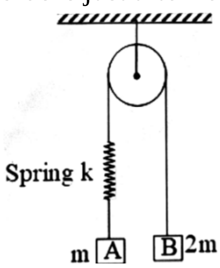
NEWTON'S LAWS OF MOTION & FRICTION

1. The action and reaction forces referred to in Newton's third law of motion
(a) Must act on the same body
(b) Must act on different bodies
(c) Need not be equal in magnitude but must have the same line of action
(d) Must be equal in magnitude but need not have the same line of action

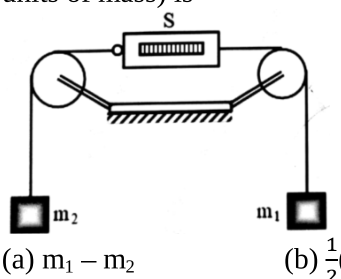
2. In a tug-of-war contest, two men pull on a horizontal rope from opposite sides. The winner will be the man who
(a) Exerts greater force on the rope
(b) Exerts greater force on the ground
(c) Exerts a force on the rope which is greater than the tension in the rope
(d) Makes a smaller angle with the vertical

3. Two blocks A and B of masses m and 2m respectively are held at rest such that the string is in natural length. Find out the accelerations of both the blocks just after release.



(a) g↓, g↓ (b) $\frac{g}{3}$↓, $\frac{g}{3}$↑
(c) 0, 0 (d) g↓, 0

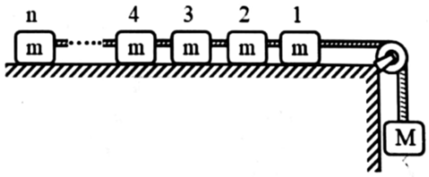
4. In the arrangement shown, the pulleys are fixed and ideal, the strings are light, $m_1 > m_2$ and S is a spring balance which is itself massless. The reading of S (in units of mass) is-



(a) $m_1 - m_2$ (b) $\frac{1}{2}(m_1 + m_2)$
(c) $\frac{m_1 m_2}{m_1+m_2}$ (d) $\frac{2m_1 m_2}{m_1+m_2}$

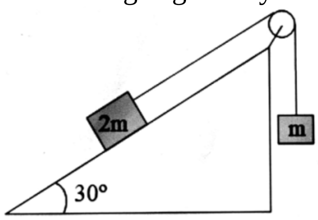
5. A chain of mass M and length L held vertical by fixing its upper end to a rigid support. The tension in the chain at a distance y from the rigid support is -
(a) mg (b) Mg(L – y)/L
(c) MgL/(L – y) (d) Mgy/L

6. In the given arrangement, n number of equal masses are connected by strings of negligible masses. The tension in the string connected to nth mass is-



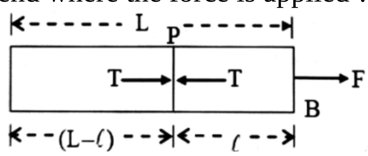
(a) $\frac{2Mg}{nm+M}$ (b) $\frac{mMg}{nmM}$
(c) mg (d) mng

7. For the arrangement shown in the figure the tension in the string is given by -



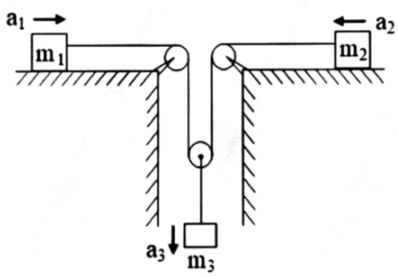
(a) $\frac{mg}{2}$ (b) mg
(c) $\frac{3}{2}$ mg (d) 2 mg

8. A uniform rope of length L, resting on a frictionless horizontal surface is pulled at one end by a force F. What is the tension of the rope at a distance *l* from the end where the force is applied ?



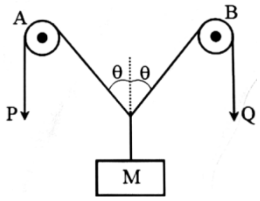
(a) F (1 – l/L) (b) F (1 + l/L)
(c) F/(1 – l/L) (d) F/(1 + l/L)

9. In the figure shown the relation between acceleration is -



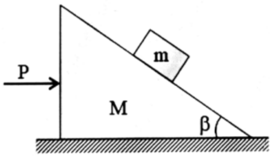
(a) $a_1 + a_2 + 2a_3 = 0$ (b) $a_1 + a_2 = 2a_3$
(c) $a_1 + a_2 = a_3$ (d) $a_1 + a_2 + a_3 = 0$

10. In the arrangement shown in th6 figure, the ends P and Q of an unstretchable string move downwards with uniform speed u, pulley A and B are fixed. Mass M move up with speed-



(a) 2u cos θ (b) u/cos θ
(c) 2u/cos θ (d) u cos θ

11. Two wooden blocks are moving on A smooth horizontal surface such that the mass 'm' remains stationary with respect to block of mass M as shown in figure. The magnitude of force P is -



(a) (M + m)g tan θ
(b) g tan θ
(c) mg cos θ
(d) (M + m) g cosec θ

12. The pendulum hanging from the ceiling of a railway carriage makes an angle 30° with the vertical when the carriage is accelerating. The acceleration of the carriage is -

(a) $\frac{\sqrt{3}}{2}$ g (b) $\frac{2}{\sqrt{3}}$ g
(c) g$\sqrt{3}$ (d) $\frac{g}{\sqrt{3}}$

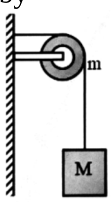
13. A man goes up in a uniformly accelerating lift. He returns downward with the lift accelerating at the same rate. The ratio of apparent weighs in the two cases is 2 : 1. The acceleration of the lift is -

(a) g/3 (b) g/4
(c) g/5 (d) g/6

14. Two weights w_1 and w_2 are suspended from the ends of a light string passing over a smooth fixed pulley. If the pulley is pulled up at an acceleration g, the tension in the string will be-

(a) $\frac{4w_1w_2}{w_1+w_2}$ (b) $\frac{2w_1w_2}{w_1+w_2}$
(c) $\frac{w_1-w_2}{w_1+w_2}$ (d) $\frac{w_1w_2}{2(w_1-w_2)}$

15. A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in figure. The force on the pulley by the clamp is given by-

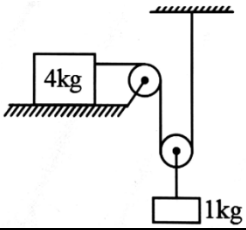


(a) $\sqrt{2}$ Mg (b) $\sqrt{2}$ mg
(c) $\sqrt{(M+m)^2+m^2}$g (d) $\sqrt{(M+m)^2+M^2}$g

16. Newton's third law is equivalent to the-
(a) law of conservation of linear momentum
(b) law of conservation of angular momentum
(c) law of conservation of energy
(d) law of conservation of energy and mass

17. Select the correct option-
STATEMENT 1: Friction is self- adjusting both in magnitude and direction as long as it is tangential
STATEMENT 2: Friction is self- adjusting only in magnitude, but its direction is fixed
(a) Statement 1 is true Statement 2 is wrong
(b) Statement 2 is true Statement 1 is wrong
(c) Both Statements are, correct.
(d) Both Statements are wrong

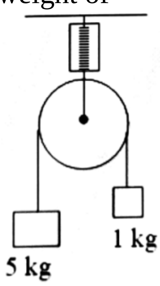
18. Consider the situation shown in fig.



Column-I	Column-II
(A) The ratio of acceleration of block of 1 kg to that of 4 kg is	(P) 0.5
(B) The ratio of velocity of 1 kg to that of 4 kg is	(Q) l
(C) The coefficient of kinetic friction between the block and table is. l or 1 kg block having a speed of 0.3 ms^{-1} after descending lm	(R) 0.6
(D) The velocity of 4 kg block at this instant mentioned in (C) is ms^{-1}	(S) 0.12

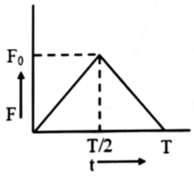
(a) A→P; B→P; C→R; D→S
(b) A→P; B→P; C→S; D→R
(c) A→P; B→S; C→P; D→R
(d) NONE

19. In the figure a smooth pulley of negligible weight is suspended by a spring balance. Weights of 1 kg and 5 kg are attached to the opposite ends of a string passing over the pulley and move with acceleration because of gravity. During the motion, the spring balance reads a weight of -



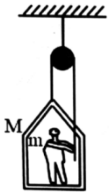
(a) 6kg
(b) less than 6 kg
(c) more than 6 kg
(d) may be more or less than 6 kg

20. A particle of mass m moving with velocity u makes an elastic one dimensional collision with a stationary particle of mass m. They are in contact for a very brief time T. Their force of interaction increases from zero to F_0 linearly in time T/2 and decreases linearly to zero in further time T/2. The magnitude of F_0 is-



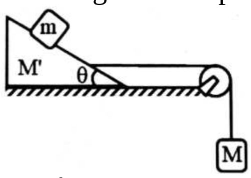
(a) mu/T (b) 2mu/T
(c) mu/2T (d) None of these

21. A man of mass m stands on a frame of mass M. He pulls on a light rope, which passes over a pulley. The other end of the rope is attached to the frame. For the system to be in equilibrium, what force must the man exert on the rope ?



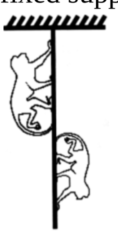
(a) (M + m)g/2 (b) (M + m)g
(c) (M – m)g (d) (M + 2m)g

22. Find the mass M of the hanging block in figure which will prevent the smaller block from slipping over the triangular block. All the surfaces are frictionless and the strings and the pulleys are light



(a) $\frac{M'+m}{\tan\theta}$ (b) (M' + m) tan θ
(c) $\frac{M'+m}{1-\tan\theta}$ (d) $\frac{M'+m}{\cot\theta-1}$

23. Two monkeys of masses 5 kg and 4 kg are moving along a vertical rope, the former climbing up with an acceleration of 2 m/s^2 while the later coming down with a uniform velocity of 2 m/s. Tension in the rope at the fixed support is -



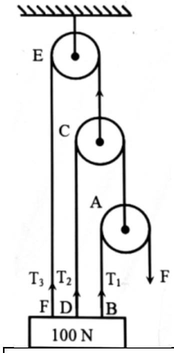
(a) 80 N (b) 100 N
(c) 98 N (d) 108 N

24. A balloon of mass M and a fixed size starts coming down with an acceleration f (f < g). The ballast mass m to be dropped from the balloon to have it go up with an acceleration f. Assuming negligible air resistance is find the value of m-
(a) $\left(\frac{M}{g+f}\right)$f (b) $\frac{Mf}{2(g+f)}$
(c) $\left(\frac{2Mf}{g+f}\right)$ (d) $\frac{M(g+a)}{g}$

25. **Statement 1:** The acceleration of a body down a rough inclined plane is greater than the acceleration due to gravity.
Statement 2: The body is able to slide on a inclined plane only when its acceleration is greater than acceleration due to gravity
(a) Both Statements are Correct.
(b) Statement 1 is correct and statement 2 is wrong.
(c) Statement 1 is incorrect and statement 2 is correct.
(d) Both Statements are wrong.

26. A car is moving in a circular horizontal track of radius 10m with a constant speed of 10m/s. A plumb bob is suspended from the roof of the car by a light rigid rod of length 1.00 m. The angle made by the rod with the track is -
(a) zero (b) 30°
(c) 45° (d) 60°

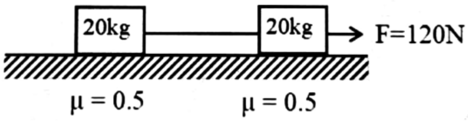
27. In the arrangement shown below, force F is just sufficient to keep equilibrium of 100 N block T_1, T_2 and T_3 are tension in string AB, CD, and EF and T_4 is total force of all tensions on block 100 N.



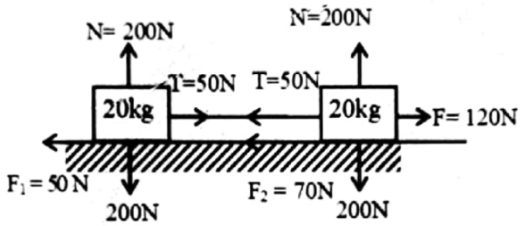
Column I	Column II
(A) Ti	(P) $\frac{400}{7}$ N
(B)T_2	(Q) $\frac{100}{7}$ N
(C)T_3	(R) $\frac{200}{7}$ N
(D)T_4	(S) 100 N

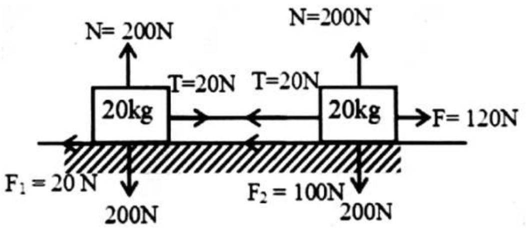
(a) (A)→R, (B)→Q, (C)→P, (D)→S
(b) (A)→Q, (B)→R, (C)→S, (D)→P
(c) (A)→Q, (B)→R, (C)→P, (D)→S
(d) (A)→Q. (B)→P, (C)→R, (D)→S

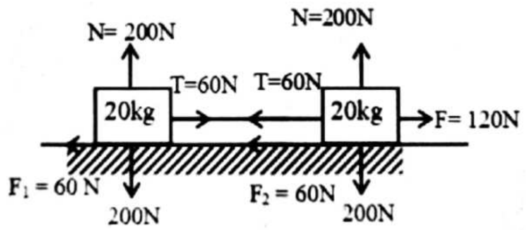
28. Two blocks each of mass 20 kg are connected by an ideal string and this system is kept on rough horizontal surface as shown. Initially the string is just tight then a horizontal force F = 120 N is applied on one block as shown.



If friction coefficient at every contact is μ = 0.5 then which of the following represents the correct free body diagram.?

(a)


(b)


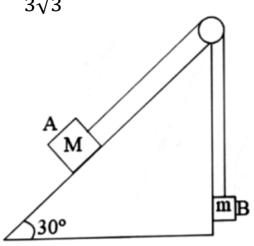
(c)


(d) All of the above

29. A block of mass m is pulled by a constant power P placed on a rough horizontal plane. The friction co-efficient between the block and the surface is μ. Maximum velocity of the block will be -

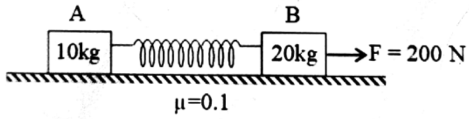
(a) $\frac{\mu P}{mg}$ (b) $\frac{\mu mg}{P}$
(c) μmgP (d) $\frac{P}{\mu mg}$

30. Block A of mass M in the system shown in the figure slides down the incline at a constant speed. The coefficient of friction between block A and the surface is $\frac{1}{3\sqrt{3}}$. The mass of block B is -



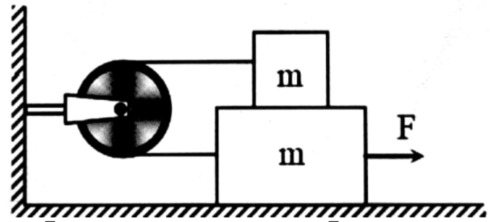
(a) M/2 (b) M/3
(c) 2M/3 (d) M/$\sqrt{3}$

31. Two blocks A and B attached to each other by a massless spring, are kept on a rough horizontal surface (μ = 0.1) and pulled by a force F = 200 N as shown in figure. If at some instant the 10 kg mass has acceleration of 12
m/s^2, what is the acceleration of 20 kg mass ?



(a) 2.5 m/s^2 (b) 4.0 m/s^2
(c) 3.6 m/s^2 (d) 1.2 m/s^2

32. For the arrangement shown in figure the coefficient of friction between the two blocks is μ. If both the block are identical, then the acceleration of each block is-

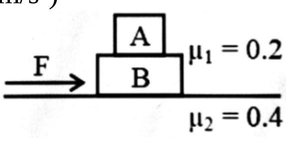


(a) $\frac{F}{2m} - 2\mu g$ (b) $\frac{F}{2m}$
(c) $\frac{F}{2m} - \mu g$ (d) zero

33. A block of mass 2 kg is held at rest against a rough vertical wall by pressing a horizontal (normal) force of 45 N. Coefficient of friction between wall and the block is equal to 0.5. Now a horizontal force of 15 N (tangential to wall) is also applied on the block. Then the block will -
(a) remain stationary
(b) move horizontally with acceleration of 5 m/s^2
(c) start to move with an acceleration of magnitude 1.25 m/s^2
(d) start to move horizontally with acceleration greater then 5 m/s^2

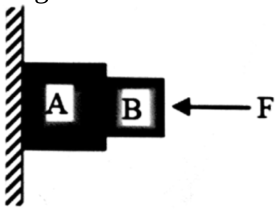
34. A block of mass 4 is suspended through two light spring balances A and B. Then A and B will read respectively.
(a) 4 kg and zero kg (b) Zero kg and 4 kg
(c) 4 kg and 4 kg (d) 2 kg and 2 kg

35. In the figure, m_A = 2 kg and m_B = 4 kg. For what minimum value of F, A starts slipping over B : (g = 10 m/s^2)-



(a) 24 N (b) 36 N
(c) 12 N (d) 20 N

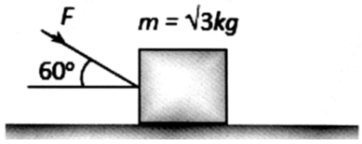
36. Consider the situation shown in figure. The wall is smooth but the surfaces of A and B in contact are rough. The friction on B due to A in equilibrium



(a) is upward
(b) is downward
(c) is zero
(d) the system can not remain in equilibrium

37. A 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 parallel to the inclined plane to make the body just move up the inclined plane is:
(a) mg sin θ
(b) μ mg cos θ
(c) μ mg cos θ – mg sin θ
(d) μ mg cos θ + mg sin θ

38. What is the maximum value of the force F such that the block shown in the arrangement, does not move ($\mu = 1/2\sqrt{3}$)

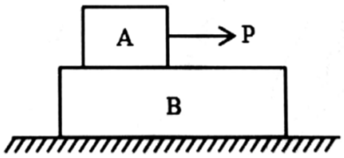


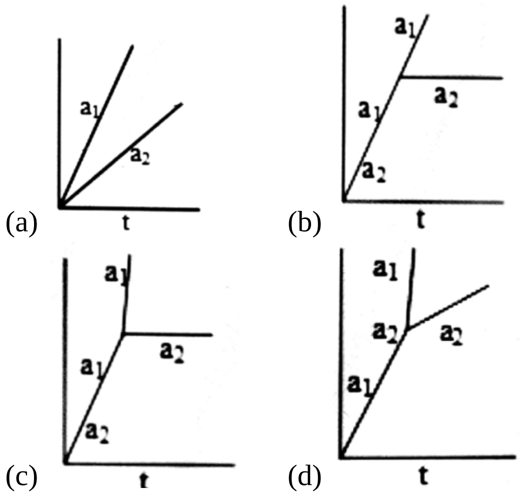
(a) 20 N (b) 12 N
(c) 15 N (d) 10 N

39. If a block moving up at θ = 30° with a velocity 5 m/s stops after 0.5 then what is μ
(a) 0.5 (b) 1.25
(c) 0.6 (d) None of these

40. A heavy uniform chain lies on a horizontal table top. If the coefficient of friction between the chain and the table surface is 0.25, then the maximum fraction of the length of the chain that can hang over one edge of the table is
(a) 20% (b) 25%
(c) 35% (d) 15%

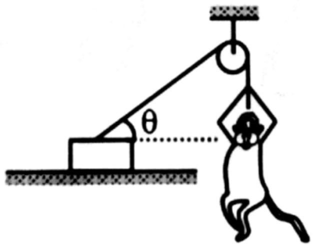
41. Block A is placed on block B, whose mass is greater than that of A. There is friction between the blocks, while the ground is smooth. A horizontal force P, increasing linearly with time, begins to act on A. The; accelerations ai and of A and B respectively are plotted against time (t). Choose the correct graph -





42. A mass m is placed on an inclined plane. If the mass is in equilibrium, the maximum inclination of the plane with the horizontal would be (where μ is the coefficient of friction between the mass and surface)-
(a) $\tan^{-1}\mu$ (b) $\tan^{-1}\left(\frac{\mu}{2}\right)$
(c) $\tan^{-1}\left(\frac{\mu}{m}\right)$ (d) $\cos^{-1}\mu$

43. A block of mass m rests on a rough horizontal surface with a rope tied to it. The co-efficient of friction between the surface and the block is μ. A monkey of the same mass climbs at the free end of the rope. The maximum acceleration with which the monkey can climb without moving the block is-



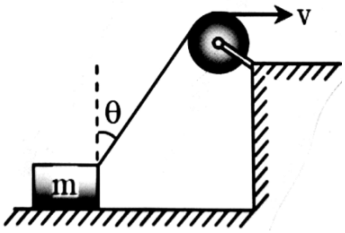
(a) $\frac{\mu g}{\mu\sin\theta-\cos\theta}-g$ (b) $\frac{\mu g}{\mu\sin\theta-\cos\theta}+g$
(c) $\frac{\mu g}{\tan\theta-\mu\cos\theta}+g$ (d) $\frac{\mu g}{\tan\theta-\mu\sec\theta}+g$

44. A box weighing 20 kg is being pulled along a wooden floor with a force of 500 N. If μk = 0.5, the acceleration of the block is [g = 10 ms^{-2}]
(a) 5 ms^{-2} (b) 25 ms^{-2}
(c) 20 ms^{-2} (d) 12.5 ms^{-2}

45. A car is moving along a straight horizontal road with a velocity of 72 km h^{-1}. If μ_s = 0.5, then the shortest distance in which the car can be stopped is : [Take g = 10 ms^{-2}].
(a) 40 m (b) 80 m

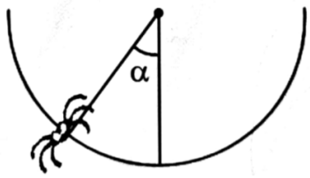
(c) 100 m (d) 120 m

46. A block is dragged on a smooth plane with the help of a rope which moves with a velocity v as shown in figure. The horizontal velocity of the block is:



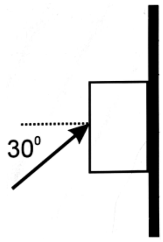
(a) v (b) v/sin θ
(c) v sin θ (d) v/cos θ

47. An insect crawls up a hemispherical surface very slowly (see figure). The coefficient of friction between the insect and the surface is 1/3. If the line joining the center of the hemispherical surface to the insect makes an angle α with the vertical, the maximum possible value of a is given by-



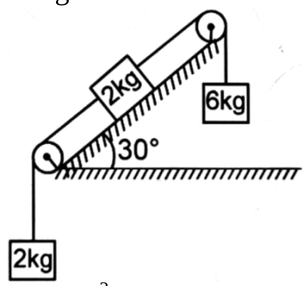
(a) cot α = 3 (b) tan α = 3
(c) sec α = 3 (d) cosec α = 3

48. A force of 100N is applied on d block of mass 3kg as shown in the figure. The coefficient of friction between the wall and block is 0.6. The magnitude of the force friction exerted by the wall on the block is:



(a) 15N downwards (b) 25N upwards
(c) 20N downwards (d) 30N upwards

49. Find the acceleration of the 6 block in the figure. All the surfaces and pulleys are smooth. Also the strings are inextensible and light. [Take g = 10 m/s^2]



(a) $4 m/s^2$ (b) $3 m/s^2$
(c) $2 m/s^2$ (d) $8 m/s^2$

50. A small mass slides down an inclined plane of inclination q with the horizontal. The coefficient of friction is $\mu = \mu_0 x$ where x is the distance through which the mass slides down and μ_0, a constant. Then the speed is maximum after the mass covers a distance of?

(a) $\frac{\cos\theta}{\mu_0}$ (b) $\frac{\sin\theta}{\mu_0}$
(c) $\frac{\tan\theta}{\mu_0}$ (d) $\frac{2\tan\theta}{\mu_0}$.