OBJECTIVE - I

1. In a situation the contact force by a rough horizontal surface on a body placed on it has constant magnitude. If the angle between this force and the vertical is decreased , the force and the vertical is decreased, the friction force between the surface and the body will

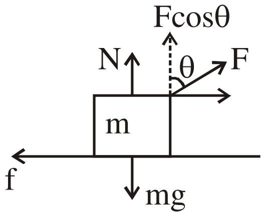
(a) increse (b*) decrease (c) remain the same (d) may increase or decrease

Sol. B

f = mN

N = mg – F cos q

q ⁻ cos q - N ⁻ f ⁻



2. While walking on ice, one should take small steps to avoid slipping . This is because smaller steps to avoid sliping . This is because smaller steps ensure

(a) larger friction (b*) smaller friction (c) larger normal force (d) smaller normal force

Sol. B

For smaller steps, normal force exerted by the ice is small.

F = mN

3. A body of mass M is kept on a rough horizontal surface (friction cofficient = μ). A person is trying to pull the body by applying a horizontal force but the body is not moving. The force by the surface on A is F where

(a) F = Mg (b) F = μ Mg (c*) $Mg \le F \le Mg\sqrt{1+\mu^2}$ (d)$Mg \ge F \ge Mg\sqrt{1-\mu^2}$ 1

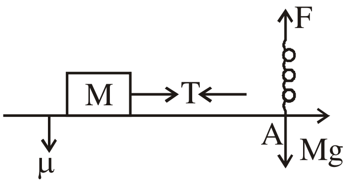
Sol. C

If T = 0 $F_{min} = Mg$

If T = T $F_{max} = \sqrt{(mg)^2 + (T)^2}$

$= mg\sqrt{1+\mu^2}$

mg £ F £ Mg $\sqrt{1+\mu^2}$



4. A scooter starting from rest moves with a constant acceleration for a time Δt_1, then with a constant deceleration for the next Δt_2 and finally with a constant deceleration for the next Δt_3 to come to rest . A 500N man sitting on the scooter behind the driver manges to stay at rest with respect to the scooter without touching any other part. The force exerted by the seat on the man is

(a) 500 N throughout the journey (b*) less than 500N throughout the journey

(c) more than 500N throughout the journey (d) > 500 N for time Δt_1 and Δt_3 and 500 N for Δt_2.

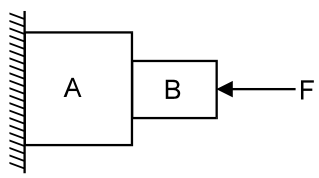
Sol. For D t_2 Þ constant velocity

force exerted by the seat on the man = mg = 500 N

for D f_1 & D f_3 friction force is also applied.

So net force exerted by the seat on the man > 500 N

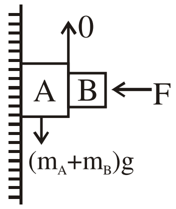
5. Consider the situation shown in figure. The wall is smooth but the surface of A and B in contact are rough. The friction on B due to A in equilibrium



(a) is upward (b) is downward

(c)is zero (d*) the system cannot remain in equilibrium.

Sol. D



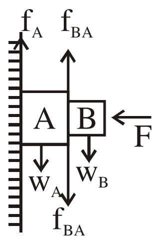
Net vertical force is downwards.

The system can not remain in equilibrium.

6. Suppose all the surfaces in the previous problem are rough. The direction of friction on B due to A

(a*) is upward
(b) is downward
(c) is zero
(d) depends on the masses of A and B.

Sol. A



F is provide the normal force. Weight of A & B in downward direction. So friction force f_A & f_{BA} (friction B due to A) is upwards direction.

7. Two cars of unequal masses use simmilar tyres. If they are moving at the same intial speed, the minimum stopping distance

(a) is smaller for the heaviercar
(b) is smaller for the lighter car
(c*) is same for both cars
(d) depends on the volume of the car.

Sol. C

Friction force on first car is = mmg

acceleration due to friction force on first car = $\frac{\mu m_1 g}{m_1}$ = mg

Friction force on second car is = mm_2g

Acceleration due to friction force on speed car = $\frac{\mu m_2 g}{m_2}$ = mg

Both acceleration are same & both initial speed are same (Given).

$S = ut + 1/2\ at^2$

So, the minimum stopping distance is same for both cars.

8. In order to stop a car in shortest distance on a horizontal road, one should

(a) apply the brakes very hard so that the weels stop rotating
(b*) apply the brakes hard enough to just prevent slipping
(c) pump the brakes (press and release)
(d) shut the engin off and not apply brakes .

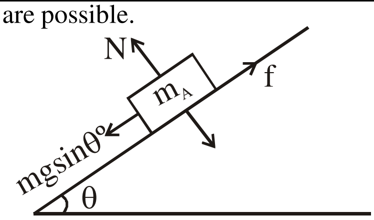
Sol. In order to stop a car in shortest distance on a horizontal road, one should apply the brakes hard enough to just present slipping because hard brakes provide the enough normal & that provides the maximum friction.

9. A block A kept on an inclined surface just begins to slide if the inclination is 30º. The block is replaced by another block B and it is found that it just begins to slide if the inclination is 40º.

(a) mass of A > mass of B
(b) mass of A < mass of B

(c) mass of A = mass of B (d*) all the three are possible.

Sol. D



N = mg cos q°

f_{max} = mN = mmg cos q°

Just begins to slide mean

mg sin q = f_{max}

mg sin q° = mmg cos q°

m depends upon 'q' not depend on mass.

Þ Block sliding condition :-

mg sin q – f_{max} = ma

mg sin q – mmg cos q = ma

a = g (sin q – m cos q)

a is depends upon 'q' & m, not depend on mass.

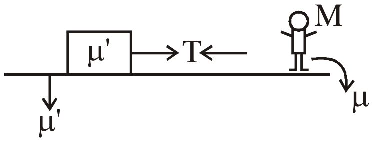
10. A boy of mass M is applying a horizontal force to slide a box of mass M’ on a rough horizontal surface . The cofficient of friction between the shoes of the boy and the floor is μ . In which of the following cases it is certainly not possible to slide the box ?

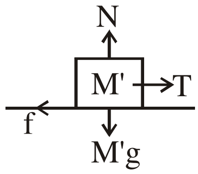
(a*) μ < μ ’, M < M’ (b) μ > μ ’, M < M’

(c) μ < μ ’, M > M’ (d) μ > μ ’, M > M

Sol. A

F.B.D. of block M'



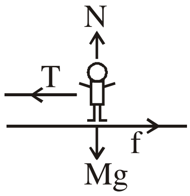


Condition to present the sliding is

f_{max} > T

m' M'g > T .... (1)

F.B.D. boy M



f_{max} = mmg

Condition to present the sliding is

f_{max} > T

mmg > T

Condition to present the sliding of the system (Block + Boy) is

f ' > f (Block is not slide)

m' M'g > mmg

m' M' > mM

m < m' M < M'

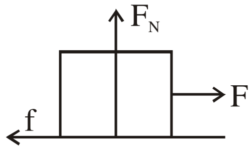
OBJECTIVE - II

1. Let F, F_N and f denote the magnitudes of the contact force , normal force and the friction exerted by one surface on the other kept in contact. If none of these is zero,

(a*) $F > F_N$ (b*) $F > f$ (c) $F_N > f$ (d*) $F_N - f < F < F_N + f$

Sol. ABD

System at equilibrium when F = f



Net horizontal force is zero.

f = mFN

(a) $F > F_N$

Q f = FN and 0 £ m £ 1

So we can say that F >f, So net horizontal force is nonzero.

(b) F > f, Net horizontal force is zero.

(c) FN > f Þ Fn > mFn Þ m < 1

Here not given the relation between F & f so we can't say that net horizontal force is zero or nonzero.

(d) Fn – f < F < Fn + f

Q f = mFn

$$\frac{f}{\mu} - f < F < \frac{f}{\mu} + f$$

$$f\left(\frac{1-\mu}{\mu}\right) < F < f\left(\frac{1+\mu}{\mu}\right)$$

for these relation we can say that F ¹ f, so net horizontal force is non zero.

2. The contact force exerted by a body A on another body B is equal to the normal force between the bodies. We conclude that

(a) the surface must be frictionless

(b*) the force of friction between the bodies is zero

(c) the magniyude of normal force equals that of friction

(d*) the bodies may be rough but they don't slip on each other.

Sol. BD

The contact force exerted by a body A on another body B is equal to the normal force between the bodies. We conclude that the force of friction between the bodies is zero and the bodies may be rough but they don't slip on each other.

3. Mark the correct statements about the friction between two bodies.

(a) Static friction is always greater than the kinetic friction.

(b*) Cofficient of static friction is always greater than the cofficient of kinetic friction.

(c*) Limiting friction is always greater than the kinetic friction.

(d*) Limiting friction is never less than static friction.

Sol. BCD

Þ Coefficient of static friction is always greater than the coefficient of kinetic friction.

Limiting friction is always greater than the kinetic & static friction.

Maximum value of static friction is called the limiting friction.

4. A block is placed on a rough floor and a horizontal force F is applied on it. The force of friction f by the floor on the block is measured for different values of F and a graph is plotted between them.

(a) The graph is a straight line of slope 45°

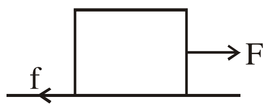
(b) The graph is straight line parallel to the F-axis.

(c*) The graph is a straight line of slope 45° for small F and a straight line parallel to the F-axis for large F.

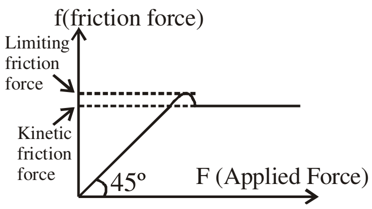
(d*) There is a small kink on the graph.

Sol. CD

Static friction force is a adjustable friction force. It adjust (equal) to applied force F upto limiting friction force than after it treat as a constant force.



If F > limiting friction force at that time kinetic friction force is applied. Kinetic friction force is always less than the limiting friction force.



5. Consider a vehicle going on a horizontal road toards east. Neglect any force by the air. The frictional forces on the vehicle by the road.

(a*) is towards east if the vehicle is accelerating

(b*) is zero if the vehicle is moving with a uniform velocity

(c) must be towards east.

(d) must be towards east.

Sol. AB

Þ If the vehicle is moving with a uniform velocity, so friction forces on the vehicle by the road is zero.

Þ If the vehicle is accelerating, the force is applied (due to tyre on the road) in west direction that cause net friction force applying east direction due to friction force car is moving in east direction.