated by its burning.



Assume that the pin wheel power the shape of a uniform circular, disc throughout and its moment of inetria $I = \frac{1}{2}mr^2$ about Z – axis. If m, r, ω and $\propto$ are the value of mass, radius,
angular velocity and angular acceleration respectively of the burning pin wheel at a certain instant, then

1) $mr\alpha$ is constant 2) $mr^2\alpha$ is constant 3) $r\omega$ is constant
4) $mr^2\omega$ is constant 5) $mr^2\omega^2$ is constant. (2006)

15) The two uniform disks *A* and *B* shown in the figure are made of the same material and have equal masses. The radius of the disk *A* is greater than that of *B*. The disks are kept in isolation at outer space. Consider the following statements,



A) The disk *A* takes a longer time than *B* to gain a given speed under an external force acting through the centres of the disks.
B) The disk *B* takes a longer time than *A* to gain a given angular speed.
C) The disk *B* has a higher rotational inertia about the axis of the disk than disk *A*.

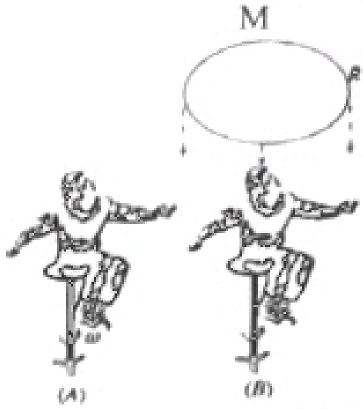
Of the above statements,

1) only (A) is true. 2) only (A) and (B) are true.
3) only (B) and (C) are true. 4) all (A), (B) and (C) are true.
5) all (A), (B) and (C) are false. (2007)

16) Starting from rest, a sphere takes a time t to roll down a rough plane. If the plane is made frictionless the time taken by the sphere to slip down will be,

1) t
2) higher than t
3) lower than t.
4) detemined by the mass of the sphere
5) determined by the radius of the sphere

(2007)



17) As shown in figure A is child sitting on a rotating chair, rotates with an angular speed ω. The moment of inertia of the system with the child around the axis of rotation is 2 kg m^2. As shown in figure B, while rotating the child catches a thin ring B of mass 4 kg and diameters 1m, which is falling vertically with its plane horizontal and with no angular momentum. The final angular momentum of the whole system would be,

1) 0 2) $\frac{2}{3}\omega$ 3) ω 4) $\sqrt{\frac{2}{3}}\omega$ 5) $\sqrt{\frac{1}{3}}\omega$

(2007)

18) A decoration consists of four independently rotating sets of small lanterns P, Q, R and S which are fixed to a rotating central pole as shown in the figure (A). All the rotation take place around vertical axes. Which of the following modes of rotations provides the best stability to the entire decoration?

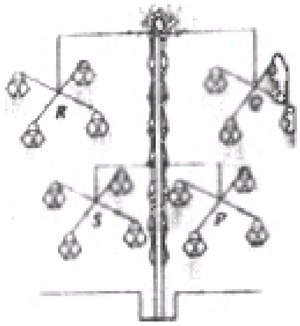
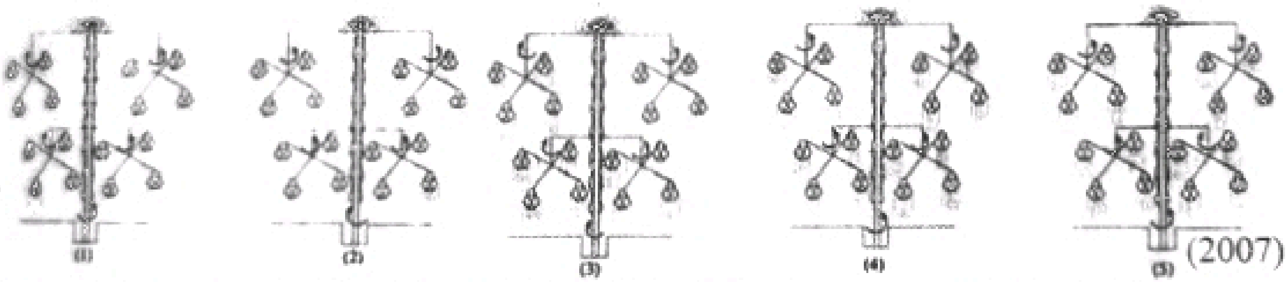
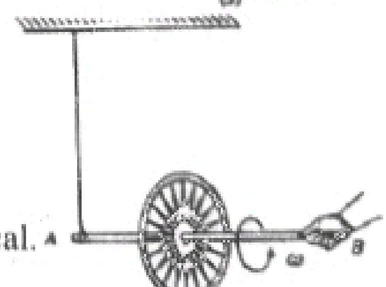


Figure A



(2007)

19) The figure shows a bicycle wheel, which is rotating with large angular velocity (ω) about the axle, AB hund from a string connected to the end A and holding from end B. If it is released from end B



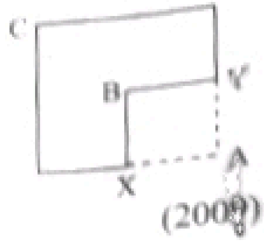
1) The end B will falldown and the axle AB becomes vertical.
2) The direction of AB remains unchanged.
3) The axle will rotate about the vertical axis through A, while AB remains approximately horizontal.
4) The end B will fall down and the wheel will start to oscillate like a pendulum.
5) The end B will move upward first and then fall down and will start to oscillate like a pendulum.

(2008)

20) The moment of inertial of a certain spinning star has dropped in $\frac{1}{3}$ of its initial value due to contraction. The ratio $\frac{\text{new rotational kinetic energy of the star}}{\text{initial rotaional kinetic energy of the star}}$ is equal to,

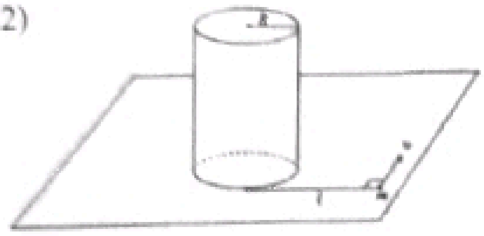
1) $\frac{1}{9}$ 2) $\frac{1}{3}$ 3) 3 4) 9 5) 27 (2009)

21) Figure shows a uniform square plate from which the part XBYA has been removed. If the moment of inertia of the plate around axes perpendicular to the plate and through the points A, B and C are I_A, I_B and I_C respectively then,



1) $I_A = I_B = I_C$ 2) $I_A = I_B > I_C$ 3) $I_A > I_B > I_C$
4) $I_A > I_C > I_B$ 5) $I_A < I_C < I_B$ (2009)

22)

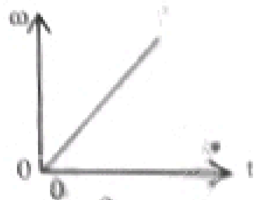


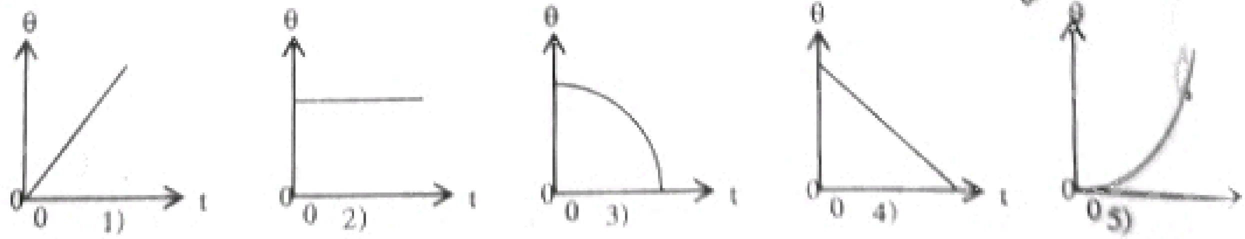
One end of a thin non elastic string of length l is attached to a small object mass m resting on a frictionless horizontal surface and the other end is fixed to a point on the surface of the vertical cylindrical pillar of radius R so that the string remains horizontal. A velocity υ is given to the object, perpendicular to the string and along the surface as shown in the figure.

The angular velocity of the object around the axis of the pillar when it hits the pillar is,

1) 0 2) $\frac{\upsilon}{R}$ 3) $\frac{\upsilon}{l}$ 4) $\frac{\upsilon}{\sqrt{R^2+l^2}}$ 5) $\frac{2\upsilon}{R}$ (2009)

23) If the anguler velocity (ω) of an object varies with time (t) as shown in the figure, the corresponding variation of angular displacement (θ) with time (t) is best represented by,





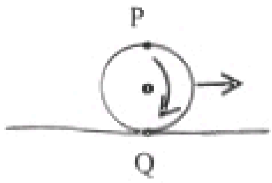
(2010)

24) Two stars, A and B of uniform density have equal radii. Star A having twice the mass of star B is spinning three times faster than star B,

The ratio, $\frac{\text{angular momentum of star A}}{\text{angular momentum of star B}}$

1) $\frac{1}{6}$ 2) 2 3) 3 4) 6 5) 18 (2010)

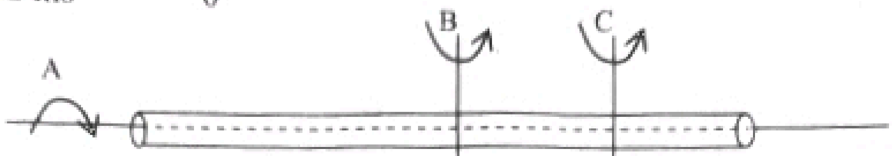
26) A cicular disk of radius 0.5m rols with a uniform angular speed 12 rad s^{-1} on a horizontal surface without slipping. Two points P and Q are located on the perimeter of the disk. The speed of the two points relative to the earth when they are at the position shown in the figure are,



	P	Q
1)	6 ms^{-1}	6 ms^{-1}
2)	6 ms^{-1}	3 ms^{-1}
3)	6 ms^{-1}	0
4)	12 ms^{-1}	6 ms^{-1}
5)	12 ms^{-1}	0

(2010)

26)

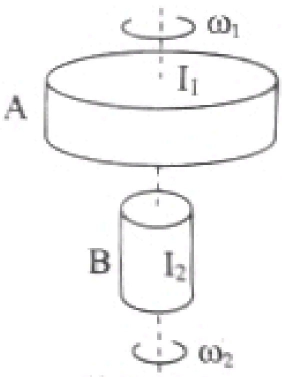


If the moments of inertia of an uniform cylindrical rod about the axes A, B and C shown are I_A, I_B and I_C respectively, then,

1) $I_A > I_B > I_C$ 2) $I_A < I_B < I_C$ 3) $I_B = I_C < I_A$
4) $I_A = I_B = I_C$ 5) $I_B > I_C > I_A$

(2010)

27) A space shuttle B of moment of inertia I_2 and angular speed ω_2 joins smoothly with a space station A of moment of inertia I_1 and angular speed ω_1 along the common axis as shown in the figure. Neglect the linear motions of both objects. The angular speed of the system about the common axis after joining the two objects would be,

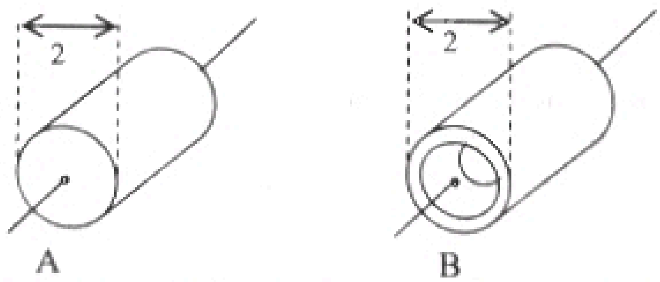


1) $\omega_1 + \omega_2$ 2) $I_1\omega_1 + I_2\omega_2$ 3) $\frac{I_1\omega_1 - I_2\omega_2}{I_1 + I_2}$

4) $\frac{I_1\omega_1 + I_2\omega_2}{I_1 + I_2}$ 5) $\frac{I_1\omega_1 + I_2\omega_2}{I_1 - I_2}$

(2011NS)

28)

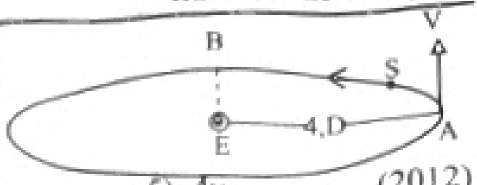


The three uniform objects shown in the figure have equal masses. Object A is a solid cylinder of radius R. Object B is a hollow thin cylinder of radius R. Object C is a solid cube whose sides are of length 2R. If the moments of inertia of the objects about the axes shown are I_A, I_B and I_C respectively, then

1) $I_B < I_C < I_A$ 2) $I_B > I_C > I_A$ 3) $I_B > I_C < I_A$
4) $I_A = I_B < I_C$ 5) $I_B > I_A = I_C$

(2011NS)

29) A satellite (S) moves in a elliptical orbit about the earth (E). If the speed of the satellite at point A is υ, then its speed at point B will be,



1) $\frac{\upsilon}{8}$ 2) $\frac{\upsilon}{4}$ 3) υ 4) 2υ 5) 4υ (2012)

30) A gain of sand is stuck to a tyre of a vehicle at a distance r from its centre. The radius of the tyre is R. When the tyre is rotating at an angular speed of ω, the sand grain detaches suddenly from the tyre. If the air resistance is neglected, the horizontal component of the velocity of the grain relative to the vehicle immediately after detachment could have a value between"

1) 0 and $(R - r)\omega$. 2) 0 and $(r + R)\omega$. 3) 0 and $r\omega$.
4) $-r\omega$ and $r\omega$. 5) $(R - r)\omega$ and $(r + R)\omega$. (2012)

31) Two wheels A and B of a machine rotate about a common axis in the same direction with angular speeds ω_1 and ω_2, respectively. See figure (a). Moment of inertia of wheel A about the axis of rotation is I_1 and that of wheel B is I_2. At a certain instant, two wheels are pushed towards each other untill they are firmly pressed and the system potates with a common angular speed ω, without slipping. See figure (b). The value of ω is given by,

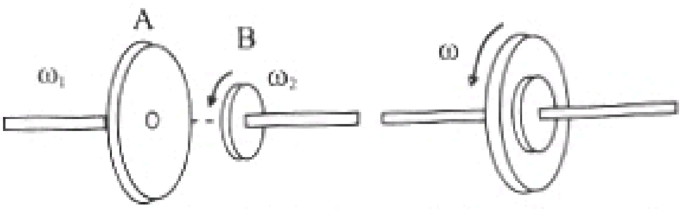


figure (a) figure (b)

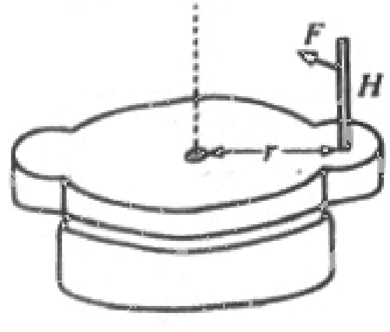
1) $\omega = \frac{\omega_1 + \omega_2}{2}$ 2) $\omega = \frac{I_1\omega_1 + I_2\omega_2}{I_1 - I_2}$ 3) $\omega = \sqrt{\omega_1\omega_2}$

4) $\omega = \frac{I_1\omega_1 + I_2\omega_2}{I_1 + I_2}$ 5) $\omega = \frac{I_1\omega_1^2 + I_2\omega_2^2}{\omega_1^2 + \omega_2^2}$ (2013)

32) A thin ring of mass Mand radius R is rotating in a horizontal plane about an axis passing through its centre perpendicular to its plane with a constant angular velocity ω. Now if two small masses, each of mass m, are attached gently to the opposite ends of a diameter of the ring, the new angular velocity of the system is,

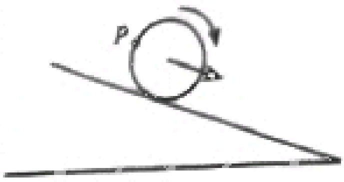
1) $\frac{\omega M}{M + 2m}$ 2) $\frac{\omega(M + 2m)}{M}$ 3) $\frac{\omega M}{M + m}$ 4) $\frac{\omega(M - 2m)}{M + 2m}$ 5) $\frac{\omega(M + m)}{M}$
(2014)

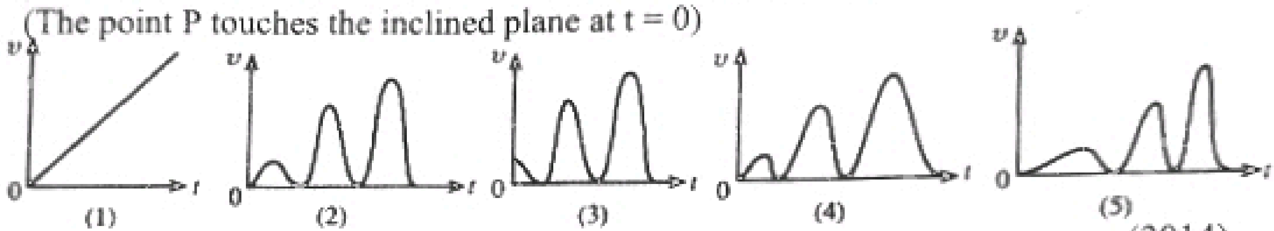
33) A traditional grain grinder consists of two flat stones. The upper stone is rotated on top of the lower stationary stone by applying a horizontal force of magnitude F to the handle H which is fixed at a distance of r from the axis of rotation as shown in figure. If the force is always applied parallel to the direction of motion of the handle, and the period of rotation is T, the power being expended is,



1) $\frac{\pi rF}{T}$ 2) $\frac{2\pi rF}{T}$ 3) $\frac{rF}{T}$ 4) $\frac{F}{\pi r^2 T}$ 5) $\pi r^2 FT$ (2014)

34) A wheel, starting from rest, is allowed to roll down without slipping, along an inclined plane as shown in figure. Which of the following graphs best represents the variation of the magnitude (v) of the velocity of a point P, located on the perimeter of the wheel, relative to the earth with time (t)? (The point P touches the inclined plane at t = 0)





(2014)

35) The variation of the angular acceleration (α), of a wheel of a motor vehicle starting from rest with time (t) is shown in figure (a). Variation of the angular velocity (ω) of the wheel with time (t) is best represented by

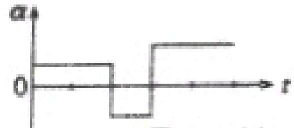
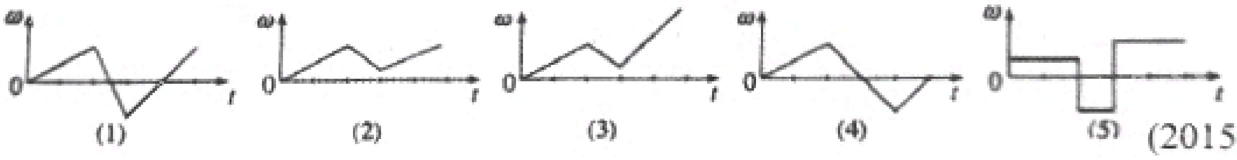
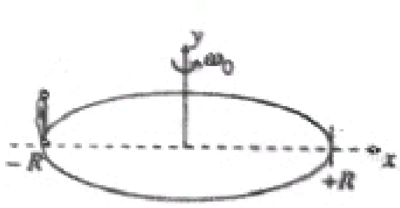


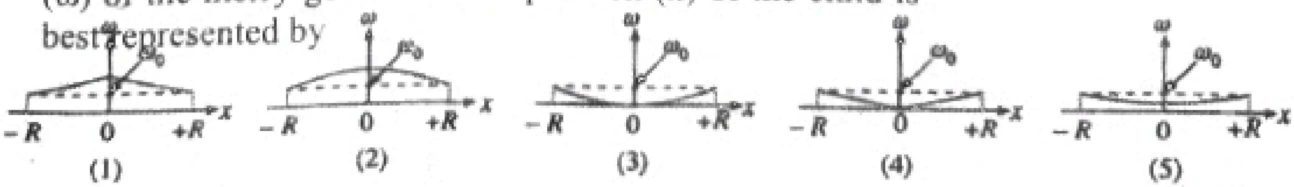
Figure (a)



(2015)

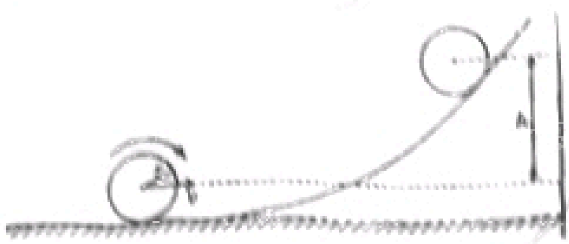
36) A child is standing at x = -R of a horizontal merry-go-round of radius R in a carnival as shown in the figure x-y is a coordinate system fixed to the merry-go-round with its y-axis along the axis of rotation. Using a driving motor, the merry-go-round is set in rotational motion with constant angular velocity ω_0 about its axis on a frictionless bearing, and subsequently allowed to **rotate freely** without the driving motor. Now if the child starts to move in the x – direction along the diameter of the merry-go-round to the location x = +R, the variation of the angular velocity (ω) of the merry-go-round with position (x) of the child is best represented by





(2015)

37) A uniform disc of mass m and radius r rolls without slipping, initially along a horizontal surface, and subsequently starts to climb up a ramp as shown in the figure. The disc has a linear velocity υ on the horizontal surface. The moment of inertia of the disc about the axis through its centre and normal to the plane of the disc is $\frac{mr^2}{2}$.



What is the maximum height h to which the centre of mass of the disc climb?

1) $\frac{\upsilon^2}{2g}$ 2) $\frac{3\upsilon^2}{2g}$ 3) $\frac{3\upsilon^2}{4g}$ 4) $\frac{\upsilon^2}{g}$ 5) $\frac{2\upsilon^2}{g}$ (2016)

38) A boy, sitting on a smooth turntable with a weight in his each extended hand, is rotating with an angular velocity ω_0. When he bends his hands towards his body, the angular velocity becomes ω_1. If I_0 and I_1 are the moments of inertia of rotating systems when the hands are extended, and bent towards his body respectively, then

1) $\omega_0 > \omega_1$, $I_0 > I_1$ and $\omega_0 I_0 > \omega_1 I_1$
2) $\omega_0 < \omega_1$, $I_0 > I_1$ and $\omega_0 I_0 < \omega_1 I_1$
3) $\omega_0 < \omega_1$, $I_0 > I_1$ and $\omega_0 I_0 = \omega_1 I_1$
4) $\omega_0 > \omega_1$, $I_0 < I_1$ and $\omega_0 I_0 = \omega_1 I_1$
5) $\omega_0 = \omega_1$, $I_0 = I_1$ and $\omega_0 I_0 = \omega_1 I_1$ (2016)

08. Circular Motion

01) A particle moving in a circle of radius 2m at constant speed has a period of rotation 2S. Its acceleration towards the centre of the circle is,

1) ½ ms^{-2} 2) 2 ms^{-2} 3) 8 ms^{-2} 4) $2\pi^2$ ms^{-2} 5) $8\pi^2$ ms^{-2} (1998)

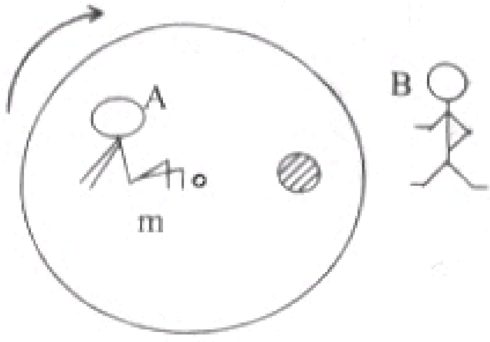
02) Two particles A and B are moving in concentric circles of radii R_A and R_B such that their periods of rotation are same. The ratio $\frac{\text{centripetal acceleration of A}}{\text{Centripetal acceleration of B}}$ is,

1) $\frac{R_A}{R_B}$ 2) $\frac{R_A^2}{R_B^2}$ 3) $\frac{R_A^3}{R_B^3}$ 4) $\frac{R_B}{R_A}$ 5) $\frac{R_B^2}{R_A^2}$ (1999)

03) A small mass is kept on a horizontal circular table which can rotate about a vertical axis passing through the centre of the table. The mass starts to slip when the angular velocity of the table becomes ω. If the distance to the mass from the centre of the table is doubled the minimum angular velocity required for the mass to start slipping is,

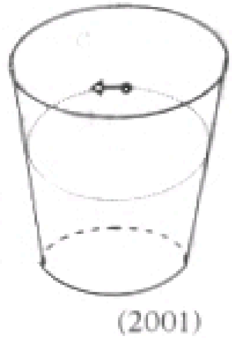
1) $\frac{\omega}{\sqrt{2}}$ 2) $\frac{\omega}{2}$ 3) ω 4) $\sqrt{2}\omega$ 5) 2ω (1999)

04) A horizontal table is rotating with a uniform angular velocity about the vertical axis passing through its centre. A mass m is at rest on the table without slopping. Observer A is sitting on the table while the observer B is standing on the floor, as shown in the figure. The total horizontal force on m



1) according to A is zero and according B is towards the centre
2) according to A is zero and according B is away from the centre
3) according to both A and B is zero
4) according to both A and B is towards the centre
5) according to both A and B is way from the centre (2000)

05) An object moves along a horizontal circular path on the inner surface of a smooth conical shaped vessel, as shown in the figure. The force/forces acting on the object as observed by a stationary observer is /are.

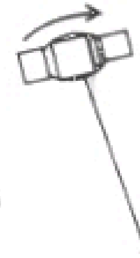


1) weight of the object only
2) weight of the object and reaction force normal to the surface only
3) weight of the object and reaction force normal to the surface only
4) reaction force normal to the surface and centripetal force only
5) centripetal force only (2001)

06) A child of mass 20 kg is sitting on a swing of negligible mass. The swing is attached to its pivot by two ropes, each of 3m length. The maximum speed of the child during a swing is found to be $3ms^{-1}$. The maximum tension in each rope is,

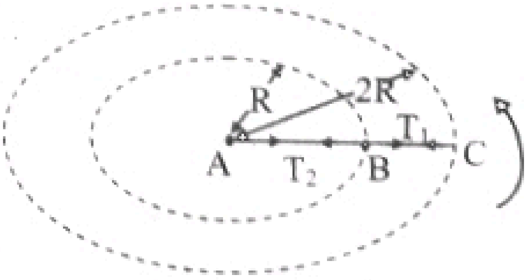
1) 130 N 2) 160 N 3) 200 N 4) 260 N 5) 300 N (2001)

07) A toy car connected to a fixed point by an elastic string as shown in figure, travels in a horizontal circle of radius 2r. The initial unstretched length of the elastic string is r. The period of rotation of the car is T. The car is then speeded up until it is moving in a circle of radius 3r. If the string obeys Hooke's law, and resistive forces are negligible, the new period of rotation on the car will be,



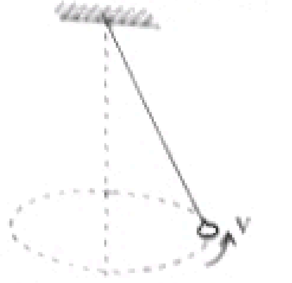
1) $\sqrt{\frac{3}{2}}T$ 2) $\sqrt{\frac{4}{3}}T$ 3) T 4) $\frac{\sqrt{3}}{2}$ T 5) $\frac{3}{4}$ T (2003)

08) Two small objects of equal masses are attached to each other by a light string BC, and this system is connected to a fixed point A with another light string AB as shown in the figure. The masses are then made to move in horizontal circular paths of radii R and 2R (see figure) with the same angular speed so that points A, B and C are always in a straight line. If T_1 and T_2 are the tensions of the strings BC and AB respective, then



1) $T_2 = \frac{1}{2}T_1$ 2) $T_2 = \frac{2}{3}T_1$ 3) $T_2 = T_1$ 4) $T_2 = \frac{3}{2}T_1$ 5) $T_2 = 2T_1$ (2004)

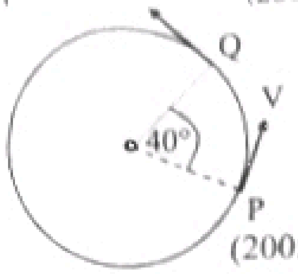
09) A sphere M attached to a thread is whirled in a horizontal circle at a constant speed as shown in the figure. The forces acting on the sphere observed by a person who is at rest in the laboratory are best represented by,



1) 2) 3) 4) 5)

(2005)

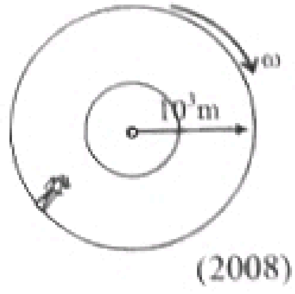
10) A particle is moving in a circle with constant speed V as shown in the figure. The magnitude of the change in velocity of the particle between points P and Q is,



1) 0 2) V sin 40° 3) 2V sin 20°
4) 2V cos 20° 5) V (2005)

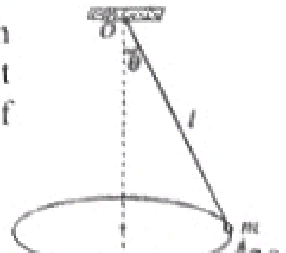
11) A particle is moving in a circular orbit of radius 10m. At one instant, the speed of the particle is 10 ms^{-1} and is increasing at a rate of 10 ms^{-2}. The angle between the velocity vector and the resultant acceleration vector of the particle at that instant is,
1) 0° 2) 30° 3) 45° 4) 60° 5) 90° (2006)

12) Figure shows a space colony of radius 10^3m, rotating about its axis. At what angular speed (ω) must the space colony be rotated so that an astronaut standing in the floor of the colony experiences a push on his feet that equals his weight on the Earth ?



1) 0.1 rad s^{-1} 2) 1 rad s^{-1} 3) 2 rad s^{-1}
4) 5 rad s^{-1} 5) 10 rad s^{-1} (2008)

13) A small object of mass m is suspended by a string of length l, and is allowed to move in a horizontal circular path about the vertical axis passing through O, as shown in figure. If the air resistance is neglegible the velocity of the particle



1) $\sqrt{lg\sin\theta\tan\theta}$ 2) $\sqrt{lg\sin\theta\cos\theta}$ 3) $\sqrt{lg\tan\theta}$
4) $\sqrt{lg\sin\theta}$ 5) $\sqrt{lg\cos\theta}$ (2008)

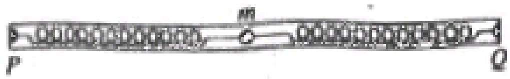
14) A car of mass m monotyres a circular bend of radius of curvature r in a horizontal that road with a speed υ. If the car skids then, μ is the coefficient of friction between the road and a tyre

1) $\upsilon > \sqrt{\mu rg}$ 2) $\upsilon < \sqrt{\frac{\mu rg}{4}}$ 3) $\upsilon > \sqrt{\frac{\mu rg}{m}}$ 4) $\upsilon < \sqrt{\mu rmg}$ 5) $\upsilon > \sqrt{\frac{\mu mg}{r}}$ (2012)

15) The athletes run a 10 km race with constant speeds v_1 and v_2 in a circular track of radius 50 m. It has been observed that the athlete with speed v_1 complete 10 rounds when the other athlete completed 9 rounds. The ratio $\frac{v_1}{v_2}$ is

1) $\frac{10}{9}$ 2) $\frac{9\pi}{10}$ 3) $\frac{18\pi}{10}$ 4) $\frac{10\pi}{9}$ 5) 9 (2013)

16) One end each of two identical, stretched springs are fixed to the two ends of a closed tube and the other ends of the springs are attached to a mass m, as shown in the figure. Which of the following motion/s of the system results in a displacement of mass m towards P from the centre of the tube?



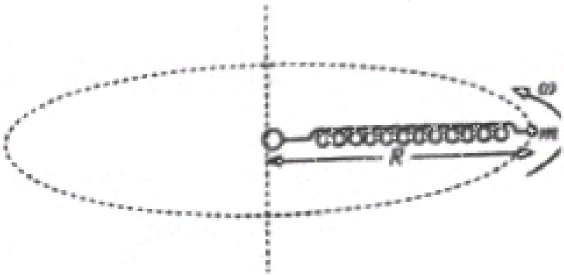
(A) Uniform acceleration of the tube in the direction of PQ, keeping the tube horizontal.

(B) Rotation of the tube around a vertical axis passing through Q, keeping the tube in a horizontal plane.

(C) Vertical motion of the tube under gravity keeping Q below P.

1) (A) only 2) (A) and (B) only 3) (B) and (C) only
4) (A) and (B) only 5) All (A), (B) and (C) (2013)

17) A light spiral spring has an unstretched length l and a spring constant k. A small object of mass m is attached to one end of the spring and the system is rotated about a vertical axis that passes through a small light ring attached to the other end of the spring as shown in figure. If the object travels along a circular path of radius R with constant angular speed ω, keeping the spring on a horizontal plane, then



1) $\omega = \sqrt{\frac{k}{m}\left(\frac{R-l}{R}\right)}$ 2) $\omega = \sqrt{\frac{k}{m}}$ 3) $\omega = \sqrt{\frac{k}{m}\cdot\frac{l}{R}}$

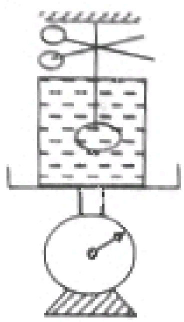
4) $\omega = \sqrt{\frac{k}{m}\left(1-\frac{R}{l}\right)}$ 5) $\omega = \sqrt{\frac{k}{m}\cdot\frac{R}{l}}$ (2014)

09. Hydrostatics

01) A block of ice, of constant thickness, floats on sea water with 1 cm appearing above the water level. If the densities of ice and sea water are 920kg m^{-3} respectively, the total thickness of the ice block is

1) 10.3 cm 2) 9.4 cm 3) 4.7 cm 4) 2.0 cm 5) 1.0 cm (1992)

02) A vessel containing a liquid of density ρ_1 is placed on a weighing scale as shown in the figure, and a piece of metal of mass m and density ρ_2 held by a string is immersed in the liquid without touching the sides or the bottom of the vessel. Now if the string is cut the reading of the scale will be,

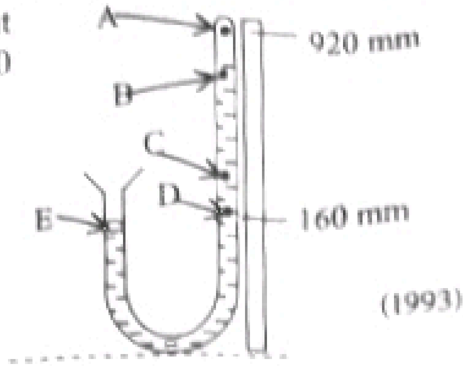


1) $mg\left(1+\frac{\rho_1}{\rho_2}\right)$ 2) $mg\left(1-\frac{\rho_1}{\rho_2}\right)$ 3) $mg\left(1+\frac{\rho_2}{\rho_1}\right)$

4) $mg\left(1-\frac{\rho_2}{\rho 1}\right)$ 5) mg (1992)

03) The diagram shows a mercury barometer. The point in the mercury column at which the pressure is 500 mm of Hg is,

1) A
2) B
3) C
4) D
5) B

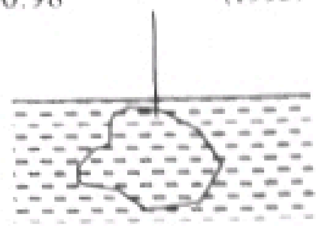


(1993)

04) A measuring cylinder contains $60cm^3$ of oil at 0^0C when a piece of ice was roped into the cylinder it sank completely in oil and the oil level rose to $90cm^3$ mark. When the ice is melted the oil level came down to 87 cm^3 mark. The relative density of ice is,

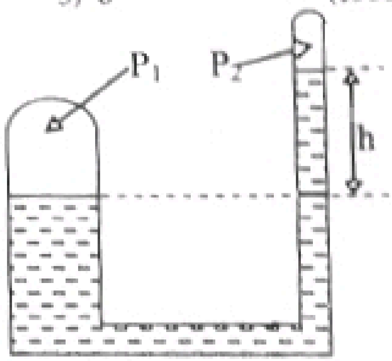
1) 0.80 2) 0.85 3) 0.90 4) 0.95 5) 0.98 (1993)

05) A thin polythene bag containing $10^{-4}m^3$ of water with no air bubbles inside is tied by a light string and lowered into a bath of water as shown in the figure. If the density of water 10^3 kg m^{-3} the tension in the string is,



1) 2 N 2) 1.5 N 3) 1 N 4) 0.5 N 5) 0 (1993)

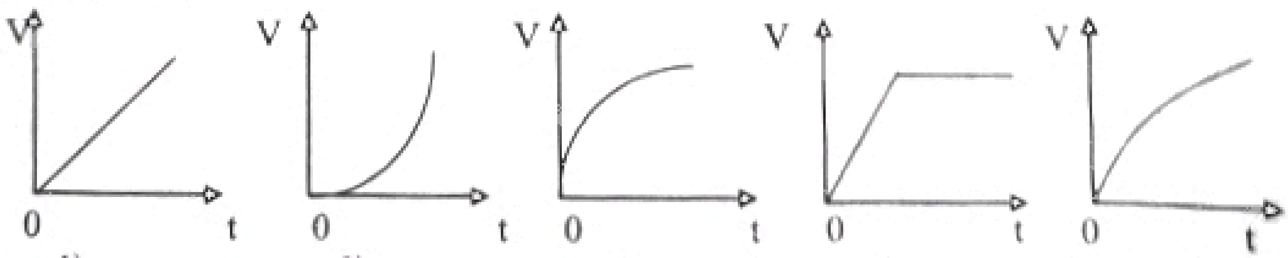
06) The given J-tube has both ends sealed and contains a liquid of density ρ the broad arm has twice the cross-sectional area of that of the narrow arm. If P_1 and P_2 pressures of the trapped air, P_1 is equal to



1) P_2 2) $P_2 + h\rho g$ 3) $P_2 - h\rho g$
4) $P_2 + 2h\rho g$ 5) $P_2 + ½\, h\rho g$

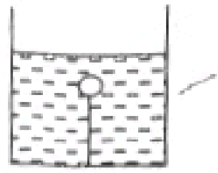
(1994)

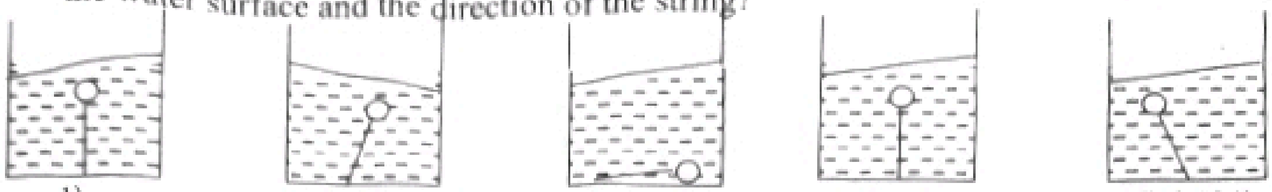
07) An air bubble liberated from the bed of a deep sea is moving upwards. Which of the following graphs best represents the variation of speed (v) of the air bubble with time t?



1) 2) 3) 4) 5) (1994)

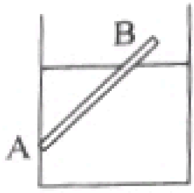
08) A piece of cork is tied to the bottom of a container of water by a light inextensible string as shown in the figure. When the container is moved horizontally to the left with a constant acceleration, which of the following diagrams best represents the changes observed in the water surface and the direction of the string?





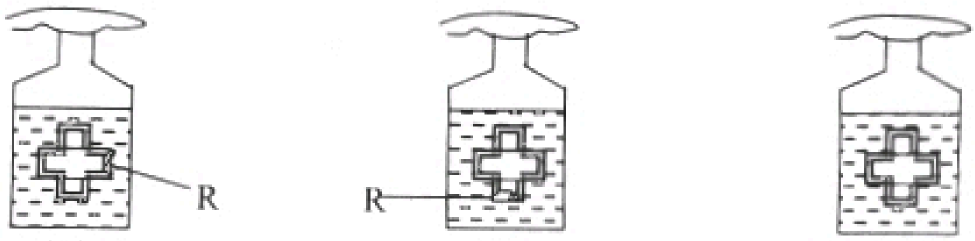
1) 2) 3) 4) 5) (1994)

09) In the diagram, AB is a thin uniform rod made of a material of density ρ freely hinged at A to the wall of a vessel containing a liquid of insitivity σ. When in equilibrium one fifth of the rod is projecting outside the liquid, the ratio of the densities $\frac{\rho}{\sigma}$ is equal to



1) $\frac{16}{25}$ 2) $\frac{9}{25}$ 3) $\frac{8}{25}$ 4) $\frac{4}{25}$ 5) $\frac{1}{25}$ (1995)

10)



(A) (B) (C)

Figures show cross – sections of three hollow objects two of which have openings closed with a soft rubber R and the other without an opening just floating inside three bottles of water labeled A,B and C when an excess pressure is applied to the air above the water surface in all three bottles by pressing their mouths with hands.

	Object in A	Object in B	Object C
1)	Remains stationary	Remains stationary	Remains stationary
2)	Moves up	Moves up	Moves down
3)	Moves down	Moves down	Moves down
4)	Moves down	Moves down	Remains stationary
5)	Moves up	Moves up	Moves up

(1995)

11) A vessel contains oil (density = 800 kgm^{-3}) and mercury (density = 13 600 kg m^{-3}) . A metal sphere floats at the interface with one half of its volume immersed in mercury and the other half in oil. The density of the metal is,

1) 1000 kg m^{-3} 2) 1700 kg m^{-3} 3) 4800 kg m^{-3}
4) 7200 kg m^{-3} 5) 12 800 kg m^{-3}

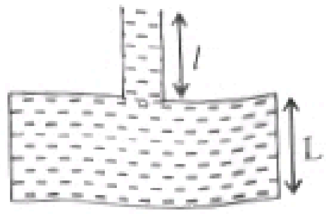
(1996)

12) A crown of mass 1.4kg has an apparent weight of 1.3 kg when submerged fully in water. The mean density of the material of the crown is
(density of water = 10^3 kg m^{-3})

1) 1.1×10^3 kg m^{-3} 2) 1.3×10^3 kg m^{-3} 3) 1.4×10^3 kg m^{-3}
4) 1.4×10^4 kg m^{-3} 5) 2.7×10^4 kg m^{-3}

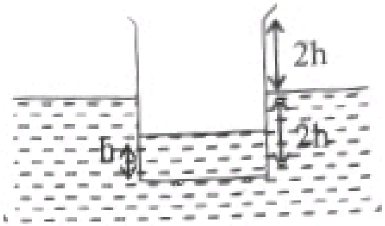
(1997)

13) A tube of length ℓ is fitted to a vessel having a height L and a bottom of area A as shown in the figure. If the internal area of cross-section of the tube is 'a' and the vessel and the tube is completely filled with a liquid of density ρ the force acting on the bottom of the vessel by the liquid is,



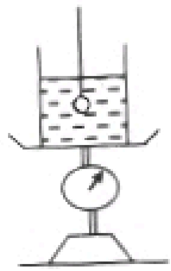
1) $A(L + l)\rho g$ 2) $(A - a)L\rho g + a(L + l)\rho g$
3) $AL\rho g$ 4) $a(L + l)\rho g$ 5) $(AL + al)\rho g$ (1997)

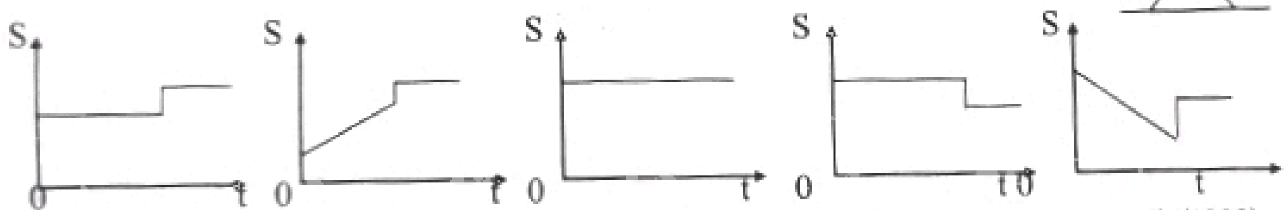
14) A cylindrical metallic vessel having thin walls of height 4h contains water up to a height h. When immersed in water this cylinder floats with half of its height below the water surface as shown. If the cylinder is to be floated with its almost entire height under water the water level inside the cylinder has to be raised from h is,



(1) $\frac{4}{3}h$ (2) 2h   (3) $\frac{8}{3}h$ (4) 3h   (5) $\frac{7}{2}h$ (1997)

15) A beaker of water is kept on a compression balance. At time t = 0, a solid object immersed just beneath the water level as shown in the figure is



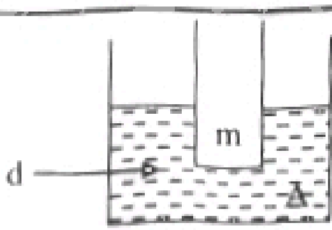


1)   2)   3)   4)   5) (1998)

16) A uniform solid cylinder of weight 6N is floating vertically in a liquid with ¼ of its height above the liquid surface. The minimum vertical force required to immerse the cylinder fully in the liquid is,
1) 1.5 N   2) 2 N   3) 3 N   4) 4 N   5) 12 N   (1999)

17) When a bottle of soda water is opened is opened gas bubbles rise in the soda water. Assume that the initial acceleration of all the gas bubbles is *a*. When the bottle falls freely, then with respect to the bottle the gas bubbles
1) will rise with the same acceleration *a*
2) will rise with an acceleration of (*a* + g)
3) will move down with an acceleration *a*
4) will remain stationary
5) will move down with an acceleration *a*   (1999)

18) A uniform solid cylinder of cross-sectional area A and mass m floats in a vessel of water of density d as shown in the figure. When the vessel is raised upwards with a constant acceleration a, the height of the cylinder submerged in water will,



1) increase by a distance of $\frac{ma}{Adg}$
2) decrease by a distance of $\frac{ma}{Adg}$
3) increase by a distance of $\frac{m(g-a)}{Adg}$
4) decrease by a distance of $\frac{m(g-a)}{Adg}$
5) remain unchanged

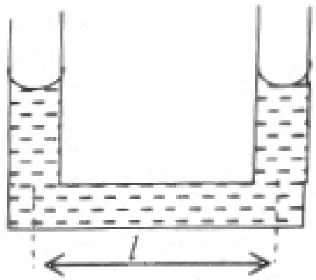
(2000)

19) A rocket carries 1.8×10^4 kg of liquid oxygen in a vertical tank of cross section $3.0 m^2$. At the lift- off the rocket accelerates vertically upward at 2.0 m s^{-2} relative to the earth. The pressure on the bottom of the tank at the lift – off is,

1) $1.2 \times 10^3 \text{ Nm}^{-2}$
2) $7.2 \times 10^3 \text{ Nm}^{-2}$
3) $1.2 \times 10^4 \text{ Nm}^{-2}$
4) $6.0 \times 10^4 \text{ Nm}^{-2}$
5) $7.2 \times 10^4 \text{ Nm}^{-2}$

(2001)

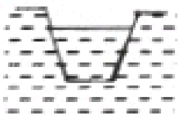
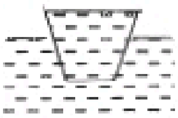
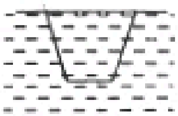
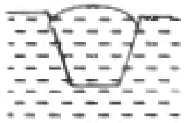
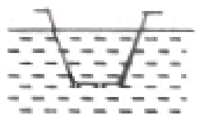
20) A U- tube contains a liquid as shown in the figure. When the tube is moved horizontally to the right with a constant acceleration a, the difference in the heights of liquid columns in the two limbs is,



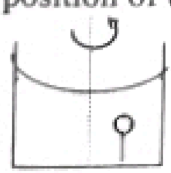
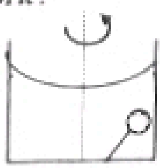
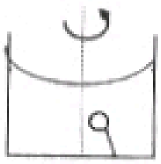
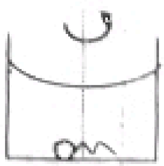
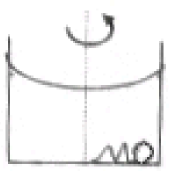
1) $\frac{la}{g}$ 2) $\frac{lg}{a}$ 3) $\frac{l(g+a)}{a}$ 4) $\frac{lg}{(a+g)}$ 5) $\frac{l(g+a)}{g}$

(2001)

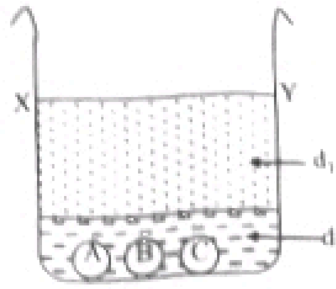
21) A steel bowl floats in water with its brim facing up. If water is poured slowly, which of the following figures shows its position at the verge of sinking?


1)

2)

3)

4)

5) (2002)

22) A cork is attached to the bottom of a water beaker with a string so that is stays under the surface of water. The beaker is then rotated with a constant angular speed about the vertical axis. Which of the following figures indicates the correct position of the cork?


1)

2)

3)

4)

5) (2002)

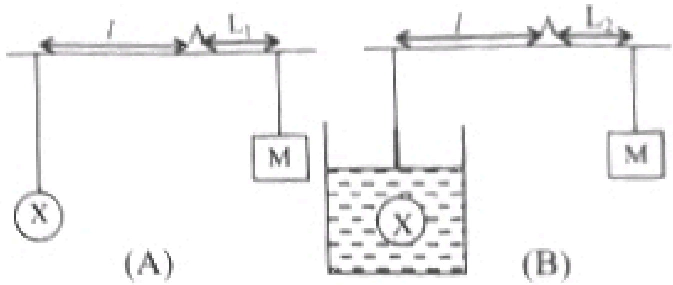
23) A beaker contains two immiscible liquids having densities d_1 and d_2. Three spheres A, B, C made of materials of densities d_A, d_B and d_C respectively, are released from the bottom of the beaker. If $d_1 > d_B < d_A < d_2 < d_C$



1) sphere C will reach the surface XY and come to rest
2) all spheres will reach the surface XY and come to rest
3) none of the spheres will move up
4) spheres A and B will reach the surface XY and come to rest
5) sphere C will stay at the bottom

(2003)

24) Fig. A shows the balanced position of a light rod carrying an object X and a mass M. Fig. B shows the balanced position of the same system when X is immersed in water. If the density of water is d, the density of the material made of X is given by,

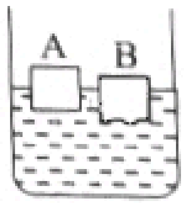


1) $\dfrac{L_1}{(L_1 - L_2)}d$ 2) $\dfrac{L_1}{L_2}d$ 3) $\dfrac{L_1}{(L_1 + L_2)}d$

4) $\dfrac{(L_1 - L_2)}{L_1}d$ 5) $\dfrac{L_2}{L_1}d$

(2003)

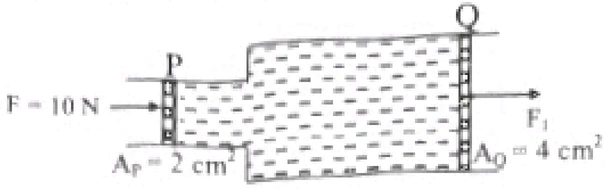
25) Two cubes A and B of the same geometrical dimensions float in water as shown in the figure. Cube A has half of its volume above the water level where as B has only ¼ of its volume above the water level. If the cube B is carefully placed on cube A , which of the following responses indicates the correct positions of the cubes A and B?



Cube A	Cube B
(1) ¾ of the volume is under water	Completely above the water level
(2) Completely submerged	Completely above the water level
(3) Completely submerged	¼ of the volume is under water
(4) Completely submerged	½ of the volume is under water
(5) Completely submerged	¾ of the volume is under water

(2004)

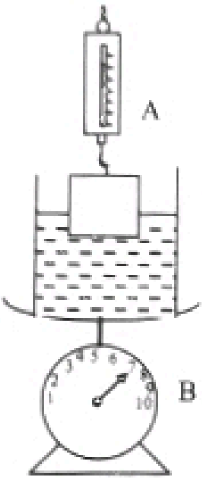
26)



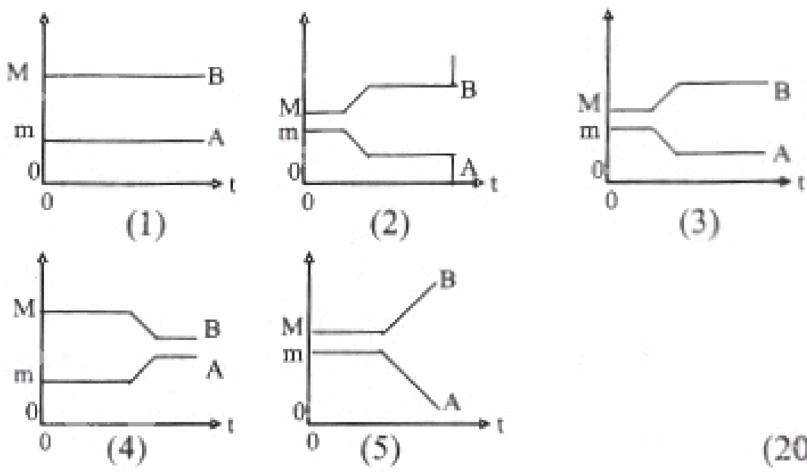
A force F = 10N is applied to the smaller piston P of area 2 cm^2 of the hydraulic system shown in the figure to produce a force F_1 on the larger piston Q of area 4 cm^2. When the surrounding temperature is decreased the liquid inside is solidified. The solidified block moves freely inside the system and the new force produced on Q due to the force F = 10N becomes F_2. The respective value of F_1 and F_2 are,

1) 20N, 20 N　　2) 20N, 10 N　　3) 5N, 10 N
4) 5N, 20 N　　5) 20N, 5 N　　(2005)

27)

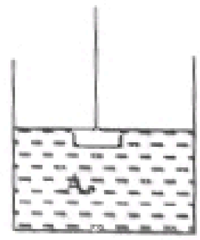


A uniform metal cylinder of mass m hangs from a spring balance A and is lowered slowly and steadily into a water container of mass M ($M > m$) until it rests totally submerged on the bottom of the container. The container is placed on the pan of the weighting scale B as shown in the figure. The variation of the readings of A and B with time t are best represented by,



(2005)

28) A metal block is suspended at rest below the surface of water in a tank as shown in the figure. When the block is released it falls to the bottom of the tank.



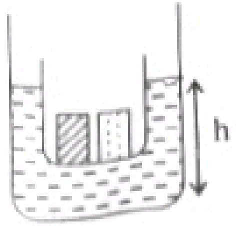
Consider the following statements,

A) The block gradually losses its gravitational potential energy as it falls.
B) Although the height of the water level does not change the water gains gravitational potential energy.
C) If water was not present, the kinetic energy of the block at the point A would be less than that at A when water was present.

Of the above statements,

1) only (A) and (B) are true　　2) only (B) and (C) are true.
3) only (A) and(C) are true　　4) only (A) is true.
5) all (A), (B) and (C) are true.　　(2005)

29) As shown in the figure, a small beaker containing a piece of wood and piece of stone, floats in water inside a larger beaker. The density of the stone is larger than that of water and the density of the piece of wood is smaller than that of water. Consider the following statements made about the height h of the water level inside the larger beaker.



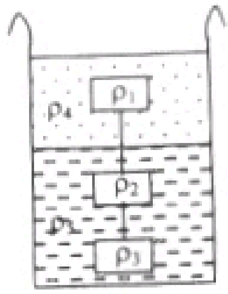
A) When the stone is taken out and dropped in water h decreases.
B) When the piece of wood is taken out and put in water h remains unchanged.
C) When the stone and the piece of wood are taken out, tied together and then put in water, if they go to the bottom of the beaker h will increase.

Of the above statements,

1) only (A) is true
2) only (A) and (B) are true.
3) only (A) and (C) are true.
4) only (B) and (C) are true.
5) all (A), (B) and (C) are true.

(2005)

30) Three masses made of materials having densities ρ_1, ρ_2 and ρ_3 and of equal volumes are connected together with light strings. The system floats as a vessels containing two immicable liquid of densities ρ_4 and ρ_5 with strings taut as shown in the figure.



(A) $\rho_1 < \rho_5$
(B) $\rho_1 < \rho_3$
(C) If the tension of the strings are equal then" $\rho_2 = \rho_5$

Of the above conclusions,

1) only (A) is true
2) only (C) is true.
3) only (A) and (B) are true
4) only (A), (B) and (C) are true
5) all (A), (B) and (C) are false.

(2006)

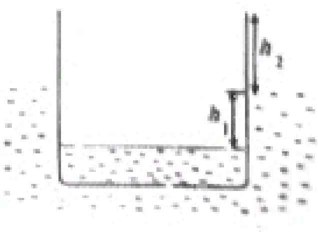
31) A boat made of metal floats in water with one fifth of its volume submerged. If a second beat is made with a volume free times than the first using the same mass of the same metal that has neen used to construct the first boat, then the ratio,

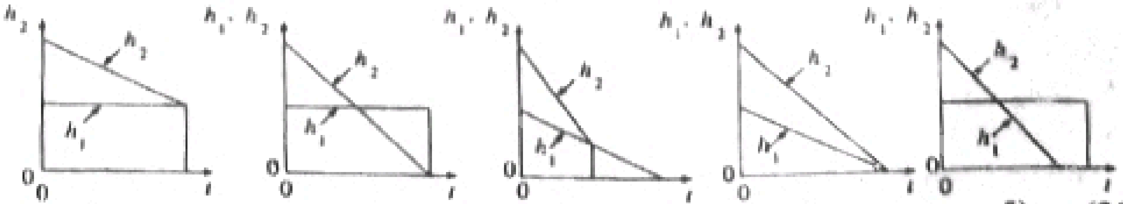
<u>The maximum load that can be carried by the second boat</u>
The maximum load that can be carried by the float boat.

Is equal to,

1) 3 2) 5 3) 6 4) 8 5) 10 (2007)

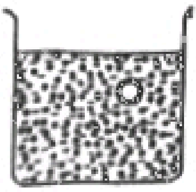
32) A thin walled cylindrical vessel is floating in a lake. At time $t = 0$ a small hole is made at the bottom of the vessel and water is allowed to flow into the vessel at a constant rate so that the vessel immerse with a constant velocity. If h_1 is the difference in heights of the water levels inside and outside the vessels and h_2 is the height of the brim above the outside water level at time t, which of the following curves best represents the variation of the heights h_1 and h_2 with (t) until the vessel is fully immersed ?





1) 2) 3) 4) 5) (2008)

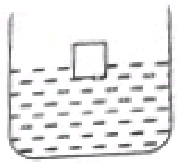
33) Water in tank is uniformly bubbled with small identical air bubbles each having volume υ_0 as shown in the figure. A sphere of mass M and volume V floats in water as shown due to the attachment of certain number of air bubbles on its surface If d_w is the density of water, and the minimum number of air bubbles that is needed to be attached to keep the sphere floating in water is n, then

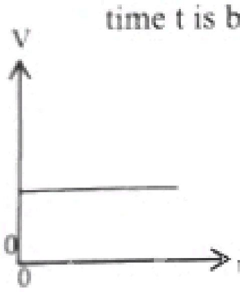


1) $n = \dfrac{M - Vd_w}{\upsilon_0 d_w}$ 2) $n > \dfrac{M - Vd_w}{\upsilon_0 d_w}$ 3) $n < \dfrac{M - Vd_w}{\upsilon_0 d_w}$

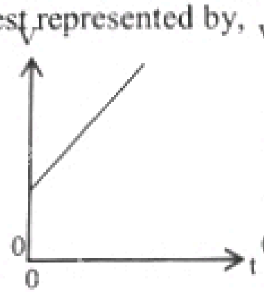
4) $n > \dfrac{\upsilon_0 d_w}{M - Vd_w}$ 5) $n < \dfrac{\upsilon_0 d_w}{M - Vd_w}$ (2009)

34) A cube of wood is floating in a beaker of water as shwon in the figure. At time t = 0, the beaker begins to move in the downward directin from rest with a constant acceleration. The variation of the volume V of the portion of the cube that is immersed in water, with time t is best represented by,

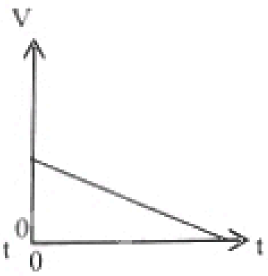




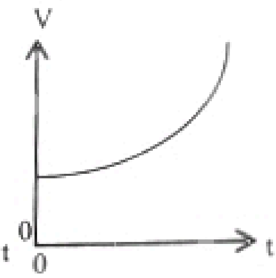
1)



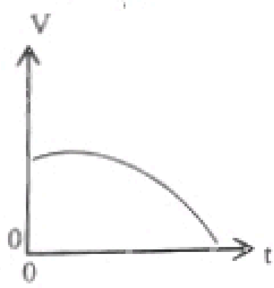
2)



3)



4)



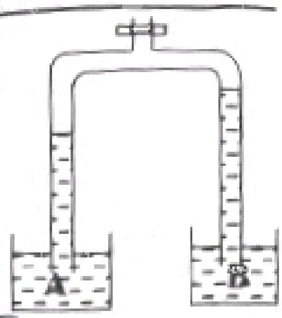
5)(2010)

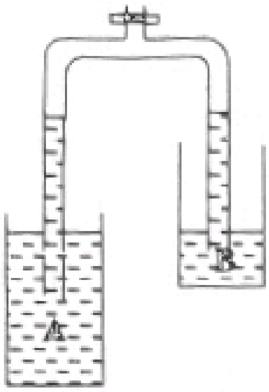
35) An empty, thin walled container of volume V and mass M_0 is filled with a number of glass and steel balls out of which x are glass balls. If M_s and M_g are the masses of a steel and a glass ball respectively, then the effective density of the container with balls would be,

1) $\dfrac{nM_s + xM_1 + M_0}{nV}$ 2) $\dfrac{M_x + (n-x)M_s}{V}$ 3) $\dfrac{xM_g + (n-x)M_s + M_0}{nV}$

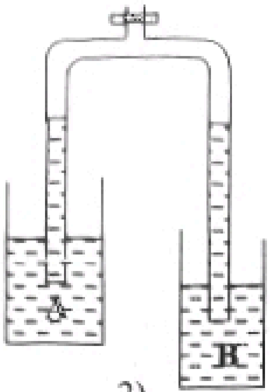
4) $\dfrac{xM_g + (n-x)(M_s + M_0)}{V}$ 5) $\dfrac{xM_g + (n-x)M_s + M_0}{V}$ (2011NS)

36) The figure (s) shows a Hare's apparatus used to compare the densities of two liquids A and B. If the same experience is done by changing the positions of the limbs of the Hare's apparatus as shown in figure 1 to 5 which of the figures correctly indicate the levels of the liquid columns?

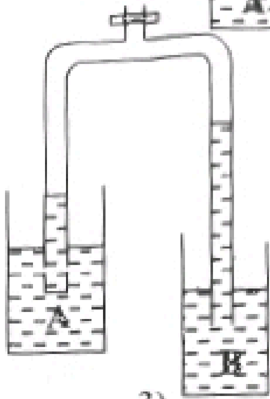




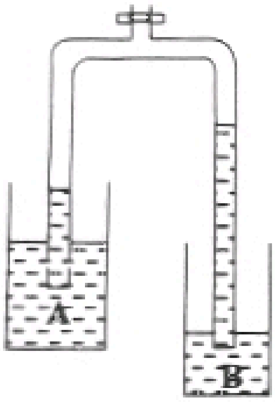
1)



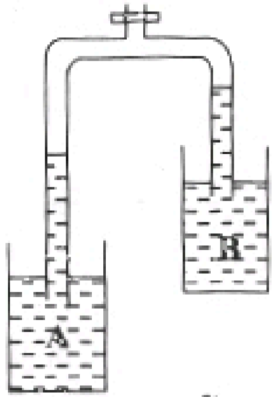
2)



3)



4)



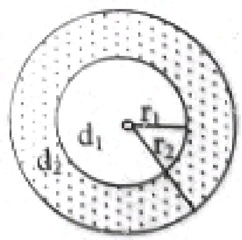
5) (2011)

37) Final masses of three liquids of densities d_1, d_2 and d_3 are added together. If the liquids mix together without causing any change, then the density of the composite liquid will be,

1) $\frac{d_1 + d_2 + d_3}{3}$ 2) $\frac{d_1 d_2 d_3}{3}$ 3) $\frac{3d_1 d_2 d_3}{d_1 d_2 + d_2 d_3 + d_3 d_1}$

4) $\frac{d_1 d_2 + d_2 d_3 + d_3 d_1}{3}$ 5) $\frac{d_1 d_2 d_3}{d_1 d_2 + d_2 d_3 + d_3 d_1}$ (2012)

38) The inner sphere of a composite solid spherical object is made of a material of density d_1 and the rest of the composite sphere is made of a material of density d_2 as shown in figure. The radius of the inner sphere is r_1 and the radius of the composite sphere is r_2. If the composite sphere floats fully immersed in a liquid of density d_3, then

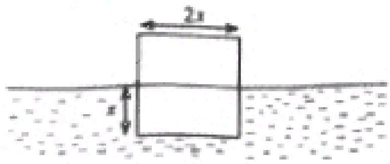


1) $r_2^3 d_3 = r_1^3 d_1 + r_2^3 d_2 - r_1^3 d_2$ 2) $r_1^3 d_1 = r_2^3 d_2 - r_2^3 d_3 + r_1^3 d_2$

3) $r_2^2 d_2 = r_1^2 d_1 + r_2^2 d_1 - r_2^2 d_2$ 4) $r_2^2 d_3 = r_1^2 d_1 + r_2^2 d_2 - r_1^2 d_2$

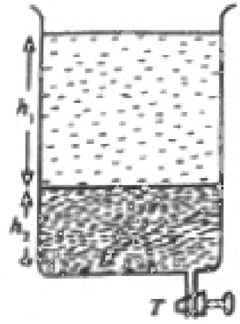
5) $r_2^3 d_2 = r_1^3 d_1 + r_1^3 d_3 - r_1^3 d_2$ (2013)

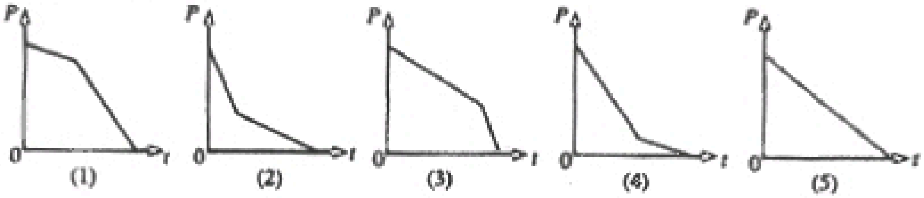
39) A solid cube of plastic of mass M and side length 2x floats in water with half the side length submerged as shown in figure. If this cube is now converted into a hollow cube of mass M with external side length 8x, the depth to which it submerges in water will be,



1) $\frac{x}{2}$ 2) $\frac{x)}{4}$ 3) $\frac{x}{8}$ 4) $\frac{x}{16}$ 5) $\frac{x}{32}$ (2014)

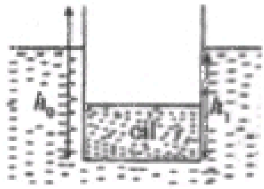
40) A cylinder contains two immiscible liquids filled to heights h_1 and h_2 as shown in figure. If the tap T at the bottom is opened at time t = 0 and the liuqids are taken out slowly at a constant volume rate, the variation of pressure (P) due to liquids at the point B at the bottom of the cylinder with time (t) is best represented by,





(2014)

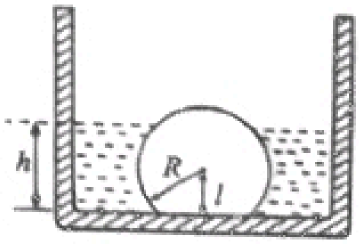
41) A vessel of uniform rectangular cross-section with height h_0 and mass M contains a certain amount of oil having mass m and density ρ_{oil} as shown in the figure. The vessel floats vertically in water of density ρ_ω ($>\rho_{oil}$) with height h_1 under water. A certain volume of oil is now replaced by an equal volume of water. If the maximum volume of oil that can be replaced while keeping the vessel floating is V and the initial volume of oil is V_0, then the ratio $\frac{V}{V_0}$ is given by (Assume that at the end of the process there is a certain amount of oil left in the vessel.)

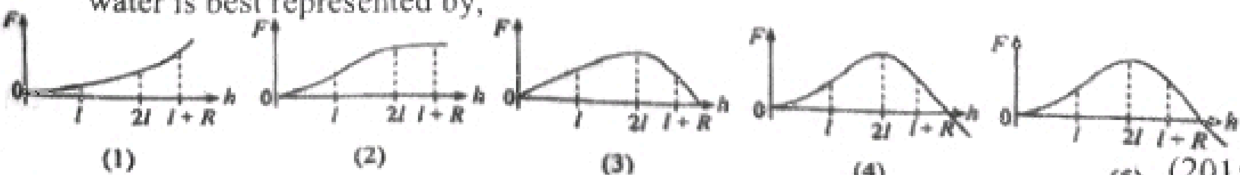


1) $\frac{(h_0-h_1)(M+m)\rho_{oil}}{h_1 m(\rho_\omega-\rho_{oil})}$ 2) $\frac{h_0(M-m)\rho_{oil}}{h_1 m(\rho_\omega-\rho_{oil})}$ 3) $\frac{h_1}{h_0}\cdot\frac{\rho_\omega}{\rho_{oil}}$

4) $\frac{(h_0-h_1)(M-m)\rho_{oil}}{h_0 m(\rho_\omega+\rho_{oil})}$ 5) $\frac{h_0(M+m)\rho_{oil}}{M(h_0+h_1)(\rho_\omega+\rho_{oil})}$ (2015)

42) An object in the shape of a truncated solid sphere of radius R is kept at the bottom of a tank as shown in the figure. The distance from the centre of the sphere to the bottom of the tank is l. The tank is now slowly filled with water. Assume that the truncated sphere is fixed to the bottom of the tank, so that its bottom surface does not get wet. The variation of the vertical upward force F, exerted on the object by the water, with the height h of water is best represented by,





(2015)

43) A glass of fresh orange solution of volume 500 cm^3 contains a few orange seeds at its bottom. It was observed that the seeds just began to float at the bottom when 10 grams of sugar was dissolved in the solution. Assume that the addition of sugar does not alter the volume of the solution. If the density of the orange solution before adding sugar was 1000 kg m^{-3}, the density of orange seeds (in kg m^{-3}) is approximately equal to,

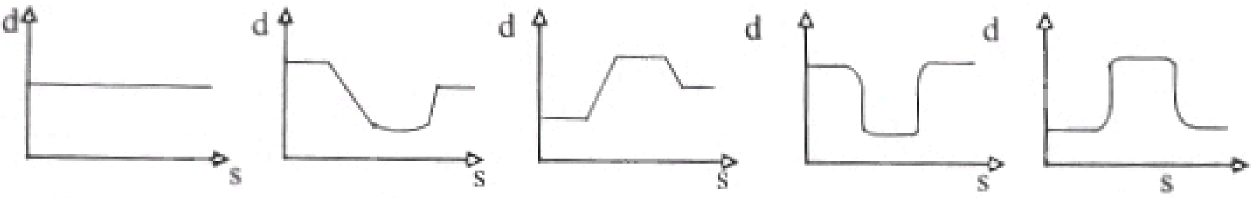
1) 1020　2) 1040　3) 1060　4) 1080　5) 1100 (2016)

10. Hydrodynamics

01) A student holds a thin strip of paper below his lower lip and blows air horizontally over it. If the surface area of one side of the paper is A and the mass of the strip is m the speed, v, with which the air should be blown in order the keep the strip horizontal is (the density of air = ρ)

1) $v=\left(\frac{2mg}{\rho A}\right)^{1/2}$　2) $v=\left(\frac{mg}{\rho A}\right)^{1/2}$　3) $v=\left(\frac{mg}{2\rho A}\right)^{1/2}$　4) $v=\left(\frac{3mg}{\rho A}\right)^{1/2}$　5) $v=\left(\frac{mg}{3\rho A}\right)^{1/2}$ (1997)

02) A river having a constant breadth is flowing steadily at a certain constant speed except in a certain region. If the speed of flow in that region is found to be lower, then which of the following curves best represents the variation of the depth (d) of the river along the length of the river(s)?

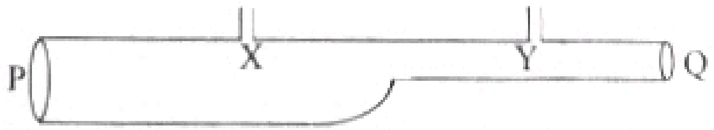


1)　2)　3)　4)　5) (1998)

03) Which one of the following cannot be explained using the Bernoulli's principle?

1) Curving of the path of a spinning ball while moving in air
2) Upward lift on an aero plane　3) action of a spray pump
4) Motion of a rocket in space　5) Rise of smoke through a tall chimney(1999)

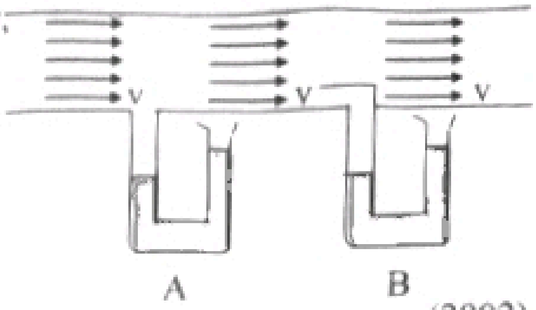
04) Air flows through the tube PQ at a constant rate. Two ping-pong balls are levitated in equilibrium above the tiny vertical tubes X and Y through which the air escapes. The heights of the two balls from the tube at equilibrium are h_x and h_y respectively. Which one of the following statements is true?



1) If air flows form P to Q $h_x > h_y$　4) If air flows form Q to P $h_x > h_y$
2) If air flows form P to Q $h_x = h_y$　5) If air flows form Q to P $h_x < h_y$
3) If air flows form P to Q $h_x < h_y$

(2001)

05) A non-viscous, incompressible fluid of density p flows thorough a pipe at a speed of v. Two manometers A and B are connected to the pipe as shown in the figure. If the pressures measured by the monometer A and manometer B are P_1 and P_2 respectively, the speed v of the flow is given by;



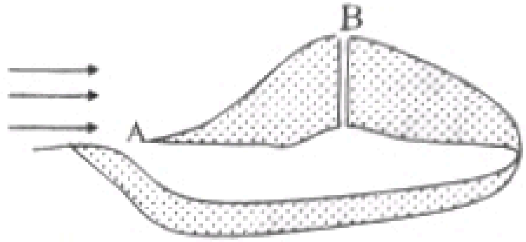
1) $\sqrt{\frac{2(P_2 - P_1)}{\rho}}$ 2) $\sqrt{\frac{2(P_1 - P_2)}{\rho}}$

3) $\sqrt{\frac{2(P_1 + P_2)}{\rho}}$ 4) $\sqrt{\frac{(P_2 - P_1)}{\rho}}$

5) $\sqrt{\frac{(P_1 - P_2)}{\rho}}$

(2002)

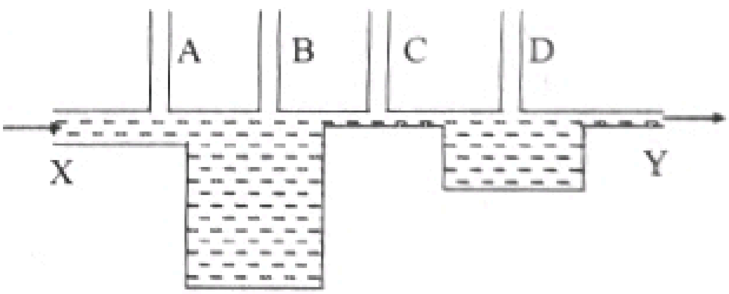
06) A Figure shows an underground cave with two small openings at A and B. A wind is blowing over the cave. Pressures and velocities of air at A and B are P_A, V_A and P_B V_B respectively.



1) $V_A > V_B$ and $P_A > P_B$ therefore air circulates from A to B through the cave
2) $V_A > V_B$ and $P_A > P_B$ therefore air circulates from A to B through the cave
3) $V_A > V_B$ and $P_A > P_B$ therefore air circulates from A to B through the cave
4) $V_A > V_B$ and $P_A > P_B$ therefore air circulates from B to A through the cave
5) P_A and P_B are the same and therefore air does not circulate through the cave

(2003)

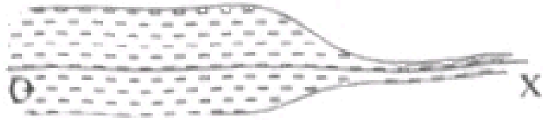
07) A water-flow system consisting of manometer tubes A, B, C and D is shown in the figure. Water enters the system at X at a constant rate and at a pressure greater than the atmospheric pressure and leaves at Y. If the heights of the water levels (not indicated in the diagram) in manometer tubes A, B, C and D are H_A, H_B, H_C and H_D respectively, then

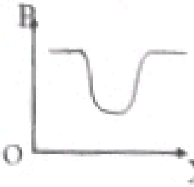


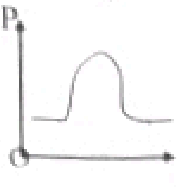
1) $H_A = H_B = H_C = H_D$ 2) $H_C > H_A > H_D > H_B$
3) $H_B > H_D > H_C > H_A$ 4) $H_D > H_C > H_A > H_B$
5) $H_B > H_D > H_A > H_C$

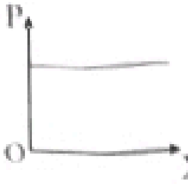
(2004)

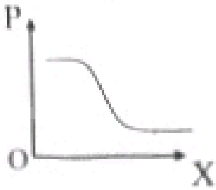
08) A non viscous and incompressible fluid flows through a tube in which the cross – section is varying as shown in the figure. The variation of pressure P along the axis OX is best represented by,

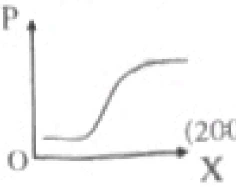


1)


2)


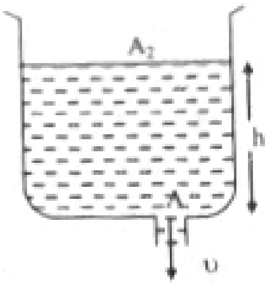
3)


4)


5)


(2005)

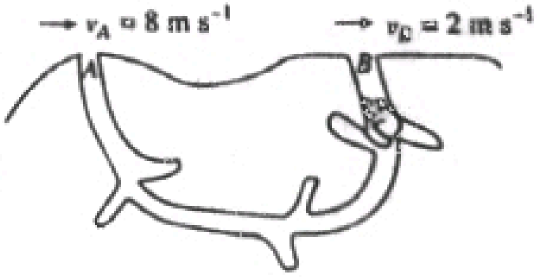
09) Water drains through an operating of area A_1, in a container of cross – sectional area A_2 as shown in the figure. If the motion of the water surface in the container is not ignored the speed υ at the water drains is given by,



1) $\upsilon = \sqrt{\dfrac{2gh}{1-\dfrac{A_1^2}{A_2^2}}}$ 2) $\upsilon = \sqrt{2gh}$ 3) $\upsilon = \sqrt{\dfrac{gh}{\dfrac{A_1^2}{A_2^2}+1}}$

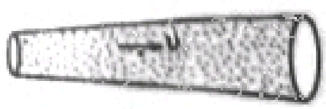
4) $\upsilon = \sqrt{\dfrac{2gh}{\dfrac{A_1^2}{A_2^2}-1}}$ 5) $\upsilon = \sqrt{\dfrac{gh}{\dfrac{A_1^2}{A_2^2}-1}}$ (2007)

10) Figure shows a burrow of some animals living undergroud. The animals maintain the shapes of two entrances A and B to the burrow different from each other and because of this, air (density 1.3 kg m^{-3}) blows past the openings at different speed of 8 ms^{-1} and 2 ms^{-1} as shown in the figure. If the openings are at the same level, the difference in air pressure between the openings and the direction of the air – movement in the burrow are,



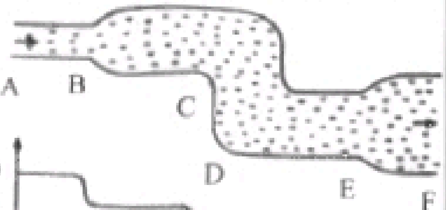
1) 78 Pa and from B to A 2) 78 Pa and from A to B 3) 39 Pa and from B to A
4) 39 Pa and from A to B 5) 3.9 Pa and from B to A (2008)

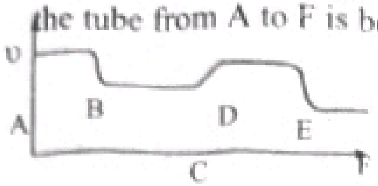
11) A non viscous fluid of density d has a streamlined flow through horizontal pipe of variable cross – section as shown in the figure. If the pressure of the fluid is P, at a point where the velocity of flow is υ, what is the pressured at another point where the velocity of flow is 3υ?



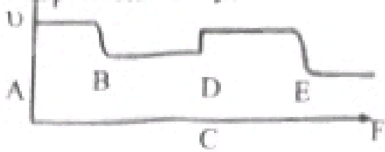
1) $P - 3d\upsilon^2$ 2) $P - 4d\upsilon^2$ 3) $P + 4d\upsilon^2$ 4) $P + 8d\upsilon^2$ 5) $P - 8d\upsilon^2$ (2009)

12) Non viscous, incompressible fluid steadily through the pipe shown in the figure. The variation of the flow speed υ of the fluid along the tube from A to F is best represented by,

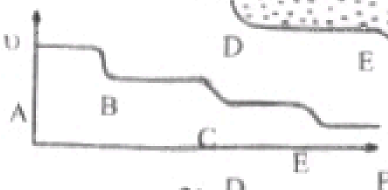




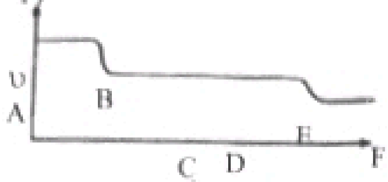
1)



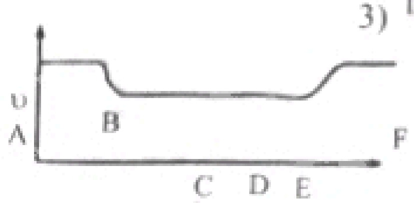
2)



3)



4)



5)

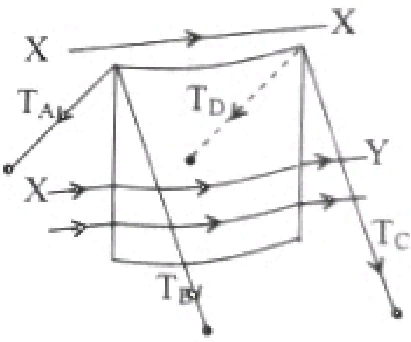
(2009)

13) A major artery with a 1.0 cm^2 cross – sectional area carring blood branches into 18 smaller arteries, each having a cross – sectional area of $0.4cm^2$ and carrying equal volumes of blood per unit time

The ratio, $\dfrac{\text{speed of blood in the major artery}}{\text{speed of blood in a smaller artery}}$

1) 3.6 2) 4.0 3) 7.2 4) 8.4 5) 4.5 (2010)

14) A large metal sheet bent into the shape shown in the figure is kept upright on the ground by means of four stretched ropes fixed to the ground.

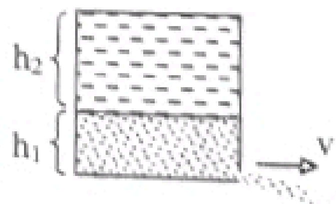


Magnitudes of the tensions in all ropes, T_A, T_B, T_C and T_D in still air are equal. When wind blows through the sheet in the direction XY.

1) $T_A < T_B$ and $T_D < T_C$
2) $T_A > T_B$ and $T_D > T_C$
3) $T_A = T_B$ and $T_C = T_D$
4) $T_A > T_B$ and $T_C > T_D$
5) $T_A < T_B$ and $T_C < T_D$

(2012)

15) A cylindrical tank having a very large diameter contains two immiscible liquids of densities d_1 and d_2 ($d_1 > d_2$). The tank has a small hole closer to the bottom (see figure). If the heights of the liquids at a certain instant, are h_1 and h_2 what will be the speed v of the liquid ejecting out of the tank at that instant? Neglect the surface tension effects and assume that the liquids are non-viscous.

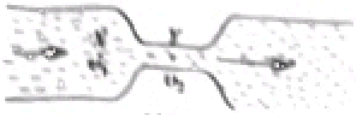


1) $\upsilon = \sqrt{2gh_1}$ 2) $\upsilon = \sqrt{\dfrac{2gh_1d_1}{d_2}}$ 3) $\upsilon = \sqrt{2g(h_1 + h_2)}$

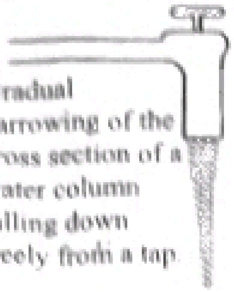
4) $\upsilon = \sqrt{2g\left(\dfrac{d_1}{d_2}h_1 + h_2\right)}$ 5) $\upsilon = \sqrt{2g\left(h_1 + \dfrac{d_2}{d_1}h_2\right)}$

(2013)

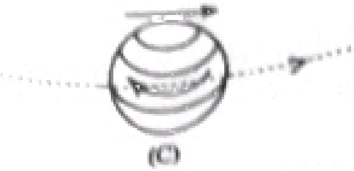
16) Consider the following physical phenomena.



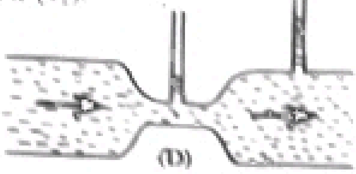
(A)
Water flowing through a tube having two different areas of cross-section, speed of water at Y (v_2) > speed of water at X (v_1).



Gradual narrowing of the cross section of a water column falling down freely from a tap.



(C)
Deflection of a cricket ball which is moving while spinning.



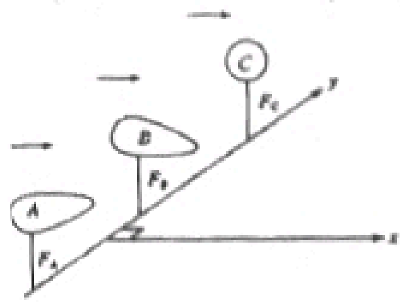
(D)
Existence of a height difference in the liqiud columns in vertical tubes.

Which of the above phenomena can be explained using the eBernoulli's theorem?

1) A and D only
2) B and D only
3) C and D only
4) B, C and D only
5) All A, B, C and D

(2014)

17) Two objects A and B of the shapes shown in the figure, and a spherical object C, all having identical masses, are mounted rigidly on a horizontal surface along the y-axis by three thin rods as shown in the figure. Both x and y axes are located on the horizontal surface.



A steam of air flows through the objects parallel to the surface and along x-direction. (Assume that the air flow causes no turbulence around the objects.) The magnitudes of forces F_A, F_B and F_C exerted by the objects and the sphere on the mounted rods, when written in the ascending order, it will be,

1) F_B, F_A, F_C
2) F_B, F_C, F_A
3) F_C, F_A, F_B
4) F_A, F_C, F_B
5) F_C, F_B, F_A

(2016)

MECHANICS

01) Motion

(01)	4	(02)	5	(03)	4	(04)	5	(05)	1	(06)	5
(07)	5	(08)	1	(09)	4	(10)	3	(11)	5	(12)	3
(13)	2	(14)	5	(15)	1	(16)	2	(17)	5	(18)	3
(19)	2	(20)	1	(21)	5	(22)	5	(23)	1	(24)	5
(25)	4	(26)	5	(27)	5	(28)	3	(29)	1	(30)	3

02) Equilibrium of Forces

(01)	3	(02)	5	(03)	3	(04)	2	(05)	2	(06)	1
(07)	5	(08)	5	(09)	1, 5	(10)	5	(11)	2	(12)	4
(13)	1	(14)	3	(15)	5	(16)	4	(17)	3	(18)	2
(19)	2	(20)	4	(21)	3	(22)	3	(23)	1	(24)	3
(25)	3	(26)	4	(27)	4	(28)	3	(29)	4	(30)	3

03) Center of Gravity

(01)	4	(02)	4	(03)	2	(04)	4	(05)	4	(06)	4
(07)	3	(08)	2	(09)	4	(10)	4	(11)	3	(12)	1
(13)	2	(14)	2	(15)	5	(16)	3	(17)	1	(18)	3
(19)	5	(20)	4								

04) Newton's Laws and Momentum

(01)	2	(02)	5	(03)	1	(04)	2	(05)	4	(06)	3
(07)	2	(08)	4	(09)	3	(10)	3	(11)	1	(12)	4
(13)	3	(14)	3	(15)	4	(16)	4	(17)	5	(18)	3
(19)	5	(20)	5	(21)	2	(22)	3	(23)	3	(24)	3
(25)	2	(26)	4	(27)	1	(28)	3	(29)	5	(30)	4
(31)	3	(32)	2	(33)	3	(34)	4	(35)	5	(36)	4
(37)	5	(38)	all	(39)	1	(40)	5	(41)	5	(42)	2

05) Friction

(01) 5	(02) 1	(03) 4	(04) 5	(05) 5	(06) 3
(07) 2	(08) 4	(09) 1	(10) 4	(11) 3	(12) 2
(13) 2	(14) 1	(15) 4			

06) Work Power and Energy

(01) 3	(02) 4	(03) 5	(04) 2	(05) 4	(06) 3
(07) 1	(08) 3	(09) 2	(10) 1	(11) 2	(12) 1
(13) 4	(14) 4	(15) 5	(16) 1	(17) 4	(18) 3
(19) 2	(20) 2	(21) 4	(22) 2		

07) Rotational Motion

(01) 1	(02) 3	(03) 2	(04) 2	(05) 4	(06) 2
(07) 2	(08) 3	(09) 2	(10) 5	(11) 4	(12) 2
(13) 3	(14) 1	(15) 5	(16) 3	(17) All	(18) 4
(19) 3	(20) 3	(21) 4	(22) 1	(23) 5	(24) 4
(25) 5	(26) 2	(27) 4	(28) 2	(29) 5	(30) 4
(31) 4	(32) 1	(33) 2	(34) 5	(35) 3	(36) 2
(37) 3	(38) 3				

08) Circular Motion

(01) 4	(02) 1	(03) 1	(04) 1	(05) 2	(06) 1
(07) 4	(08) 4	(09) 2	(10) 3	(11) 3	(12) 1
(13) 21	(14) 1	(15) 1	(16) 2	(17) 1	

09) Hydrostatics

(01) 2	(02) 2	(03) 3	(04) 3	(05) 5	(06) 2
(07) 2	(08) 5	(09) 1	(10) 4	(11) 4	(12) 4
(13) 1	(14) 4	(15) 1	(16) 2	(17) 4	(18) 5
(19) 5	(20) 1	(21) 1	(22) 3	(23) 5	(24) 1
(25) 3	(26) 2	(27) 2	(28) 1	(29) 2	(30) 4
(31) 3	(32) 2	(33) 2	(34) 1	(35) 5	(36) 2
(37) 3	(38) 1	(39) 4	(40) 2	(41) 1	(42) 2
(43) 1					

10) Hydrodynamics

(01) 1	(02) 5	(03) 4	(04) 1	(05) 1	(06) 2
(07) 5	(08) 4	(09) 1	(10) 3	(11) 2	(12) 4
(13) 3	(14) 2	(15) 5	(16) 3	(17) All	