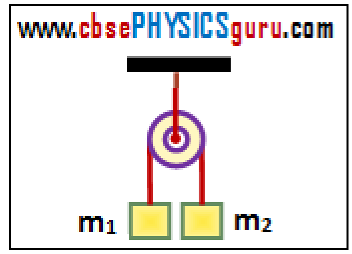
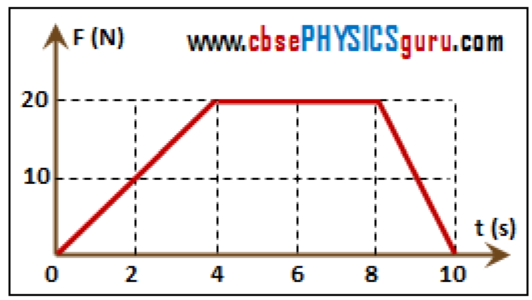
NEWTON'S LAWS OF MOTION

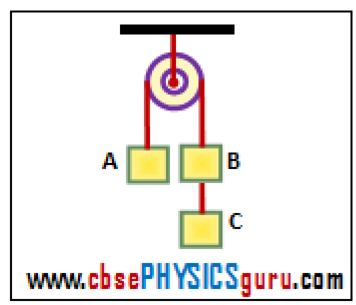
1. Two masses m_1 = 4 kg and m_2 = 2 kg are connected at the ends of an inextensible string passing over a frictionless pulley as shown. When the masses are released, then the acceleration of the masses will be:
   (a) g **(b)** g/3 (c) 2g/3 (d) 3g/4



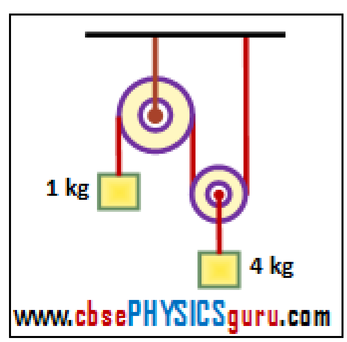
2. The ratio of the weight of a man in a stationary lift and when it is moving downwards with uniform acceleration is 4 : 3, then the value of a is:
   (a) 2g/3 (b) 3g/2 **(c)** g/4 (d) 2g
3. A block of mass 2 kg is resting on a smooth horizontal plane. If it is struck by a jet of water at the rate of 4 kg/s and at the speed of 8 m/s, then the initial acceleration of the block is:
   (a) 16 m/s^2 (b) 12 m/s^2 (c) 8 m/s^2 (d) 5 m/s^2
4. A body of mass 4 kg is acted on by a force F which varies with time t as shown in the given figure. Then the momentum gained by the body at the end of 10 seconds is:
   (a) 60 kg m/s (b) 100 kg m/s (c) 120 kg m/s **(d)** 140 kg m/s



5. A string of length L and mass M is lying on a horizontal table. A force F is applied at one of its ends. Tension in the string a distance x from the end at which the force applied is:
   (a) zero **(b)** $\frac{F\,(L-x)}{L}$ (c) $\frac{F\,(L-x)}{x}$ (d) $\frac{F\,(x}{L}$
6. Three equal weights A, B, C of mass 4 kg each are hanging on a string passing over a fixed frictionless pulley as shown in the figure. The tension in the string, connecting weights B and C is:
   (a) Zero (b) 3.3 N (c) 13.3 N **(d)** 26.1 N



7. Sand drops vertically at the rate of 4 kg/sec on to a conveyor belt moving horizontally with a velocity of 0.5 m/sec. Then the extra force required to keep the belt moving is:
   (a) 2.0 N (b) 0.04 N (c) 0.02 N (d) 0.6 N
8. In the system shown in the figure, the acceleration of 4 kg block is:
   (a) g/4 upwards **(b)** g/4 downwards (c) g/3 downwards (d) g/2 upwards

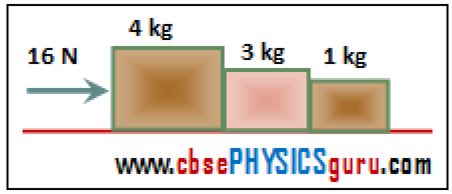


9. An object is kept on a smooth inclined plane of 1 in L. The horizontal acceleration to be imparted to the inclined plane so that the object is stationary relative to the incline is:

(a) $\frac{gL}{\sqrt{L^2-1}}$ (b) $g\sqrt{L^2-1}$ (c) $\frac{g\sqrt{L^2-1}}{L}$ **(d)** $\frac{g}{\sqrt{L^2-1}}$

10. Three blocks of mass 4 kg, 3 kg, 1 kg respectively are in contact on a frictionless surface as shown in the figure. If a force of 16 N is applied on the 4 kg block, the contact force between the 4 kg and the 3 kg block will be:

(a) 4 N **(b)** 8 N (c) 12 N (d) 16 N

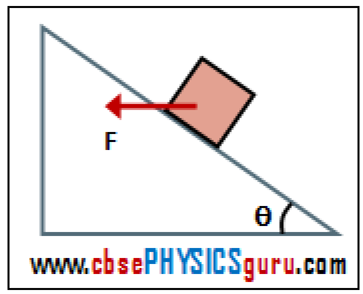


11. A player caches a ball of mass 100 g moving at a rate of 25 m/s. If the catch is completed in 0.1 s, the force exerted by the ball on the hand of the player is:

(a) 10 N (b) 20 N **(c)** 25 N (d) 100 N

12. A horizontal force F acting on a block of mass m on an inclined plane inclined at an angle θ is shown in the figure. What is the normal reaction N on the block?

(a) mg cosθ + Fsinθ (b) mgsinθ - Fcosθ (c) mgcosθ - Fsinθ (d) mgsinθ + Fcosθ

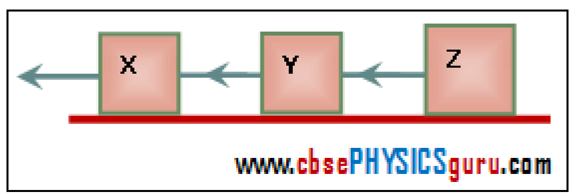


13. A ball of mass m is thrown upwards by a man with a velocity v. If air exerts an average resisting force F, the velocity with which the ball returns to the man is:

(a) $v\sqrt{\frac{mg-F}{mg+F}}$ (b) $v\sqrt{\frac{mg+F}{mg-F}}$ (c) $v\sqrt{\frac{mg}{mg+F}}$ (d) $v\sqrt{\frac{F}{mg+F}}$

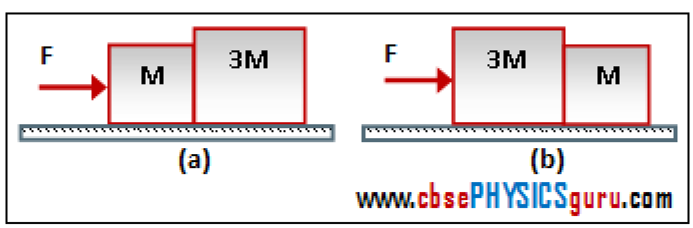
14. Three blocks of masses X, Y and Z of masses 5 kg, 7 kg and 8 kg respectively are connected by massless strings as shown in the figure on a frictionless surface. If they are pulled with a force of 80 N, then tension in the string connecting X and Y will be:

(a) 10 N (b) 20 N (c) 45 N **(d)** 60 N



15. Two bodies with masses M and 3M are in contact on a smooth surface as shown in the figure (a) and (b). A force F is applied to the masses. The ratio of the contact forces between the two masses in the two cases will be:

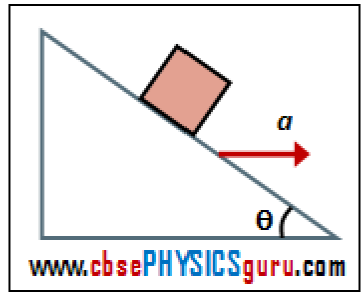
(a) 2: 1 **(b)** 3:1 (c) 2:3 (d) 1:1



16. A lift is moving upwards with an acceleration *a*. A man in the lift drops a coin inside the lift. The acceleration of the coin as observed by the man in the lift and a man standing stationary on the ground are respectively:

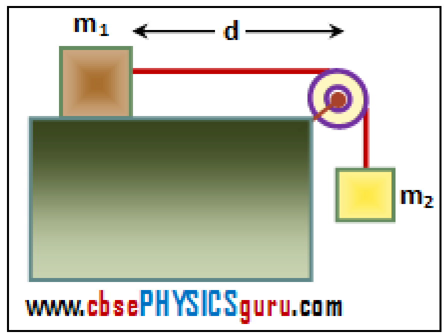
(a) (g + a), g (b) g, a (c) g, g (d) a, g - a

17. A block is kept on a frictionless inclined surface with angle of inclination θ as shown in figure. The incline is given an acceleration *a* to keep the block stationary. Then *a* is equal to:
(a) g sinθ (b) g cosθ **(c)** g tanθ (d) g/tan θ

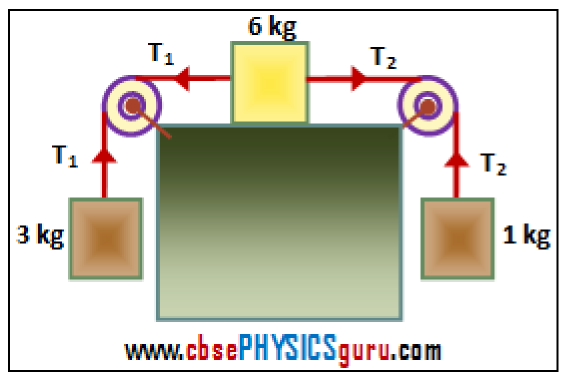


18. A block of mass m is resting on a smooth horizontal surface. One end of a uniform chain of mass m/2 is fixed to the block, which is pulled in the horizontal direction by applying a force F at the free end. The tension in the middle of the chain is:
(a) F/3 (b) 2F/3 (c) 7F/8 **(d)** 5F/6

19. A block of mass m_1 lies on a smooth horizontal table and is connected to another freely hanging block of mass m_2 by a light inextensible string passing over a smooth fixed pulley situated at the edge of the table as shown in the figure. Initially the system is at rest with m_1 at a distance d from the pulley. The time taken for m_1 to reach the pulley is:
(a) $\sqrt{\frac{2d(m_1+m_2)}{m_2 g}}$ (b) $\sqrt{\frac{d(m_1-m_2)}{m_2 g}}$ (c) $\frac{d(m_1+m_2)}{m_2 g}$ (d) $\frac{2dm_2}{(m_1+m_2)g}$



20. Three masses of 1 kg, 6 kg and 3 kg are connected to each other with strings and are placed on a table as shown in figure. The acceleration of the system and the ratio of the tensions T_1 and T_2 are respectively? (Take g = 10 m/s^2):
(a) 0.5 m/s^2, 3 (b) 1 m/s^2, 2 **(c)** 2 m/s^2, 2 (d) 3 m/s^2, 4



21. A boy stands on a weighing machine inside a lift. When the lift is going down with acceleration g/4, the machine shows a reading 30 kg. When the lift goes upwards with acceleration g/4, the reading would be:
(a) 20 kg (b) 35 kg (c) 45 kg **(d)** 50 kg

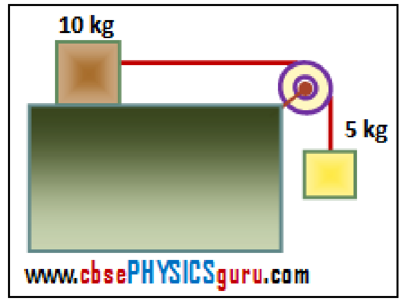
22. A man sits on a chair supported by a rope passing over a frictionless fixed pulley. The man who weighs 1000 N exerts a force of 450 N on the chair downwards, while pulling on the rope. If the chair weighs 250 N and g is 10 m/s^2, then the acceleration of the chair is:
(a) 1 m/s^2 **(b)** 2 m/s^2 (c) 3.5 m/s^2 (d) 5 m/s^2

23. A 5 kg shell kept at rest suddenly splits up into three parts. If two parts of mass 2 kg each are found flying due north and east with a velocity of 5 m/s each, what is the velocity of the third part after explosion?
(a) $10\sqrt{2}$ m/s due south-west s(b) $10\sqrt{2}$ m/ due south-east (c) $5\sqrt{2}$ m/s due south-west (d) $5\sqrt{2}$ m/s due south-east

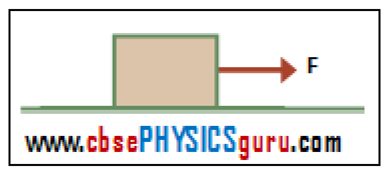
24. A man of 50 kg is standing at one end on a boat of length 25 m and mass 200 kg. If he starts running and when he reaches the other end, he has a velocity 2 m/s with respect to the boat. The final velocity of the boat is:

(a) 0.2 m/s **(b)** 0.4 m/s (c) 0.6 m/s (d) 1 m/s

FRICTION



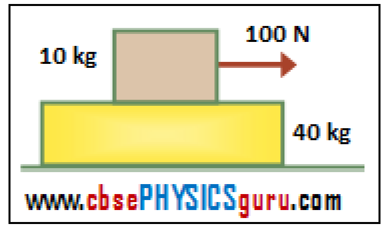
1. Identify the correct statement:
   (a) Static friction depends on the area of contact.
   (b) Kinetic friction depends on the area of contact.
   (c) Coefficient of static friction does not depend on the surfaces in contact.
   (d) Coefficient of kinetic friction is less than the coefficient of static friction.
2. A block of mass 5 kg lies on a horizontal surface in a truck, the coefficient of static friction between the block and the surface is 0.4. What is the force of friction on the block if the acceleration of the truck is 3 m/s^2? (Take g = 10 m/s^2):
   (a) 5 N (b) 10 N **(c)** 15 N (d) 20 N
3. A body of mass 40 kg resting on a rough horizontal surface is subjected to a force F which is just enough to start the motion of the body. If μ_s = 0.5, μ_k = 0.4 and the force F is continuously applied on the body, then the acceleration of the body is (Take g = 10 m/s^2):
   (a) zero **(b)** 1 m/s^2 (c) 2 m/s^2 (d) 4 m/s^2
4. A block of mass 5 kg is placed on the floor. The coefficient of static friction between the floor and the block is 0.4. A force F of 12 N is applied on the block as shown in figure. The force of friction between the block and the floor is (Take g = 10 m/s^2):
   (a) 4 N (b) 6 N (c) 12 N (d) 20 N
5. A homogeneous chain of length L lies on a table. The coefficient of friction between the chain and the table is μ. The maximum length which can hang over the table in equilibrium is:
   (a) $\left(\frac{\mu}{\mu-1}\right)L$ **(b)** $\left(\frac{\mu}{\mu+1}\right)L$ (c) $\left(\frac{\mu-1}{\mu+1}\right)L$ (d) $\left(\frac{\mu+1}{\mu}\right)L$



6. A horizontal force of 20 N is required to just hold a block of mass m stationary against a wall. The coefficient of friction between the block and the wall is 0.4. The mass of the block is (g = 10 ms^2):
   (a) 0.8 kg (b) 1.0 kg (c) 1.2 kg (d) 2 kg
7. An object is placed on the surface of a smooth inclined plane of inclination 45^0. It takes time t to reach the bottom. If the same object is allowed to slide down a rough inclined plane of same inclination, it takes time 2t to reach the bottom. The coefficient of friction is given by:
   (a) 0.25 (b) 0.40 (c) 0.55 **(d)** 0.75
8. The backside of a truck is open and a box of 40 kg is placed 5 m away from the rear end. The coefficient of friction of the box with the surface of the truck is 0.15. The truck starts from rest with 2 m/s^2 acceleration. The distance covered by the truck when the box falls off will be:
   (a) 20 m (b) 30 m (c) 40 m (d) 50 m
9. The coefficient of static friction between block of mass 10 kg and the surface as shown in figure is 0.2. What minimum mass should be placed over the 10 kg block so that the two blocks do not move? The string and the pulley are assumed to be smooth and massless. (Take g = 10 m/s^2):
   (a) 5 kg (b) 10 kg **(c)** 15 kg (d) 20 kg

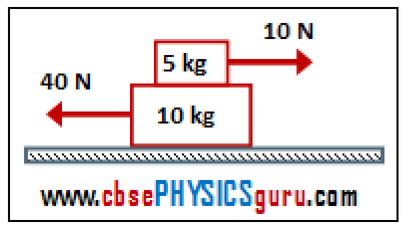
10. A 40 kg slab rests on a frictionless floor. A 10 kg block rests on top of the slab as shown in the figure. Coefficient of static friction between the block and the slab is 0.60 while the coefficient of kinetic friction between the block and slab is 0.40. The 10 kg block is acted upon by a horizontal force of 100 N. If g = 10 m/s^2, the resulting acceleration of the slab and the block will be, respectively:
(a) 0.5 m/s^2, 1.5 m/s^2 **(b)** 1.0 m/s^2, 6.0 m/s^2 (c) 2.5 m/s^2, 4.5 m/s^2 (d) 0.5 m/s^2, 4.5 m/s^2

11. In the figure shown, coefficient of friction between the two blocks is 2/5. If g = 10 m/s^2, the force of friction acting between the two blocks is:
(a) 8 N (b) 12 N (c) 16 N **(d)** 20 N

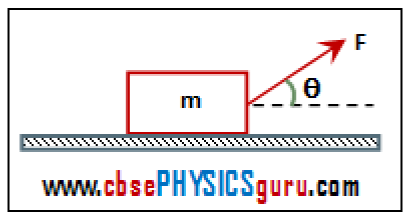


12. A wooden block of mass m resting on a rough horizontal surface is pulled by a force F as shown in figure. The coefficient of friction between block and surface μ. The minimum value of the force F to move the block will be:
(a) $\frac{\mu mg}{cos\theta + \mu\ sin\theta}$ (b) $\frac{\mu mg}{cos\theta - \mu\ sin\theta}$ (c) $\frac{\mu mg}{sin\theta + \mu\ cos\theta}$ (d) $\frac{\mu mg\ tan\theta}{cos\theta + \mu\ sin\theta}$

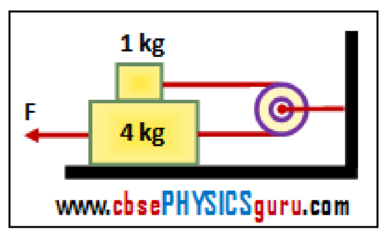
13. How large must F be in the figure shown to give the 4 kg block an acceleration of 1 m/s^2? The coefficient of friction between all surfaces is 0.1:
(a) 4 N (b) 5 N (c) 6 N **(d)** 11 N



14. A force F pushes a block of weight W at an angle θ with the horizontal. The block is placed on a horizontal surface. If the angle of friction is ϕ, the magnitude of force F required to move the block is equal to:
(a) $\frac{W cos\phi}{\sin(\theta+\phi)}$ **(b)** $\frac{W sin\phi}{\cos(\theta+\phi)}$ (c) $\frac{W cos\phi}{\sin(\theta-\phi)}$ (d) $\frac{W sin\theta}{\cos(\theta+\phi)}$



15. A horizontal force, just sufficient to move a body of mass 2 kg lying on a rough horizontal surface, is applied on it. The coefficients of static and kinetic friction between the body and the surface are 0.6 and 0.4 respectively. If the force continues to act even after the block has started moving, the acceleration of the block in m/s^2 is (Take g = 10 m/s^2):
(a) 2 N (b) 3 N (c) 5 N (d) 0.5 N



16. A body takes time t to reach the bottom of an inclined plane of angle θ with the horizontal. If the plane is made rough, time taken now is 2t. The coefficient of friction of the rough surface is:
(a) $\frac{1}{4}\ tan\theta$ (b) $\frac{2}{4}\ tan\theta$ **(c)** $\frac{3}{4}\ tan\theta$ (d) $\frac{3}{5}\ tan\theta$

17. A block of mass m placed on a rough inclined plane of inclination θ = 60° can just be prevented from sliding down by applying a force F_1 up the plane and it can be just made to slide up the plane by applying a force F_2 up the plane. If the coefficient of friction between the block and plane is $\frac{1}{2\sqrt{3}}$, the relation between F_1 and F_2 inclined plane is:
(a) $5F_2 = 7F_1$ (b) $7F_2 = 5F_1$ (c) $5F_2 = 3F_1$ (d) $3F_2 = 4F_1$

18. A boy of mass 60 kg is climbing a vertical pole at a constant speed. If the coefficient of friction between his palms and the pole is 0.5 and g = 10 m/s^2, the horizontal force that he is applying on the pole is:
    (a) 300 N (b) 600 N (c) 900 N **(d)** 1200 N

DYNAMICS OF UNIFORM CIRCULAR MOTION

1. A cyclist bends while taking turn to:
   (a) reduce friction **(b)** generate required centripetal force (c) reduce apparent weight (d) reduce speed
2. A body is moving in a circular path with. If its velocity gets doubled, then the ratio of acceleration after and before the change is: (a) 1 :2 (b) 2:1 (c) 3 1 **(d)** 4 : 1
3. A cyclist riding the bicycle at a speed $10\sqrt{3}$ m/s takes a turn around a circular road of radius $10\sqrt{3}$ m without skidding. Given, g = 10 m/s^2, what is his inclination to the vertical?
   (a) 30° (b) 90° (c) 45° **(d)** 60°
4. A car of mass 1200 kg moves on a circular track of radius 20 m. If the coefficient of friction is 0.5, then the maximum velocity with which the car move is (g = 10 m/s^2):
   (a) 15.4 m/s (b) 12.6 m/s **(c)** 10.0 m/s (d) 7.5 m/s
5. A toy car is moving along a circular path of radius 2 m. The coefficient of friction between the surface of the path and the body is 0.45. The angular velocity in rad/s, with which the body should move so that it does not leave the path is (Take g = 10 m/s^2):
   (a) 4.5 (b) 3.5 (c) 2.5 **(d)** 1.5
6. A car is moving with speed 30 m/s on a circular path of radius 500 m. Its speed is increasing at the rate of 2 m/s^2, its resultant acceleration will be nearly:
   (a) 2.3 m/s^2 **(b)** 2.7 m/s^2 (c) 2.9 m/s^2 (d) 3.5 m/s^2
7. A particle of mass 5 kg moves in a circle of radius 20 cm. Its linear speed at a time t is given by v = 4t, t is in s and v is in m/s. The net force acting on the particle at t = 0.5 s:
   (a) $20\sqrt{26}$ N (c) 104 N (b) 120 N (d) $10\sqrt{26}$ N
8. A coin placed on a rotating table just slips if it is placed at a distance 4r from the centre. On doubling the angular velocity of the table, the coin will just slip when at a distance from the centre equal to:
   (a) 4r (b) 2r **(c)** r (d) r/4
9. A cyclist moving with a velocity of 36 km/h on a flat road takes a turn at a point where the radius of curvature of the road is 40 m. The acceleration due to gravity is 10 m/s^2. In order to avoid skidding, he must not bent with respect to the vertical plane by an angle greater than:
   (a) $tan^{-1}\left(\frac{1}{4}\right)$ (b) $tan^{-1}\left(\frac{1}{3}\right)$ (c) $tan^{-1}(3)$ (d) $tan^{-1}\left(\frac{1}{2}\right)$
10. A tube one metre long is filled with liquid of mass 1 kg. The tube is closed at both the ends and is revolved about one end in a horizontal plane at 2 rev/s. The force experienced by the liquid at the other end is:
    (a) $2\pi^2$ N (b) $4\pi^2$ N (c) $6\pi^2$ N **(d)** $8\pi^2$ N
11. The banking angle for a curved road of radius 490 m for a vehicle moving at 35 m/s is:
    (a) $tan^{-1}\left(\frac{1}{2}\right)$ (b) $tan^{-1}(1)$ (c) $tan^{-1}\left(\frac{2}{3}\right)$ **(d)** $tan^{-1}\left(\frac{1}{4}\right)$