CPP-04
FS JEE(M) &
ADVANCED

Physics

Chapterwise Practise Problems (CPP) for JEE (Main & Advanced)

Chapter - Laws of Motion

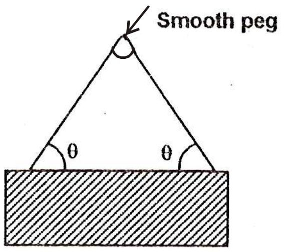
Level-1

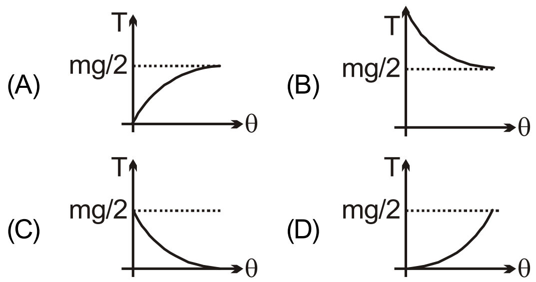
SECTION - A

Straight Objective Type

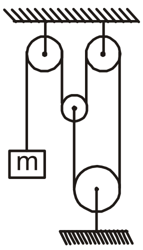
This section contains multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

1. A block of mass m is supported by a string passing through a smooth peg as shown in the figure. Variation of tension in the string T as a function of θ is best represented by (here the total length of the string is varied)





2. If the string and all the pulleys are ideal, acceleration of mass m is



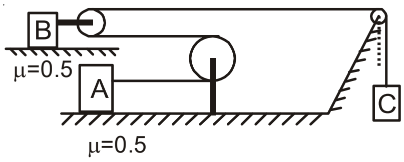
(A) $\frac{g}{2}$ (B) 0
(C) g (D) dependent on m

3. A cyclist starts running on a circle of radius $6\sqrt{3}$ m with tangential acceleration of 2 m/s^2. Find the time when it starts sliding on circular path if friction co-efficient is μ = 0.4.
(A) 8 sec (B) 4 sec
(C) 3 sec (D) 5 sec

4. A boy of mass 30 kg starts running from rest along a circular path of radius 6 m with constant tangential acceleration of magnitude 2 m/s^2. After 2 sec from start he feels that his shoes started slipping on ground. The friction coefficient between his shoes and ground is (Take g = 10 m/s^2)
(A) $\frac{1}{2}$ (B) $\frac{1}{3}$
(C) $\frac{1}{4}$ (D) $\frac{1}{5}$

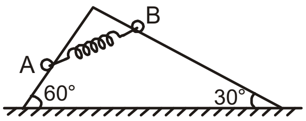
5. A lift of total mass M is raised by cables from rest to rest through a height h. The maximum tension which the cables can safely bear is nMg. The maximum speed of lift during its journey if the ascent is to be made in shortest time is
(A) $\sqrt{2gh\left(\frac{n+1}{n}\right)}$ (B) $\sqrt{2ghn}$
(C) $\sqrt{2gh\left(\frac{n}{n+1}\right)}$ (D) $\sqrt{2gh\left(\frac{n-1}{n}\right)}$

6. Three blocks A, B, and C, whose masses are 9 kg, 9 kg and 18 kg respectively as shown in the figure, are released from rest. The co-efficient of friction between blocks A and B with the horizontal surface is 0.5 . Find the acceleration of block C just after release. All strings and pulleys are identical. [Take g = 10 m/s^2]



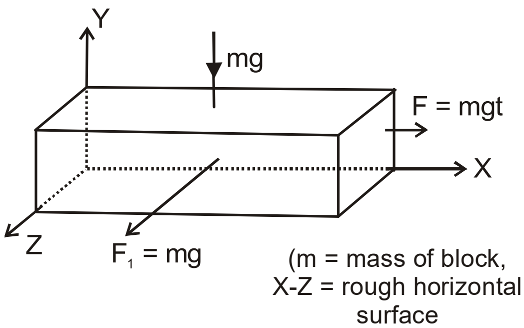
(A) $\frac{30}{9}$ m/s^2 (B) $\frac{50}{9}$ m/s^2
(C) $\frac{70}{9}$ m/s^2 (D) $\frac{85}{11}$ m/s^2

7. Two uniform solid cylinders A and B each of mass 1 kg are connected by a light spring of force constant 200 N/m at their axles and are placed on a fixed wedge as shown in the figure. The coefficient of friction between the wedge and the cylinders is 0.2. The angle made by the line AB with the horizontal in equilibrium is



(A) 0° (B) 15°
(C) 30° (D) None of these

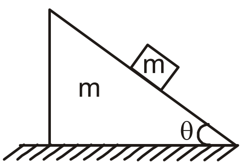
8. A block is placed on a rough horizontal plane (xz-plane) with coefficient of friction is equal to μ. In each of Y and Z directions constant force mg is applied as shown, and in the X-direction a time varying force F = mgt is applied, where t is time. If block starts moving at time t = 1s. Then value of μ is



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

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

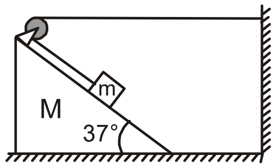
9. A block of mass m slides down an inclined wedge of same mass m shown in the figure. Friction is absent everywhere. Magnitude of acceleration of the center of mass of the block and wedge is



(A) Zero (B) $\frac{g\sin^2\theta}{(1+\sin^2\theta)}$

(C) $\frac{g\cos^2\theta}{(1+\sin^2\theta)}$ (D) $\frac{g\sin\theta}{(1+\cos\theta)}$

10. A block of mass m = 5 kg is placed on the wedge of mass M = 32 kg as shown in the figure. Find the acceleration of wedge with respect to ground on releasing the system from rest. (Neglect any type of friction. String and pulley are ideal)



(A) $\frac{1}{2}$ m/s^2 (B) $\frac{3}{4}$ m/s^2

(C) $\frac{4}{3}$ m/s^2 (D) $\frac{3}{5}$ m/s^2

11. A block is kept on a smooth inclined plane of angle of inclination θ that moves with a constant acceleration so that the block does not slide relative to the inclined plane. If the inclined plane stops, the ratio of final and initial normal contact forces offered by the plane on the block will be (velocity gained by block is negligible)

(A) $\cos\theta$ (B) $\sec^2\theta$

(C) $\cos^2\theta$ (D) $\tan^2\theta$

SECTION - B

Multiple Correct Answer Type

This section contains multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

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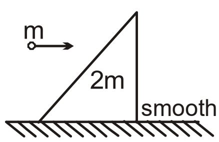
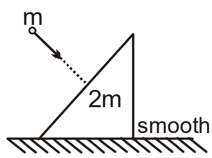
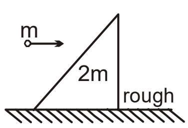
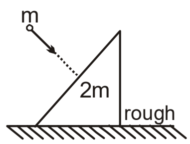
12. In which of the following sytems linear momentum of mass *m* and wedge cannot be conserved during collision along horizontal line

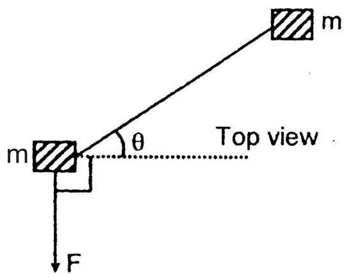
(A)


(B)


(C)


(D)


13. Figure shows top view of a horizontal surface. Two blocks each of mass m are placed on the surface and connected with a string. The friction coefficient is μ for each block. A horizontal force F is applied on one of the blocks as shown in the figure. F is maximum so that there is no sliding



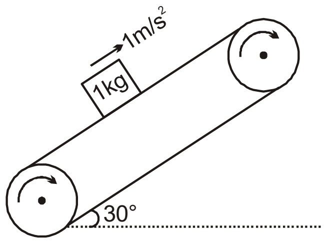
(A) If $\theta = 30°, F = \frac{2\mu mg}{\sqrt{3}}$ and T < μmg

(B) If $\theta = 45°, F = \sqrt{2}\mu mg$ and T = μmg

(C) If $\theta = 60°, F = 2\mu mg$ and T < μmg

(D) If $\theta = 60°, F = \sqrt{3}\mu mg$ and T = μmg

14. A block of mass 1 kg is stationary with respect to a conveyer belt that is accelerating with 1 m/s^2 upwards at an angle of 30° as shown in figure. Which of the following is/are correct?



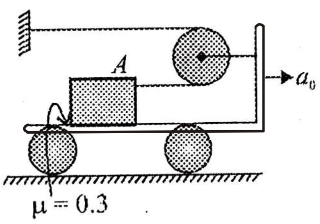
(A) Force of friction on block is 6N

(B) Force of friction on block is 1.5 N

(C) Contact force between the block and belt is $\sqrt{111}$N

(D) Contact force between the block and belt is $5\sqrt{3}$ N

15. A flat car is given an acceleration a_0 = 2m/s^2 started from rest as shown in figure. Neglect friction between floor and car wheels and also the mass of pulley. Mass of Block A is 50 kg



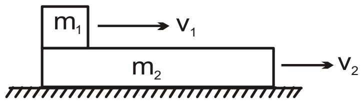
(A) Tension in the string is 350 N

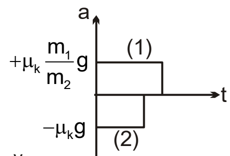
(B) Friction force acting on A is 150 N

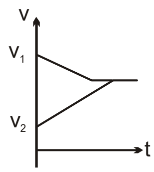
(C) Acceleration of block A is 4 m/s^2

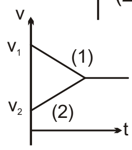
(D) None of these

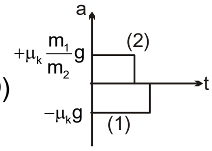
16. Block m_1 is projected on a long plank of mass m_2. Plank is placed on a smooth horizontal surface. There is friction between block and plank, coefficient of friction is μ. Block m_1 has initial velocity v_1 and plank has initial velocity v_2 with $v_1 > v_2$. Which of following graphs is correct ?



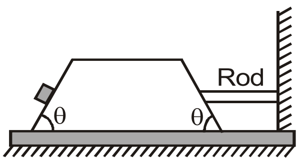
(A) 

(B) 

(C) 

(D) 

17. In the shown figure, no relative motion takes place between the wedge and the block placed on it. The rod slides downwards over the wedge and pushes the wedge to move in the horizontal direction. The mass of the wedge is the same as that of the block and is equal to M. If tanθ = $1/\sqrt{3}$. Choose the correct options. (Neglet the rotation of the rod and all surfaces are smooth).



(A) acceleration of wedge is $\frac{g}{\sqrt{3}}$

(B) mass fo rod is 4M

(C) acceleration of rod is $\frac{g}{3}$

(D) mass of rod is 3M

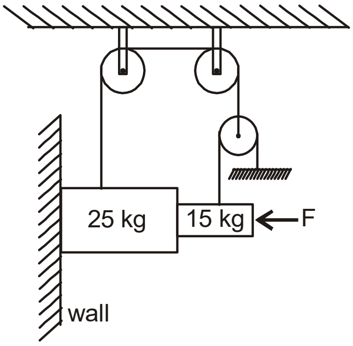
SECTION - C

Linked Comprehension Type

This section contains paragraphs. Based upon these paragraphs, some multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE OR MORE** is/are correct.

Paragraph for Question Nos. 18 and 19

The coefficient of friction between the surface of 25 kg block and fixed vertical wall is 0.4, and that between both the blocks is also 0.4. All the shown pulleys are light and frictionless. Strings are light, perfectly inextensible and smooth. The applied force F is perpendicular to the surface of 15 kg block. (Take $g = 10\ m/s^2$)



18. To have the complete system in static equilibrium, the magnitude of minimum horizontal force F needed towards left as shown is equal to

(A) $\frac{125}{4}$N (B) 62.5 N

(C) 150 N (D) None of these

19. In the equilibrium state, the direction of frictional force exerted by vertical wall on 25 kg block and the direction of frictional force exerted by 25 kg block on 15 kg block respectively are

(A) upwards, upwards

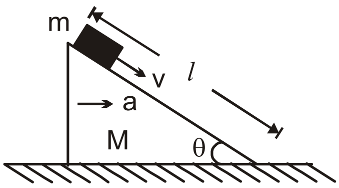
(B) upwards, downwards

(C) downwards, downwards

(D) downwards, upwards

Paragraph for Question Nos. 20 to 21

A smooth wedge of mass M is pushed with an acceleration $a = g\tan\theta$ on a horizontal surface and a block of mass m is projected down the slant with a speed v relative to wedge. Then answer the following



20. Time taken by the block to reach the ground is

(A) $\frac{\ell}{v}$ (B) $\sqrt{\frac{2\ell}{g\sin\theta}}$

(C) $\sqrt{\frac{2\ell}{g\cos\theta}}$ (D) $\frac{v}{g\sin\theta}$

21. Normal reaction offered by ground to the wedge is

(A) $(M+m)g$

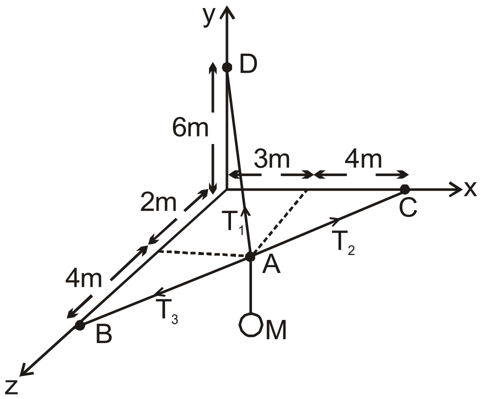
(B) $(M+m)g\cot\theta$

(C) $mg\sin^2\theta + Mg$

(D) $(M+m)g + mg\cos^2\theta$

Paragraph for Question Nos. 22 to 24

A mass M of 6.12 kg is supported by the three wires as shown in the figure. AB and AC are in the X-Z plane. Now answer the following (assume $g = 9.8\ m/s^2$)



22. The value of tension in wire AD is

(A) 50 N (B) 70 N

(C) 80 N (D) None of these

23. The tension in wire AB is

(A) 70 N (B) 50 N

(C) 80.5 N (D) 60 N

24. In the wire AC the tension is

(A) 70 N (B) 50 N

(C) 80.5 N (D) 60 N

SECTION-E

Integer Answer Type

This section contains Integer type questions. The answer to each of the questions is an integer.

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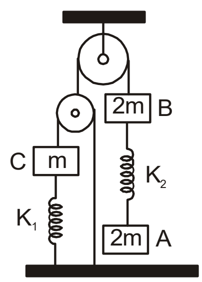
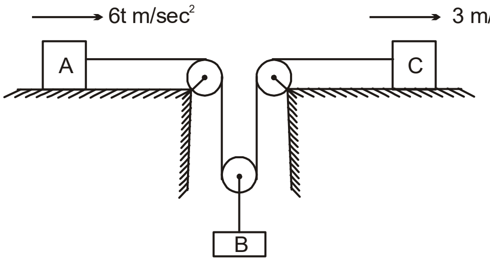
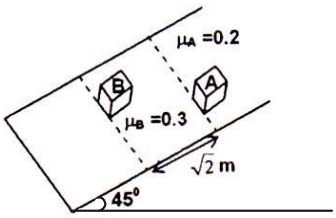
25. The system shown is in equilibrium. At the strings and pulleys are massless. Instantaneous acceleration of C, when string above B is cut, is found to be 5x (in ms^{-2}). Find the value of x.



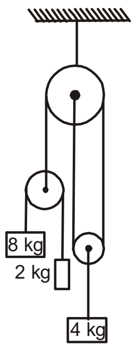
26. Blocks A and C start from rest and move to right with accelerations $a_A = 6t$ m/sec^2 and $a_C = 3$ m/sec^2 where t in sec. The time when block B will come to rest again.



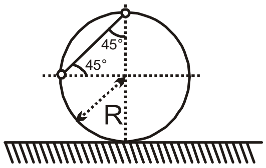
27. Two identical blocks A and B are placed on a rough inclined plane of inclination 45°. The coefficient of friction between block A and incline is 0.2 and that of between B and incline is 0.3. The initial separation between the two blocks is $\sqrt{2}$ m. The two blocks are released from rest, then find the time (in sec) after which front faces of both blocks come in same line.



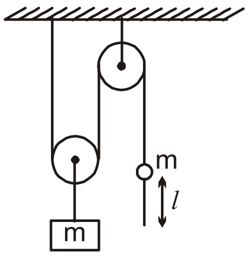
28. Determine the acceleration of 4 kg block (in m/s^2) in the system shown in figure assuming the pulleys and strings are ideal ($g = 10$ m/s^2). Round your ans to nearest integer if required



29. Two beads connected by a light inextensible string are placed over fixed vertical ring as shown in figure. Mass of each bead is 100 gms and all surfaces are frictionless. If the tension is T in the string just after the beads are released from the shown position, then find $10T^2$ (in N^2)



30. In the figure shown, friction force between the bead and the light string is $\frac{mg}{4}$, find the time in which the bead looses contact with the string after the system is released from rest. If this time $t = x\sqrt{\frac{2\ell}{7g}}$. Find x



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SECTION - A

Straight Objective Type

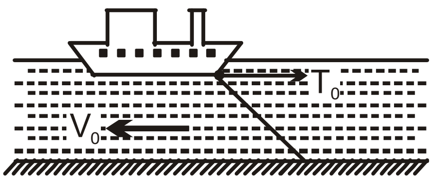
This section contains multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

1. A person throws a ball in vertical plane such that velocity of ball along horizontal is v_x and along vertical is v_y. Coefficient of friction between man and ground is μ. Necessary condition so that man always remains at rest will be (Note: The process is done in time $\Delta t \to 0$)

   (A) $v_x > \mu v_y$ (B) $v_x \le \mu v_y$

   (C) $v_y \le \mu v_x$ (D) $\mu v_x \le v_y$

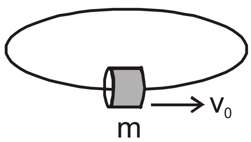
2. A ship of total mass m is anchored in the middle of a river and water is flowing with a constant velocity v_0. The horizontal component of the force exerted on the ship by the anchor chain is T_0. If the anchor chain suddenly breaks, determine the time required for the ship to attain a velocity equal to 0.5 v_0. Assume that the frictional resistance force of the water is proportional to the velocity of the ship relative to the water.



   (A) $\frac{mv_0}{T_0}\ln 2$ (B) $\frac{mv_0}{2T_0}\ln 2$

   (C) $\frac{3mv_0}{2T_0}\ln 2$ (D) None of these

3. A small collar of mass m is given an initial velocity of magnitude v_0 on the horizontal circular track fabricated from a slender rod. If the coefficient of kinetic friction is μ_k, determine the distance travelled before the collar comes to rest.



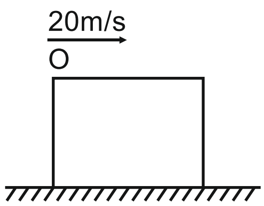
   (A) $\frac{r}{\mu_k}\ln\left[\frac{v_0^2+\sqrt{v_0^4+r^2g^2}}{rg}\right]$

   (B) $\frac{r}{4\mu_k}\ln\left[\frac{v_0^2+\sqrt{v_0^4+r^2g^2}}{rg}\right]$

   (C) $\frac{2r}{\mu_k}\ln\left[\frac{v_0^2+\sqrt{v_0^4+r^2g^2}}{rg}\right]$

   (D) $\frac{r}{2\mu_k}\ln\left[\frac{v_0^2+\sqrt{v_0^4+r^2g^2}}{rg}\right]$

4. Over a cube placed on a smooth horizontal plane, a particle of same mass is placed with initial speed 20m/s. The co-efficient of friction between the particle and the cube is $\frac{1}{\sqrt{2}}$. What should be the minimum side length of the cube so that the particle does not fall off from it? [Take g = 10m/s^2]



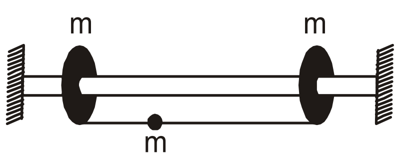
   (A) $\frac{10}{\sqrt{2}}$m

   (B) 10 m

   (C) $10\sqrt{2}$ m

   (D) 20 m

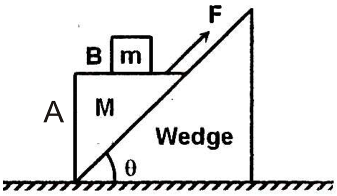
5. A smooth horizontal rod passes through two identical rings, each of mass m. Rings are connected to a block of same mass through two strings of length 2ℓ and ℓ as shown in figure. Block is released and when it is crossing the lowest point its velocity is 2 m/s, velocity of left ring is



   (A) 4 m/s (B) 2 m/s

   (C) 3 m/s (D) None of these

6. Wedge is fixed on horizontal surface. Block A is pulled upward by applying a force F as shown in the figure and there is no friction between the wedge and the block A while coefficient of friction between A and B is μ. If there is no relative motion between the block A and B then frictional force developed between A and B is



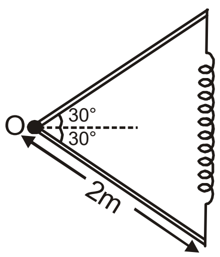
(A) $\left[\frac{F+(m-M)g\sin\theta}{(m+M)}\right]m\cos\theta$

(B) μmg

(C) $\left[\frac{F-(m+M)g\sin\theta}{(m+M)}\right]m\cos\theta$

(D) $\mu mg/2$

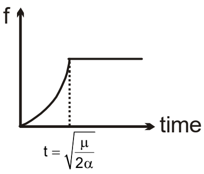
7. Two identical rods each of length 2 m and having same mass are connected from end to end by means of a spring of spring constant $(3+2\sqrt{2})$ N/m. The other two ends of the rods are riveted to ground at O and are lying on a smooth horizontal surface. These two rods are free to rotate about the rivet on the horizontal surface. When the spring is in natural length the angle between the two rods is 60°. From this position each rod is pulled away from each other by an angle of 15° and released. Then the force on the rivet when they come back to their initial position in Newton is

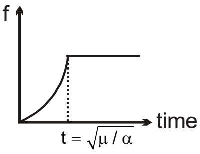


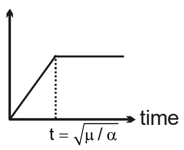
(A) $\frac{3\sqrt{3}}{2}$ (B) $\frac{3\sqrt{3}}{4}$

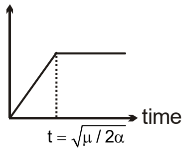
(C) $\frac{3}{2\sqrt{3}}$ (D) $\frac{3}{4\sqrt{3}}$

8. A long horizontal rod has a bead which can slide along its length, the bead is initially at a distance L from one end A of the rod. The rod is set in angular motion in the horizontal plane about end A with constant angular acceleration α. If the coefficient of friction between rod and the bead is μ, the gravity is neglected then graph between frictional force acting on bead and the time is (given that the speed of bead relative to rod is zero or negligible for the time interval shown in the graphs below)

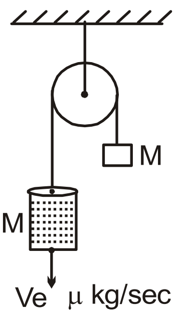
(A) 

(B) 

(C) 

(D) 

9. A block of mass M and a cylindrical tank which contains water having small hole at bottom, which is closed initially (total mass of cylinder + water is also M), are attached at two ends of an ideal string which passes over an ideal pulley as shown. At t = 0 hole is opened such that water starts coming out of the hole with a constant rate μ kg/s and constant velocity V_e relative to the cylinder. Then choose the correct option. (Magnitude of V_e is such that string does not get slack)



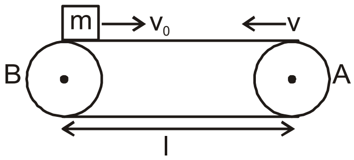
(A) Magnitude of acceleration of the block at any time t is $\frac{\mu(V_e+gt)}{(2M-\mu t)}$

(B) Magnitude of acceleration of the block at any time t is $\frac{\mu(V_e-gt)}{(2M-\mu t)}$

(C) Magnitude of acceleration of the block at any time t is $\frac{\mu gt}{2M}$

(D) Magnitude of acceleration of the block at any time t is μg

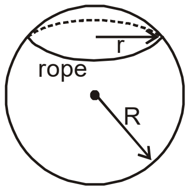
10. A conveyor belt of length l is moving with velocity v. A block of mass m is pushed against the motion of conveyor belt with velocity v_0 from end B. Coefficient of friction between block and belt is μ. The value of v_0, so that the amount of heat liberated as a result of retardation of the block by conveyer belt is maximum, is:



(A) $\sqrt{\mu gl}$ (B) $\sqrt{2\mu gl}$

(C) $2\sqrt{\mu gl}$ (D) $\sqrt{3\mu gl}$

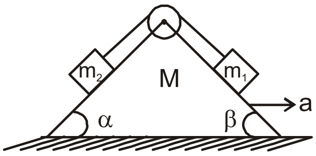
11. A circular rope of weight W and radius $r = \frac{R}{2}$ is resting on a smooth sphere of radius R. The tension in rope is



(A) $\frac{W}{(\pi\sqrt{6})}$ (B) $\frac{W}{(\pi\sqrt{12})}$

(C) $\frac{W}{(\pi\sqrt{10})}$ (D) None of these

12. Two blocks of mass m_1 and m_2 are connected by a light string passing over a smooth light pulley fixed with wedge of mass M. Both the blocks are in contact with wedge. Consider all surfaces to be smooth. Now an external force is applied on wedge such that it moves with horizontal acceleration 'a' ($0 < a < g\cot\alpha$) as shown. Then the value of $\frac{\cos\alpha}{\cos\beta}$ such that the tension in string is independent of acceleration of wedge a, will be



(A) $\frac{m_1}{m_2}$ (B) $\frac{m_2}{m_1}$

(C) $\frac{m_1+m_2}{M}$ (D) 1

SECTION - B

Multiple Correct Answer Type

This section contains multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

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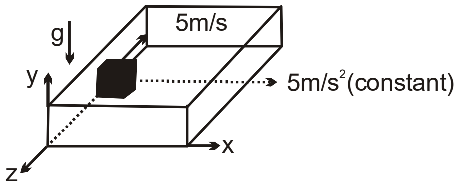
13. Block of mass 5 kg is moving with initial velocity $-5\hat{k}$ (m/s) relative to the platform as shown in figure (block is in contact with vertical surface also). Vertical and horizontal surfaces of large platform are having friction coefficient $\frac{1}{2}$ and $\frac{1}{4}$ respectively. The platform is being moved with constant acceleration $5\hat{i}$ m/s^2 select correct alternative/alternatives ($g = 10m/s^2$)



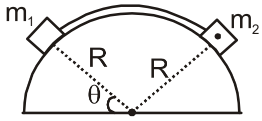
(A) Block will stop after travelling $\frac{5}{2}$ m relative to platform

(B) Block will stop after travelling 5m relative to platform

(C) Time after which the block will stop with respect to platform is 2 sec

(D) Time after which the block will stop with respect to platform is 1 sec

14. Two blocks of masses $m_1 = 3m$ and $m_2 = 4m$ are connected with an inextensible and massless string of length L and are resting on a fixed frictionless semi-cylinder of radius R as shown in figure, such that $\frac{L}{R} = \frac{\pi}{2}$.



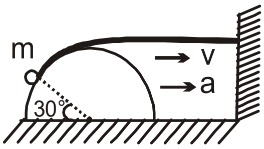
(A) System is in equilibrium if $\theta = 37°$

(B) Magnitude of tangential accelerations of the blocks after they are slightly displaced from the equilibrium position as function of instantaneous angle θ is $\left(\frac{3\cos\theta - 4\sin\theta}{7}\right)g$

(C) The angular speed as function of instantaneous angle θ after they are slightly displaced from the equilibrium postion is $\left[\frac{2g}{7R}(5-4\cos\theta-3\sin\theta)\right]^{1/2}$

(D) The angular speed as function of instantaneous angle θ after they are slightly displaced from the equilibrium position is $\left[\frac{2g}{7R}(5-3\cos\theta-4\sin\theta)\right]^{1/2}$

15. A point object of mass m is slipping down on a smooth hemispherical body of mass M and radius R. The point object is tied to a wall by an ideal string as shown. At a certain instant shown in figure, speed of the hemisphere is v and its acceleration is a. Then speed v_P and acceleration a_P of the point object is(Assume all the surfaces in contact are frictionless and the point object does not lose contact with hemisphere at the instant shown.)



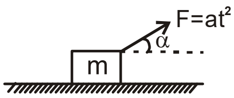
(A) $v_P = v\sin 60°$

(B) $v_P = v$

(C) $a_P = a$

(D) $a_P = \sqrt{\left(\frac{a\sqrt{3}}{2}+\frac{v^2}{R}\right)^2+\left(\frac{a}{2}\right)^2}$

16. At t = 0, a force $F = at^2$ is applied to a small body of mass m at an angle α resting on a smooth horizontal plane [a is a positive constant]. Identify the correct options



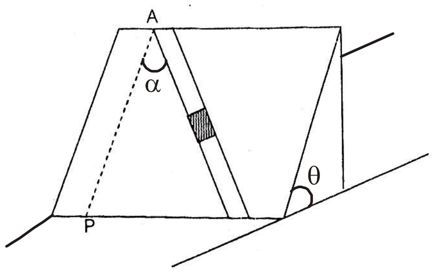
(A) Velocity of the body at the moment it breaks off the plane is $\sqrt{\frac{mg^3}{9a\tan^2\alpha\sin\alpha}}$

(B) The distance travelled by the body before breaking off the plane is $\frac{mg^2}{12a\sin\alpha\tan\alpha}$

(C) Its acceleration at the time of breaking off the plane is g $\cot\alpha$.

(D) Time at which it breaks off the plane is $\sqrt{\frac{mg}{a\sin\alpha}}$

17. A block of mass M is placed inside a slot made on the inclined plane as shown. The coefficient of friction between the block and the sidewalls of the slot is k and that between the block and the base of the slot is also k. The plane is inclined at angle θ. The angle made by the line along the slot and the line AP is α. It is found that body is at rest.



(A) The normal reaction acting from the base on the block is mgcosθ

(B) The normal reaction acting from the side wall on the block is mgsinθsinα

(C) If the block is just in the state of rest then the value of the coefficient of friction k is sinθcosα/ $(\cos\theta+\sin\theta\sin\alpha)$

(D) None of these

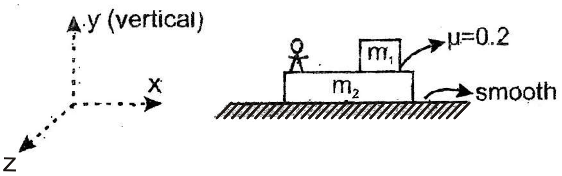
SECTION - C

Linked Comprehension Type

This section contains paragraphs. Based upon these paragraphs, some multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE OR MORE** is/ are correct.

Paragraph for Question Nos. 18 to 19

The system shown in figure is initially (t = 0) at origin and is moving with velocity 5 m/s on a smooth horizontal xz-plane along positive z-direction. A force $\vec{F}=(120t)\hat{i}$ starts acting on mass m_2 at t = 0, [where F is in Newton, t is in sec]. The man throws a light ball (at the instant when m_1 starts slipping on m_2) with a velocity 10 m/s vertically up with respect to himself. Assuming that man never slips on m_2. (Take $m_1 = m_2 = 60$ kg and mass of man = 60 kg) (Neglect the dimensions of system, and g = 10 m/s^2)



18. Projection velocity of ball with respect to ground is

(A) $\left(10\hat{i}+5\hat{k}\right)m/s$ (B) $\left(3\hat{i}+10\hat{j}+5\hat{k}\right)m/s$

(C) $\left(1.5\hat{i}+10\hat{j}+5\hat{k}\right)m/s$ (D) $\left(3\hat{i}+10\hat{j}\right)m/s$

19. The time of flight of the ball is

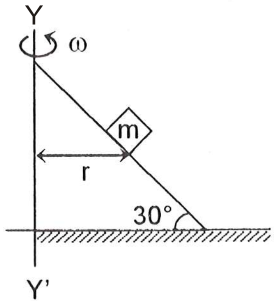
(A) 4s (B) 6s

(C) 2s (D) 8s

SECTION-D
Matrix-Match Type

This **Section D** has "match the following" type question. This question contains two columns, **Col-I** and **Col-II**. Match the entries in **Col-I** with the entries in **Col-II**. One or more entries in **Col-I** may match with one or more entries in **Col-II**.

20. A small block of mass m is placed on rough inclined plane, which is rotating about YY′ axis with some angular speed ω. Coefficient of friction between block and inclined plane is $\mu = \sqrt{3}$ while angle of inclination is 30°. Let f_{max} and ω_{max} represents maximum value of friction and angular speed for which block will not slip on inclined. N_{min} and N_{max} represents minimum and maximum value of normal contact force between block and inclined respectively for no slipping of block.



Now match the column I with column II

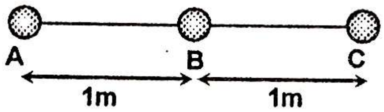
Column I	Column II
(A) $\dfrac{f_{max}}{mg}$	(p) $\dfrac{\sqrt{3}}{2}$
(B) $\dfrac{r\omega_{max}^2}{g}$	(q) $\dfrac{1}{\sqrt{3}}$
(C) $\dfrac{N_{min}}{mg}$	(r) 1
(D) $\dfrac{N_{max}}{mg}$	(s) $\sqrt{3}$
	(t) $\dfrac{1}{2}$

SECTION-E
Integer Answer Type

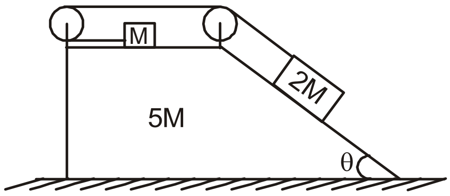
This section contains Integer type questions. The answer to each of the questions is an integer.

21. Three identical balls A, B and C each of mass m = 3 kg are connected by strings AB and BC as shown in the figure. The whole system is placed on a smooth horizontal surface.

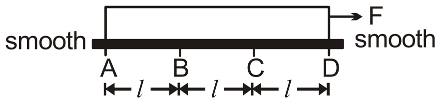
Now the ball B is given an initial velocity $v_0 = \sqrt{3}$ m/s, perpendicular to the strings and along the horizontal surface. Find the tension (in Newton) in the string just before the balls A and C collide.



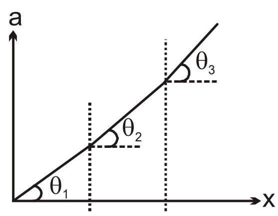
22. In the system shown, the acceleration of the wedge of mass 5M is zero. If angle 'θ' of wedge is $\frac{\pi}{x}$, then calculate x. (all surfaces are smooth)



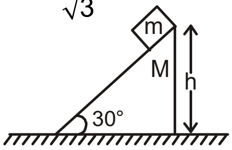
23. In the diagram, the variation of coefficient of friction of the surface is shown. The external force F applied on board is equal to $2\mu Mg$. Now the board of mass M is gently pushed so that it starts moving. The variation of acceleration a of board with respect to displacement x has been shown. Find the value of $\left(\dfrac{\tan\theta_1}{\tan\theta_3}\right)^2$



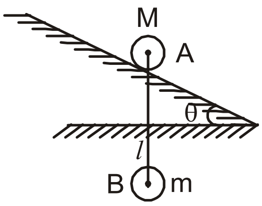
Coefficient of friction for
A to B = 3μ, B to C = 2μ, C to D = μ
and remaining surface is smooth



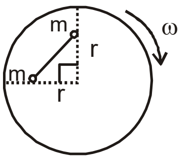
24. A block of mass m is released on a smooth inclined wedge of inclination 30° and mass M. Height of the block (from ground) varies with time as h = 1.5 – $1.5t^2$ (h is in metre and t = time is in second) The acceleration of M is $\frac{x}{\sqrt{3}}$ m/s^2. Find the value of x



25. A disc 'A' of mass M is placed at rest on the smooth inclined surface of inclination θ. A ball B of mass m is suspended vertically from the centre of the disc A by a light inextensible string of length l as shown in the figure. If the acceleration of the disc B immediately after the system is released from rest is $\frac{(M+km)g\sin^2\theta}{M+m\sin^2\theta}$. Find k.

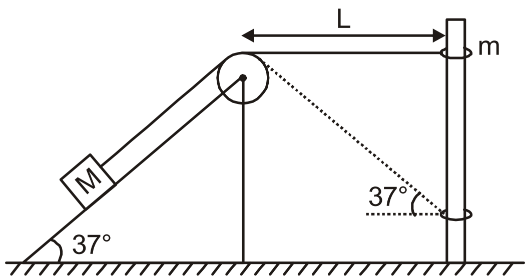


26. Two particles of mass m each are kept on a horizontal circular platform on two mutually perpendicular radii at equal distance r from the center of the table. The particles are connected with a string, which is just taut when the platform is not rotating. The coefficient of static friction between the platform and particles is μ. (Now if angular speed of platform is slowly increased, find the maximum angular speed of platform about its centre so that the particles remain stationary realtive to platform ($\mu = \frac{1}{\sqrt{2}}$, r = 2.5 m and g = 10 m/s^2)

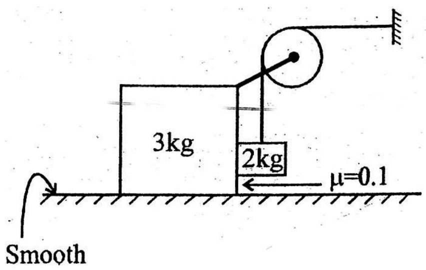


27. A rocket of mass m_0 travelling at constant velocity v_0 is required to change its direction at constant speed v_0 by an angle of 0.7 radian. So it ejects gases at constant rate of $\frac{35}{6}m_0$ per hour with a relative velocity of $\frac{v_0}{3}$ in a direction perpendicular to its instataneous velocity. After how many minutes, it should stop ejecting gases? (Use $\log_e 2 = 0.7$)

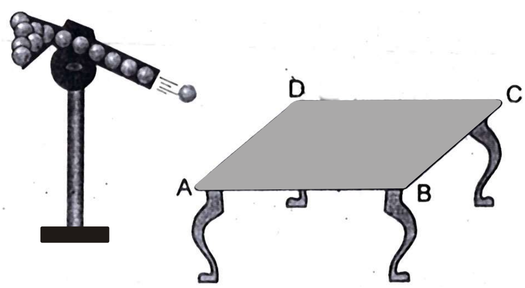
28. A ring of mass m = 1 kg can slide over a smooth vertical rod. A light string attached to the ring passing over a smooth fixed pulley at a distance of L = 0.7 m from the rod as shown in the figure. At the other end of the string mass M = 5 kg is attached, lying over a smooth fixed inclined plane of inclination angle 37°. The ring is held in level with the pulley and released. Determine the velocity of ring (in m/s) when the string makes an angle 37° with the horizontal. [sin 37°=0.6]



29. System shown in figure is released from rest. Then the acceleration of 2kg block is $\frac{25\sqrt{2}}{x}$ ms^{-2}, then x is



30. A gun which fires small balls each of mass 20 gm is firing 20 balls per second on the smooth horizontal table surface ABCD. If the collision is perfectly elastic and balls are striking at the centre of table with a speed 5 m/sec at an angle of 60° with the vertical just before collision, then force (in N) exerted by one of the legs on ground is (assume total mass of the table is 0.2 kg and g = 10 m/s^2)



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ANSWERS

LEVEL-1

1. (B)	2. (C)	3. (C)	4. (B)	5. (D)	6. (C)
7. (C)	8. (B)	9. (B)	10. (D)	11. (C)	12. (C,D)
13. (A,B,D)	14. (A,C)	15. (A,B,C)	16. (C)	17. (A,C,D)	18. (A)
19. (D)	20. (A)	21. (A,)	22. (B)	23. (A)	24. (A)
25. (4)	26. (1)	27. (2)	28. (3)	29. (5)	30. (2)

LEVEL-2

1. (B)	2. (A)	3. (D)	4. (C)	5. (A)	6. (C)
7. (A)	8. (B)	9 (A)	10. (B)	11. (B)	12. (D)
13. (A ,D)	14. (A,B,C)	15. (B,D)	16. (A,B,C,D)	17. (A,B,C)	18. (B)
19. (C)	20. (A-r, B-q ,C-q, D-p)		21. (1)	22. (3)	23. (9)
24. (2)	25. (1)	26. (2)	27. (9)	28. (0)	29. (9)
30. (1)					

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