FRICTION

ONLY ONE OPTION CORRECT TYPE

SECTION (A) : KINETIC FRICTION

1. If the normal force is doubled, the co-efficient of friction is :

(1) halved (2) doubled (3) tripled (4) not changed

2. If the coefficient of friction of a plane inclined at 45º is 0.5, then acceleration of a body sliding freely on it is ($g = 9.8 m/s^2$)-

(1) $4.9\ m/s^2$ (2) $9.8\ m/s^2$ (3) $\frac{9.8}{\sqrt{2}}\ m/s^2$ (4) $\frac{9.8}{2\sqrt{2}}\ m/s^2$

3. A body of mass 100 g is sliding downward from an inclined plane of inclination 30°. What is the frictional force experienced if $\mu = 1.7$ -

(1) $1.7 \times \sqrt{2} \times \frac{1}{\sqrt{3}}$ N (2) $1.7 \times \sqrt{3} \times \frac{1}{2}$ N

(3) $1.7 \times \sqrt{3}$ N (4) $1.7 \times \sqrt{2} \times \frac{1}{3}$ N

4. A car is moving along a straight horizontal road with a speed v_0. If the coefficient of friction between the tyres and the road is μ then the shortest distance in which the car can be stopped is-

(1) $\frac{v_0^2}{2\mu g}$ (2) $\frac{v_0}{\mu g}$ (3) $\left(\frac{v_0}{\mu g}\right)^2$ (4) $\frac{v_0}{\mu}$

5. A block of mass 10 kg is moving up an inclined plane of inclination 30° with an initial speed of 5 m/s. It stops after 0.5 s, what is the value of coefficient of kinetic friction ?

(1) 0.5 (2) 0.6 cm (3) $\sqrt{3}$ (4) $\frac{1}{\sqrt{3}}$

6. A particle is projected along a rough plane inclined at an angle of 45° with the horizontal, if the coefficient of friction is $\frac{1}{2}$, then the retardation is-

(1) $\frac{g}{\sqrt{2}}$ (2) $\frac{g}{2}$ (3) $\frac{g}{\sqrt{2}}\left(1+\frac{1}{2}\right)$ (4) $\frac{g}{\sqrt{2}}\left(1-\frac{1}{2}\right)$

7. A body of mass 10 kg lies on a rough horizontal surface. When a horizontal force of F newtons acts on it, it gets an acceleration of $5\ m/s^2$. And when the horizontal force is doubled, it gets an acceleration of $18\ m/s^2$. The coefficient of friction between the body and the horizontal surface is- (Take $g = 10\ m/s^2$)

(1) 0.2 (2) 0.4 (3) 0.6 (4) 0.8

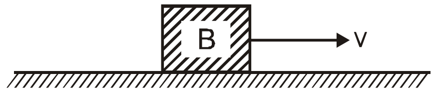
8. On the horizontal surface of a truck, a block of mass 1kg is placed ($\mu = 0.6$) and truck is moving with acceleration $5\ m/sec^2$, then frictional force on block will be -

(1) 5 N 2) 6 N (3) 5.88 N (4) 8 N

9. A 10 kg box is placed on surface. Coefficient of friction between surface and box is $\mu = 0.5$. If horizontal force 100 N is applied acceleration of box will be ($g = 10\ m/sec^2$) -

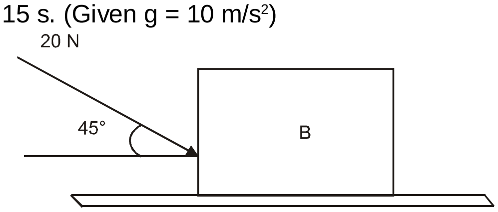
(1) $2.5\ m/s^2$ (2) $5\ m/s^2$ (3) $7.5\ m/s^2$ (4) none

10. A block B is pushed momentarily along a horizontal surface with an initial velocity v. If μ is the coefficient of sliding friction between B and the surface, block B will come to rest after a time :



(1) $\frac{v}{g\mu}$ (2) $\frac{g\mu}{v}$ (3) $\frac{g}{v}$ (4) $\frac{v}{g}$

11. A block of mass 5 kg is placed on horizontal surface and a pushing force 20 N is acting on back as shown in figure. If coefficient of friction between block and surface is 0.2, then calculate frictional force and speed of block after 15 s. (Given g = 10 m/s^2)



(1) 2.936 MS^{-1} (2) 4.936 MS^{-1} (3) 3.936 MS^{-1} (4) None of these

12. A marble block of mass 2 kg lying on ice when given a velocity of 6 m/s is stopped by friction in 10s. Then the coefficient of friction is :

(1) 0.02 (2) 0.03 (3) 0.06 (4) 0.01

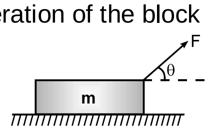
13. Consider a car moving on a straight road with a speed of 100 m/s. The distance at which car can be stopped is (μ_k = 0.5)

(1) 100 m (2) 400 m (3) 800 m (4) 1000 m

14. Starting from rest a body slides down a 45º inclined plane in twice the time it takes to slide down the same distance in the absence of friction. The co-efficient of friction between the body and the inclined plane is:

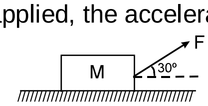
(1) 0.75 (2) 0.33 (3) 0.25 (4) 0.80

15. A wooden block of mass m resting on a rough horizontal table (coefficient of friction = μ) is pulled by a force F as shown in figure. The acceleration of the block moving horizontally is :



(1) $\frac{F\cos\theta}{m}$ (2) $\frac{\mu F\sin\theta}{M}$ (3) $\frac{F}{m}(\cos\theta+\mu\sin\theta)-\mu g$ (4) none

16. A block of mass M = 5 kg is resting on a rough horizontal surface for which the coefficient of friction is 0.2. When a force F = 40 N is applied, the acceleration of the block will be (g = 10 m/s^2) :



(1) 5.73 m/sec^2 (2) 8.0 m/sec^2 (3) 3.17 m/sec^2 (4) 10.0 m/sec^2

17. A body is projected up a rough inclined plane from the bottom with some velocity. It travels up the incline and then returns back. If the time of ascent is t_a and time of descent is t_d, then

(1) $t_a = t_d$ (2) $t_a > t_d$ (3) $t_a < t_d$ (4) data insufficient

18. The upper half of an incline plane with inclination ϕ is perfectly smooth while the lower half is rough. A body starting from rest at the top will again come to rest at the the bottom if the coefficient of friction for the lower half is given by

(1) 2 tan ϕ (2) tan ϕ (3) 2 sin ϕ (4) 2 cos ϕ

SECTION (B) : STATIC FRICTION

1. The frictional force is -

(1) Self adjustable (2) Not self adjustable (3) scalar quantity (4) Equal to the limiting force

2. 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 small kink on the graph

(1) c, d (2) a, d (3) a, b (4) a, c

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

(1) mass of A > mass of B (2) mass of A < mass of B

(3) mass of A = mass of B (4) all the three are possible

4. It is easier to pull a body than to push, because-

(1) the coefficient of friction is more in pushing than that in pulling

(2) the friction force is more in pushing than that in pulling

(3) the body does not move forward when pushed.

(4) none of these

5. The coefficient of static friction between two surfaces depends on -

(1) Nature of surfaces (2) The shape of the surfaces in contact

(3) The area of contact (4) All of the above

6. A box is lying on an inclined plane. If the box starts sliding when the angle of inclination is 60°, then the coefficient of static friction of the box and plane is-

(1) 2.732 (2) 1.732 (3) 0.267 (4) 0.176

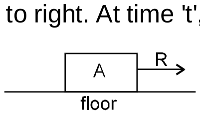
7. A 20 kg block is initially at rest. A 75 N force is required to set the block in motion. After the motion, a force of 60 N is applied to keep the block moving with constant speed. The coefficient of static friction is-

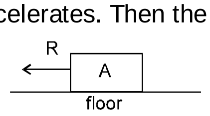
(1) 0.6 (2) 0.52 (3) 0.44 (4) 0.35

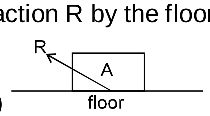
8. A block of metal is lying on the floor of a bus. The maximum acceleration which can be given to the bus so that the block may remain at rest, will be-

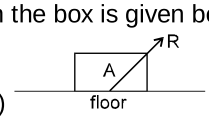
(1) μg (2) $\frac{\mu}{g}$ (3) $\mu^2 g$ (4) μg^2

9. A box 'A' is lying on the horizontal floor of the compartment of a train running along horizontal rails from left to right. At time 't', it decelerates. Then the reaction R by the floor on the box is given best by :

(1) 

(2) 

(3) 

(4) 

10. A block of mass 0.1 kg is held against a wall by applying a horizontal force of 5N on the block. If the co-efficient of friction between the block and the wall is 0.5, the magnitude of frictional force acting on the block is ($g = 9.8 m/s^2$)

(1) 2.5 N (2) 0.98 N (3) 4.9 N (4) 0.49 N

11. A block of mass 2 kg rests on a rough inclined plane making an angle of 30^0 with the horizontal. The coefficient of static friction between the block and the plane is 0.7. The frictional force on the block is ($g = 9.8 m/s^2$) :

(1) 9.8 N (2) 0.7 × 9.8 N (3) 9.8 × 7 N (4) 0.8 × 9.8 N

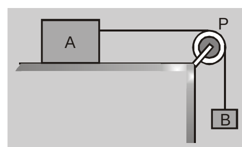
12. A block of mass 5 kg and surface area 2 m^2 just begins to slide down on an inclined plane when the angle of inclination is 30º. Keeping mass same, the surface area of the block is doubled. The angle at which it starts sliding down is :

(1) 30º (2) 60º (3) 15º (4) none

13. A 60 kg body is pushed horizontally with just enough force to start it moving across a floor and the same force continues to act afterwards. The coefficient of static friction and sliding friction are 0.5 and 0.4 respectively. The acceleration of the body is ($g = 10 m/s^2$) :

(1) 6 m/s^2 (2) 4.9 m/s^2 (3) 3.92 m/s^2 (4) 1 m/s^2

14. The blocks A and B are arranged as shown in the figure. The pulley is frictionless. The mass of A is 10 kg. The coefficient of friction between block A and horizontal surface is 0.20. The minimum mass of B to start the motion will be-



(1) 2 kg (2) 0.2 kg (3) 5 kg (4) 10 kg

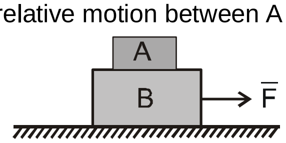
15. In the case of horse pulling a cart, the force that causes the horse to move forward is the force that :

(1) the horse exerts on the ground (2) the horse exerts on the cart
(3) the ground exerts on the horse (4) the cart exerts on the horse

16. A uniform rope of length ℓ lies on a table. If the coefficient of friction is μ then the maximum length l_1 of the part of this rope which can overhang from the edge of the table without sliding down is

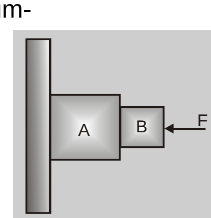
(1) $\frac{\ell}{\mu}$ (2) $\frac{\ell}{\mu+1}$ (3) $\frac{\mu\ell}{1+\mu}$ (4) $\frac{\mu\ell}{1-\mu}$

17. Block A of mass 4 kg and block B of mass 6 kg are resting on a horizontal surface as shown in the figure. There is no friction between the block B and the horizontal surface. The coefficient of friction between the blocks is 0.2. If the value of $g = 10 ms^{-2}$, the maximum horizontal foce F that can be applied on block B without any relative motion between A and B is



(1) 20 N (2) 40 N (3) 60 N (4) 100 N

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



(1) is upward (2) is downward
(3) is zero (4) the system cannot remain in equilibrium

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

(1) is upward (2) is downward
(3) is zero (4) depends on the masses of A and B

20. A body of mass M is kept on a rough horizontal surface (friction coefficient = 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-

(1) F = Mg (2) F = μMg
(3) $Mg \le F \le Mg\sqrt{1+\mu^2}$ (4) $Mg \ge F \ge Mg\sqrt{1+\mu^2}$

21. 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 frictional force between the surface and the body will-

(1) increase (2) decrease
(3) remain the same (4) may increase or decrease

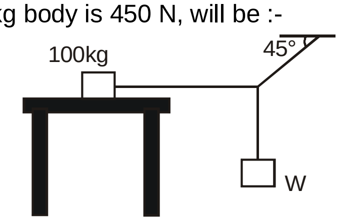
22. An inclined plane is inclined at an angle θ with the horizontal. A body of mass m rests on it, if the coefficient of friction is μ, then the minimum force that has to be applied to the inclined plane to make the body just move up the inclined plane is-

(1) mgsinθ (2) μmgcosθ
(3) μmgcosθ – mgsinθ (4) μmgcosθ + mgsinθ

23. A block W is held against a vertical wall by applying a horizontal force F. The minimum value of F needed to hold the block is if μ < 1

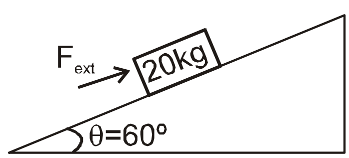
(1) Less than W (2) Equal to W (3) Greater than W (4) Data is in insufficient

24. The system shown in the figure is in equilibrium. The maximum value of W, so that the maximum value of static frictional force on 100 kg body is 450 N, will be :-



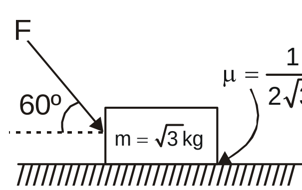
(1) 100 N (2) 250 N (3) 450 N (4) 1000 N

25. A block of mass 20 kg is kept on rough incline plane. If angle of repose is 30° ,then what should be value of F_{ext} so that the block does not move over inlcine plane ?



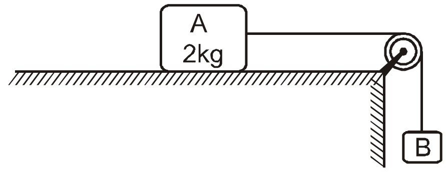
(1) 120 N (2) 200 N (3) 110 N (4) Both (1) & (2)

26. What is the maximum value of the force F such that the block shown in the arrangement, does not move :



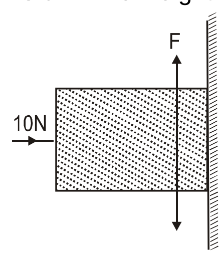
(1) 20 N (2) 10 N (3) 12 N (4) 15 N

27. The coefficient of static friction, μ_s, between block A of mass 2kg and the table as shown in the figure, is 0.2. What would be the maximum mass value of block B so that the two blocks do not move ? The string and the pulley are assumed to be smooth and massless : (g = 10 m/s^2)



(1) 2.0 kg (2) 4.0 kg (3) 0.2 kg (4) 0.4 kg

28. A horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2. The weight of the block is :

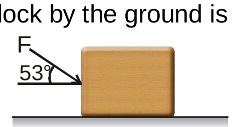


(1) 2 kg (2) 50 N (3) 100 N (4) 2 N

29. A block rests on a rough inclined plane making an angle of 30º with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, the mass of the block (in kg) is (take g = 10 m/s^2) :

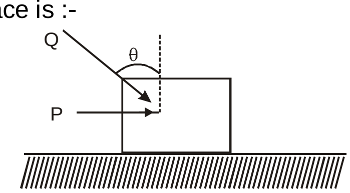
(1) 2.0 (2) 4.0 (3) 1.6 (4) 2.5

30. A block of mass 20 kg is acted upon by a force F = 30 N at an angle 53° with the horizontal in downward direction as shown. The coefficient of friction between the block and the horizontal surface is 0.2. The friction force acting on the block by the ground is (g = 10 m/s^2)



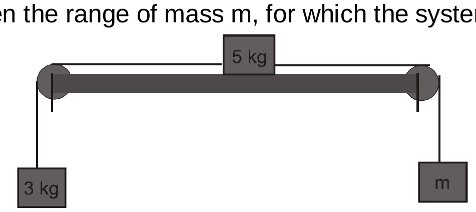
(1) 40.0 N (2) 30.0 N (3) 18.0 N (4) 44.8 N

31. A block of mass m lying on a rough horizontal plane is acted upon by a horizontal force P and another force Q inclined at an angle θ to the vertical. The block will remain in equilibrium if the coefficient of friction between it and the surface is :-



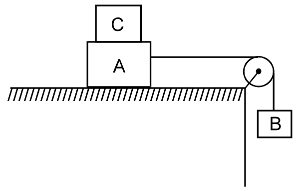
(1) $\frac{P+Q\sin\theta}{mg+Q\cos\theta}$ (2) $\frac{P\cos\theta+Q}{mg-Q\sin\theta}$ (3) $\frac{P+Q\cos\theta}{mg+Q\sin\theta}$ (4) $\frac{P\sin\theta+Q}{mg-Q\cos\theta}$

32. In the arrangement shown in figure, 5 kg block is placed on a rough table (μ =0.4) and a 3kg mass is connected at one end. then the range of mass m, for which the system will remain in equilibrium is



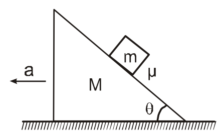
(1) 1 kg to 3 kg (2) 1 kg to 5 kg (3) Any value greater than 8 kg (4) 3 kg to 5 kg

33. Two masses A and B of 10 kg and 5 kg respectively are connected with a string passing over a frictionless pulley fixed at the corner of a table as shown. The coefficient of static friction of A with table is 0.2. The minimum mass of C that may be placed on A to prevent it from moving is



(1) 15 kg (2) 10 kg (3) 5 kg (4) 12 kg

34. A block of mass m is at rest relative to the stationary wedge of mass M. The coefficient of friction between block and wedge is μ. The wedge is now pulled horizontally with acceleration 'a' as shown in figure. Then the minimum magnitude of 'a' for the friction between block and wedge to be zero is :



(1) g tan θ (2) μ g tan θ (3) g cot θ (4) μ g cot θ

35. A uniform rope of length *l* lies on a table. If the coefficient of friction is μ, then the maximum length l_1 of the part of this rope which can overhang from the edge of the table without sliding down is

(1) $\frac{l}{\mu}$ (2) $\frac{l}{\mu+l}$ (3) $\frac{\mu l}{1+\mu}$ (4) $\frac{\mu l}{\mu-1}$

36. A heavy uniform chain lies on a horizontal table-top. If the coefficient of friction between the chain and table surface is 0.25, then the maximum fraction of length of the chain,that can hang over one edge of the table is

(1) 20% (2) 25% (3) 35% (4) 15%

37. A uniform chain of length *L* changes partly from a table which is kept in equilibrium by friction. The maximum length that can withstand without slipping is *l*, then coefficient of friction between the table and the chain is

(1) $\frac{l}{L}$ (2) $\frac{l}{L+l}$ (3) $\frac{l}{L-l}$ (4) $\frac{L}{L+l}$

38. A uniform metal chain is placed on a rough table such that one end of chain hangs down over the edge of the table. When one-third of its length hangs over the edge, the chain starts sliding. Then, the coefficient of static friction is

(1) $\frac{3}{4}$ (2) $\frac{1}{4}$ (3) $\frac{2}{3}$ (4) $\frac{1}{2}$

39. A rope lies on a table such that part of it lays over. The rope begins to slide when the length of hanging part is 25 % of entire length. The co-efficient of friction between rope and table is:

(1) 0.33 (2) 0.25 (3) 0.5 (4) 0.2

ANSWER KEY

SECTION (A) :

1.	(4)	**2.**	(4)	**3.**	(2)	**4.**	(1)	**5.**	(4)	**6.**	(3)	**7.**	(4)
8.	(1)	**9.**	(2)	**10.**	(1)	**11.**	(3)	**12.**	(3)	**13.**	(4)	**14.**	(1)
15.	(3)	**16.**	(1)	**17.**	(3)	**18.**	(1)						

SECTION (B) :

1.	(1)	**2.**	(1)	**3.**	(4)	**4.**	(2)	**5.**	(1)	**6.**	(2)	**7.**	(4)
8.	(1)	**9.**	(3)	**10.**	(2)	**11.**	(1)	**12.**	(1)	**13.**	(4)	**14.**	(1)
15.	(3)	**16.**	(3)	**17.**	(1)	**18.**	(4)	**19.**	(1)	**20.**	(3)	**21.**	(2)
22.	(4)	**23.**	(3)	**24.**	(3)	**25.**	(4)	**26.**	(1)	**27.**	(4)	**28.**	(4)
29.	(1)	**30.**	(3)	**31.**	(1)	**32.**	(2)	**33.**	(1)	**34.**	(3)	**35.**	(3)
36.	(1)	**37.**	(3)	**38.**	(4)	**39.**	(1)						