Exercise

Newton's Laws of Motion & Friction

(Physicsaholics)

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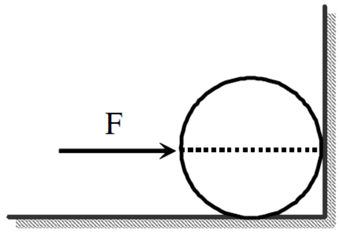
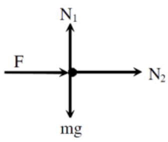
Exercise-1

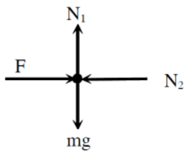
(Objective Type: Single Correct)

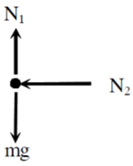
Level-1

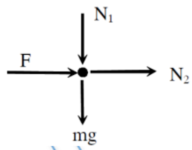
Q 1. A ball of mass m kept at the corner as shown in the figure, is acted by a horizontal force F. The correct free body diagram of ball is



(A) 

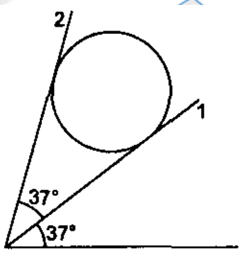
(B) 

(C) 

(D) 

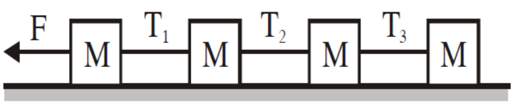
Q 2. Under what condition(s) will an object be in equilibrium?
(A) Only if it is at rest
(B) Only if it is moving with constant velocity
(C) Only if it is moving with constant acceleration
(D) If it is either at rest or moving with constant velocity

Q 3. A sphere of mass m is held between two smooth inclined walls. For sin 37° = 3/5, the normal reaction of the wall (2) is equal to



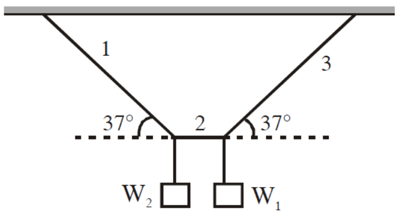
(A) mg (B) mg sin 74° (C) mg cos74° (D) none

Q 4. Four blocks of same mass connected by cords are pulled by force F on a smooth horizontal surface, as in figure. The tension T_1, T_2 and T_3 will be



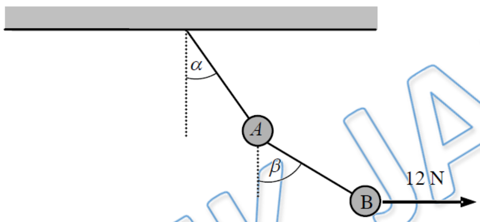
(A) $T_1 = F/4$, $T_2 = 3F/2$, $T_3 = F/4$
(B) $T_1 = F/4$, $T_2 = F/2$, $T_3 = F/2$
(C) $T_1 = 3F/4$, $T_2 = F/2$, $T_3 = F/4$
(D) $T_1 = 3F/4$, $T_2 = F/2$, $T_3 = F/2$

Q 5. In a given figure system is in equilibrium. If $W_1 = 300$ N. Then W_2 is approximately equal to



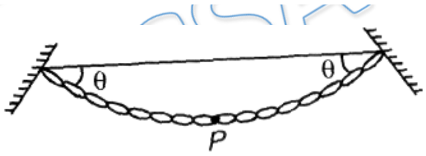
(A) 500 N (B) 400 N (C) 670 N (D) 300 N

Q 6. Two balls A and B weighing 7 N and 9 N are connected by a light cord. The system is suspended from a fixed support by connecting the ball A with another light cord. The ball B is pulled aside by a horizontal force 12 N and equilibrium is established. Angles α and β respectively are



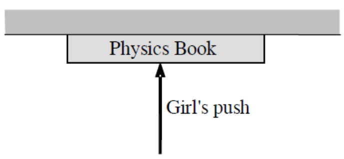
(A) 30° and 60° (B) 60° and 30° (C) 37° and 53° (D) 53° and 37°

Q 7. A flexible chain of mass m hangs between two fixed points A and B at the same level. The inclination of the chain with the horizontal at the two points of support is 0. The tension at the mid point of the chain is



(A) $\frac{mg}{\tan\theta}$ (B) $\frac{mg}{2\tan\theta}$ (C) 0(Zero) (D) mg$\left(\frac{\sin\theta+\cos\theta}{2}\right)$

Q 8. A girl pushes her physics book up against the horizontal ceiling of her room as shown in the figure. The book weighs 20 N and she pushes upwards with a force of 25 N. The choices below list the magnitudes of the contact force F_{CB} between the ceiling and the book, and F_{BH} between the book and her hand. Select the correct pair.



(A) F_{CB} = 20 N and F_{BH} = 25 N (B) F_{CB} = 25 N and F_{BH} = 45 N

(C) F_{CB} = 5 N and F_{BH} = 25 N (D) F_{CB} = 5 N and F_{BH} = 45 N

Q 9. Two astronauts A and B connected with a rope stay stationary in free space relative to their spaceship. Mass of A is more than that of B and the rope is straight. Astronaut A starts pulling the rope but astronaut B does not. If you were the third astronaut in the spaceship, what do you observe?

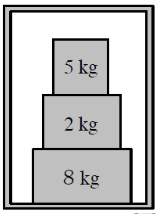
(A) Astronaut B accelerates towards A and A remains stationery.

(B) Both accelerate towards each other with equal accelerations of equal modulus.

(C) Both accelerate towards each other but acceleration of B is greater than that of A.

(D) Both accelerate towards each other but acceleration of B is smaller than that of A.

Q 10. Three boxes are placed in a lift. When acceleration of the lift is 4 m/s^2, the net force on the 8 kg box is closest to

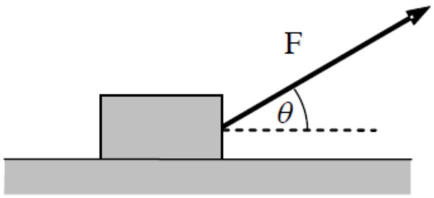


(A) 80 N (B) 48 N (C) 40 N (D) 32 N

Q 11. A man is standing on a weighing machine with a block in his hand. The machine records w. When he takes the block upwards with some acceleration the machine records w_1. When he takes the block down with some acceleration, the machine records w_2. Then choose correct option

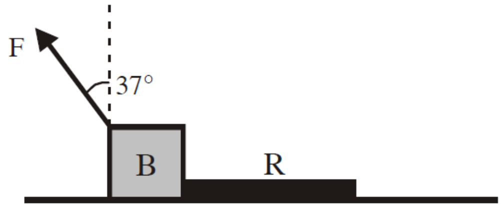
(A) $w_1 = w = w_2$ (B) $w_1 < w < w_2$ (C) $w_2 < w < w_1$ (D) $w_2 = w_1 > w$

Q 12. A block is being pulled by a force F on a long frictionless level floor. Magnitude of the force is gradually increases from zero until the block lifts off the floor. Immediately before the block leaves the floor, its acceleration is



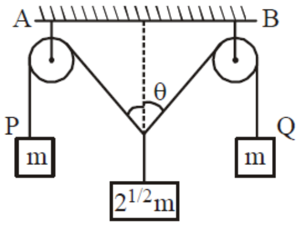
(A) gcos θ (B) gcot θ (C) gsin θ (D) g tan θ

Q 13. A block B is tied to one end of a uniform rope R as shown. The mass of block is 2 kg and that of rope is 1 kg. A force F = 15 N is applied at angle 37° with vertical. The tension at the mid-point of rope is



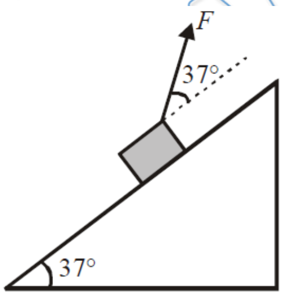
(A) 1.5 N (B) 2 N (C) 3N (D) 4.5 N

Q 14. The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be **[JEE (Scr) 2001]**



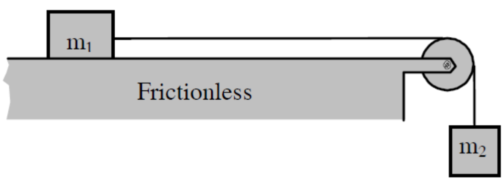
(A) 0° (B) 30° (C) 45° (D) 60°

Q 15. A block resting on a smooth inclined plane is acted upon by a force F as shown. If mass of block is 2 kg and F = 20 N and sin 37°= 3/5, the acceleration of block is



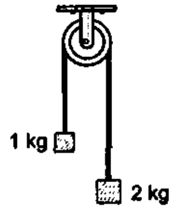
(A) 2 m/s^2 (B) 6 m/s^2 (C) 8 m/s_2 (D) zero

Q 16. In the arrangement shown, the blocks of unequal masses are held at rest. When released, acceleration of the blocks is



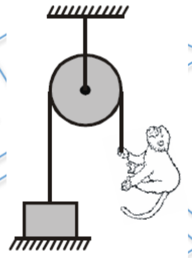
(A) g/2. (B) g.
(C) a value between zero and g. (D) a value that could be greater than g.

Q 17. Two unequal masses are connected on two sides of a light suing passing over a light and smooth pulley as shown in figure. The system is released from rest. The larger mass is stopped for a moment, 1.0 s after the system is set into motion. The time elapsed before the string is tight again is : ($g = 10\ m/s^2$)



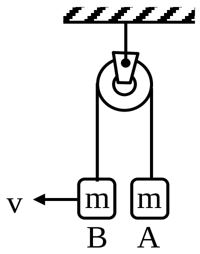
(A) 1/4 s (B) 1/2 s (C) 2/3 s (D) 1/3 s

Q 18. A monkey weighing 10 kg is climbing up a light rope and frictionless pulley attached to 15 kg mass at other end as in figure. In order to raise the 15 kg mass off the ground the monkey must climb-up



(A) with constant acceleration g/3.
(B) with an acceleration greater than g/2.
(C) with an acceleration greater than g/4.
(D) It is not possible because weight of monkey is lesser than the block.

Q 19. In the given figure–



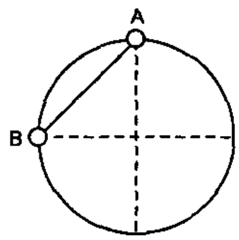
(A) both masses always remain in same level

(B) after some time, A is lower than B

(C) after some time, B is lower than A

(D) no sufficient information

Q 20. Two beads A and B of equal mass m are connected by a light inextensible cord. They are constrained to move on a frictionless ring in vertical plane. The blocks are released from rest as shown in figure. The tension in the cord just after the release is:



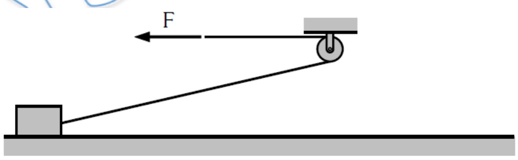
(A) $\frac{mg}{4}$ (B) $\sqrt{2}$ mg (C) $\frac{mg}{2}$ (D) $\frac{mg}{\sqrt{2}}$

Q 21. In the figure, the blocks A, B and C of mass m each have accelerations a_1, a_2 and a_3 respectively. F_1 and F_2 are external forces of magnitudes 2mg and mg respectively.

(A) $a_1 = a_2 = a_3$ (B) $a_1 > a_3 > a_2$

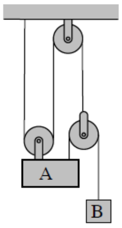
(C) $a_1 = a_2$, $a_2 > a_3$ (D) $a_1 > a_2$, $a_2 = a_3$

Q 22. A heavy cart is pulled by a constant force F along a horizontal track with the help of a rope that passes over a fixed pulley, as shown in the figure. Assume the tension in the rope and the frictional forces on the cart remain constant and consider motion of the cart until it reaches vertically below the pulley. As the cart moves to the right, its acceleration



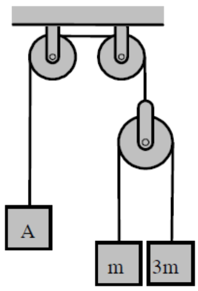
(A) decreases. (B) increases. (C) remains constant. (D) is zero

Q 23. In arrangement shown the block A of mass 15 kg is supported in equilibrium by the block B. Mass of the block B is closest to



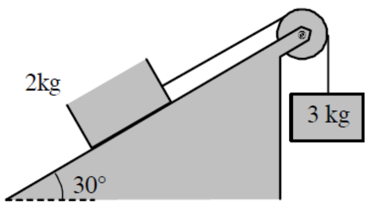
(A) 2 kg (B) 3 kg (C) 4 kg (D) 5 kg

Q 24. In the given figure, find mass of the block A, if it remains at rest, when the system is released from rest. Pulleys and strings are massless. [g = 10 m/s^2]



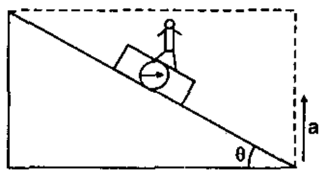
(A) m (B) 2m (C) 3m (D) 4m

Q 25. In the arrangement shown, the 2 kg block is held to keep the system at rest. The string and pulley are ideal. When the 2 kg block is set free, by what amount the tension in the string changes? [g = 10 m/s^2]



(A) Increase of 12 N (B) Decrease of 12 N (C) Increase of 18 N (D) Decrease of 18 N

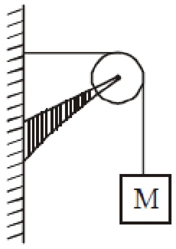
Q 26. A man of mass in =60 kg is standing on weighing machine fixed on a triangular wedge of angle θ = 60° as shown in the figure. The wedge is moving up with an upward acceleration a = 2 m/s^2. The weight registered by machine is:



(A) 600 N (B) 1440 N (C) 360 N (D) 240 N

Q 27. A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given

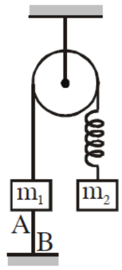
[JEE (Scr) 2001]



(A) $\sqrt{2}Mg$ (B) $\sqrt{2}mg$

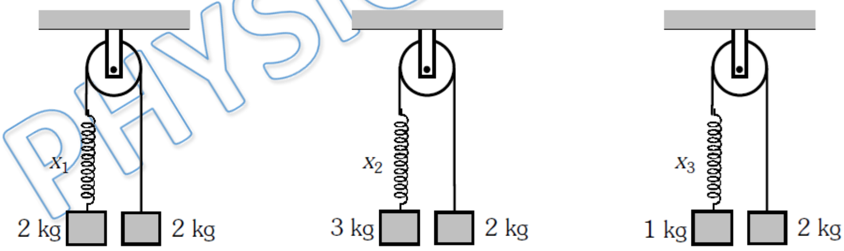
(C) $\sqrt{(M+m)^2+m^2}g$ (D) $\sqrt{(M+m)^2+M^2}g$

Q 28. In a given figure two masses m_1 & m_2 $(m_2 > m_1)$ are at rest in equilibrium position. Find the tension in string AB



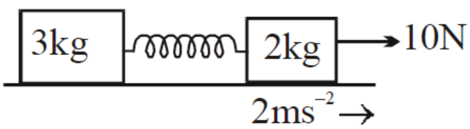
(A) m_1g (B) m_2g (C) $(m_1+m_2)g$ (D) $(m_2-m_1)g$

Q 29. Same spring is attached with 2 kg, 3 kg and 1 kg blocks in three different cases as shown. If x_1, x_2 and x_3 be the extensions in the spring in these three cases, when acceleration of both the blocks have same magnitude, then



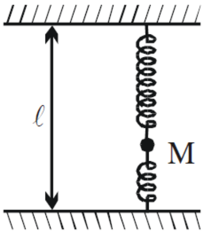
(A) $x_2 > x_3 > x_1$ (B) $x_2 > x_1 > x_3$ (C) $x_3 > x_1 > x_2$ (D) $x_1 > x_2 > x_3$

Q 30. Find the acceleration of 3 kg mass when acceleration of 2 kg mass is 2 ms^{-2} as shown in figure.



(A) 3 ms^{-2} (B) 2 ms^{-2} (C) 0.5 ms^{-2} (D) zero

Q 31. A small ball of mass M is held in equilibrium with two identical springs as shown in the figure. Force constant of each spring is k and relaxed length of each spring is $\ell/2$. What is distance between the ball and roof?



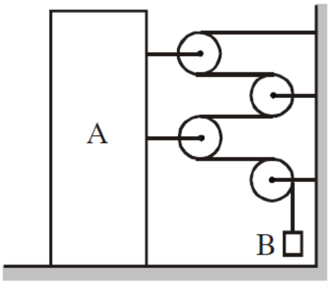
(A) $\frac{\ell}{2}+\frac{Mg}{k}$ (B) $\frac{\ell}{2}-\frac{Mg}{k}$

(C) $\frac{\ell}{2}+\frac{Mg}{2k}$ (D) $\frac{\ell}{2}-\frac{Mg}{2k}$

Q 32. An elastic spring of relaxed length ℓ_0 and force constant k is cut into two parts of lengths ℓ_1 and ℓ_2. The force constants of these parts are respectively

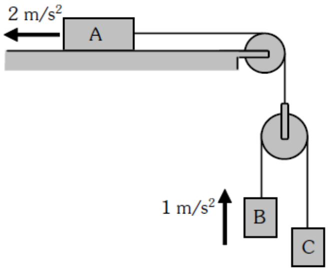
(A) $\frac{k\ell_0}{\ell_1}$and $\frac{k\ell_0}{\ell_2}$ (B) $\frac{k\ell_1}{\ell_0}$and $\frac{k\ell_2}{\ell_0}$ (C) $\frac{k\ell_0}{\ell_2}$ and $\frac{k\ell_0}{\ell_1}$ (D) $\frac{k\ell_2}{\ell_0}$ and $\frac{k\ell_1}{\ell_0}$

Q 33. Block A is moving away from the wall at a speed v and acceleration a.



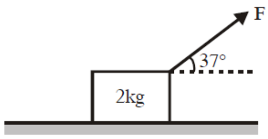
(A) Velocity of B is v with respect to A.
(B) Acceleration of B is a with respect to A.
(C) Acceleration of B is 4a with respect to A.
(D) Acceleration of B is $\sqrt{17}$a with respect to A.

Q 34. In the setup shown, find acceleration of the block C.



(A) 3 m/s² ↑ (B) 3 m/s² ↓ (C) 5 m/s² ↑ (D) 5 m/s² ↓

Q 35. A block of mass 2 kg is kept on a rough horizontal floor and pulled with a force F. If the coefficient of friction is 0.5. then the minimum force required to move the block is :-



(A) 10 N (B) $\frac{100}{11}N$ (C) $\frac{100}{8}N$ (D) 20 N

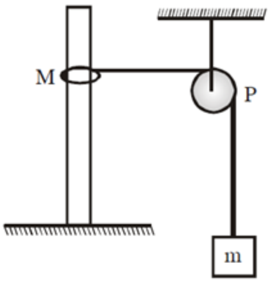
Q 36. A block released on a rough inclined plane of inclination θ = 30º slides down the plane with an acceleration $g/4$, where g is the acceleration due to gravity. What is the coefficient of friction between the block and the inclined plane?

(A) $\frac{2}{\sqrt{3}}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\frac{1}{2\sqrt{3}}$ (D) $\frac{\sqrt{3}}{2}$

Q 37. A box is gently placed on a horizontal conveyer belt moving with a speed of 4 ms^{-1}. If the coefficient of friction between the box and the belt is 0.8, through what distance will the block slide with respect to the belt? Take g = 10 ms^{-2}.

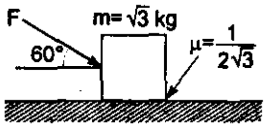
(A) 0.6 m (B) 0.8 m (C) 1.0 m (D) 1.2 m

Q 38. In the figure shown a ring of mass M and a block of mass m are in equilibrium. The string is light and pulley P does not offer any friction and coefficient of friction between pole and M is μ. The frictional force offered by the pole on M is



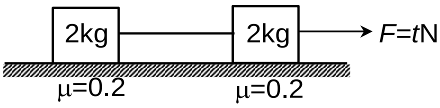
(A) Mg directed up (B) μmg directed up
(C) (M –m)g directed down (D) μmg directed down

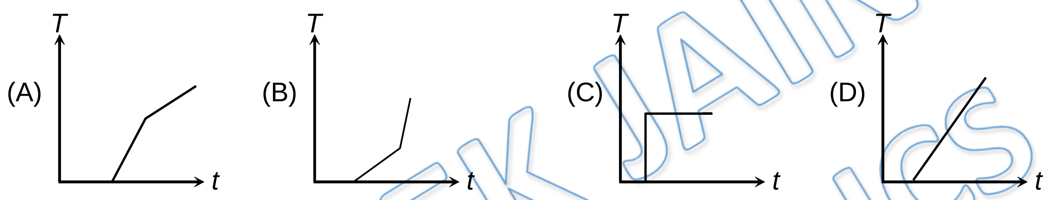
Q 39. What is the maximum value of the force F such that the block shown in the arrangement, does not move?



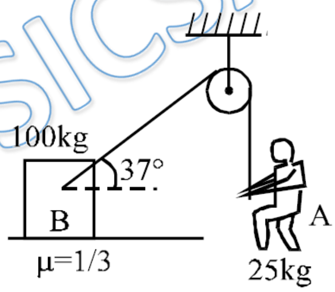
(A) 20 N (B) 1ON (C) 12 N (D) 15 N

Q 40. Two blocks each of mass m = 2kg placed on rough horizontal surface connected by massless string as shown in the figure. A variable horizontal force $F = t$ N (where t is time) is applied. The tension T in string versus time graph is





Q 41. Block B of mass 100 kg rests on a rough surface of friction coefficient μ = 1/3. A rope is tied to block B as shown in figure. The maximum acceleration with which boy A of 25 kg can climbs on rope without making block move is :



(A) $\frac{4g}{3}$ (B) $\frac{g}{3}$ (C) $\frac{g}{2}$ (D) $\frac{3g}{4}$

Q 42. A body is placed on a rough inclined plane of inclination θ. As the angle θ is increased from 0° to 90°, the contact force between the block and the plane

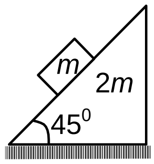
(A) remains constant

(B) first remains constant then decreases

(C) first decreases then increases

(D) first increases then decreases

Q **43.** A block of mass *m* is placed on a wedge of mass 2*m* which rests on a rough horizontal surface. There is no friction between the block and the wedge. The minimum coefficient of friction between the wedge and the ground so that the wedge does not move is

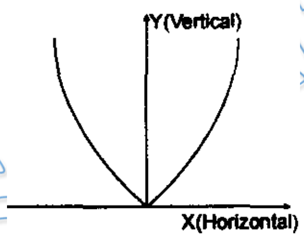


(A) 0.167 (B) 0.2 (C) 0.23 (D) 0.33

Q 44. The force required to just move a body up the inclined plane is double the force required to just prevent the body from sliding down the plane. The coefficient of friction is μ. The inclination θ of the plane is

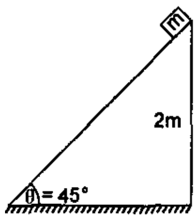
(A) $tan^{-1}\mu$ (B) $tan^{-1}(\mu/2)$ (C) $tan^{-1}2\mu$ (D) $tan^{-1}3\mu$

Q 45. A parabolic bowl with its bottom at origin has the shape $y = x^2/20$. Here x and y are in metres. The maximum height at which a small mass m can be placed on the bowl without slipping (coefficient of static friction is 0.5) is :



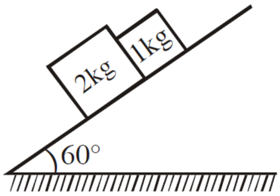
(A) 2.5 m (B) 1.25 m (C) 1.0 m (D) 4.0 m

Q 46. A wedge of mass 2m and a cube of mass m are shown in figure. Between cube and wedge, there is no friction. The minimum coefficient of friction between wedge and ground so that wedge does not move is:



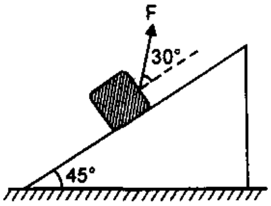
(A) 0.10 (B) 0.20 (C) 0.25 (D) 0.50

Q 47. In the figure shown if friction coefficient of block 1kg and 2kg with inclined plane is μ_1=0.5 and μ_2 = 0.4 respectively, then



(A) both block will move together.
(B) both block will move separately.
(C) there is a non zero contact force between two blocks.
(D) none of these

Q 48. A block of mass m = 4 kg is placed over a rough inclined plane as shown in figure. The coefficient of friction between the block and the plane is 11 = 0.6. A force F = 10 N is applied on the block at an angle of 300. The contact force between the block and the plane is:

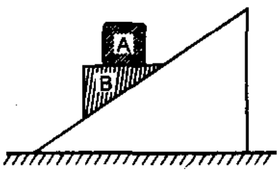


(A) 27.15 N (B) 16.32 N (C) 10.65 N (D) 32.16 N

Q 49. A block is pushed with some velocity up a rough inclined plane. It stops after ascending few meters and then reverses its direction and returns back to point from where it started. If angle of inclination is 37° and the time to climb up is half of the time to return back then coefficient of friction is

(A) $\frac{9}{20}$ (B) $\frac{7}{5}$ (C) $\frac{7}{12}$ (D) $\frac{5}{7}$

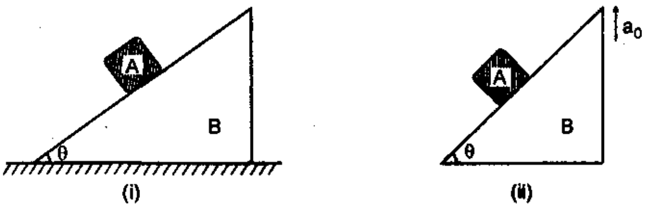
Q 50. Block A is placed over the block B as shown in figure. Wedge is smooth and fixed. Force of friction on block A is:



(A) towards right (B) towards left

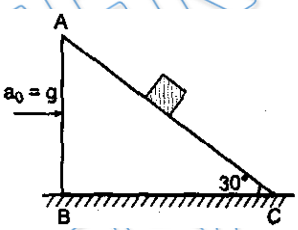
(C) zero (D) always kinetic

Q 51. In case (i) wedge B is stationary and block A starts sliding when the angle of plane is greater than θ, while in case (ii) wedge B is' moving upwards with an acceleration a_0 and the block A starts sliding when the angle of plane is greater than α. Coefficient of friction between A and B in both the cases is same. Then



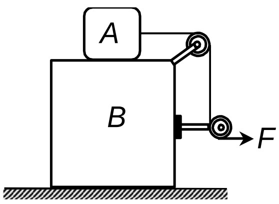
(A) $\theta = \alpha$ (B) $\theta > \alpha$ (C) $\theta < \alpha$ (D) $\frac{\tan\theta}{\tan\alpha} = \frac{g}{a_0}$

Q 52. A block is placed on an inclined plane moving towards right horizontally with an acceleration $a_0 = g$. The length of the plane AC = 1 m. Friction is absent everywhere. The time taken by the block to reach from C to A is: ($g = 10\ m/s^2$)



(A) 1.2 s (B) 0.74 s (C) 2.56 s (D) 0.42 s

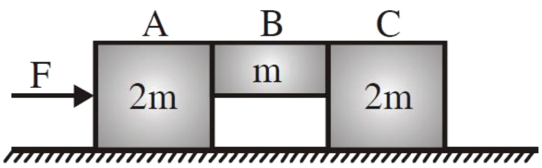
Q 53. In the arrangement shown in figure $m_A = m_B = 2kg$. String is massless and pulley is frictionless. Block *B* is resting on a smooth horizontal surface, while friction coefficient between blocks *A* and *B* is μ = 0.5. The maximum horizontal force *F* can be applied so that block *A* does not slip over the block *B* is. ($g = 10\ m/s^2$)



(A) 25 N (B) 40 N

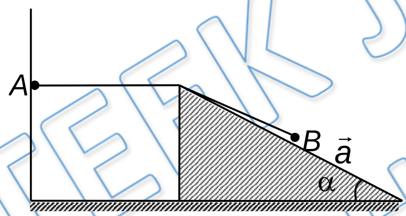
(C) 30 N (D) 20 N

Q 54. The system is pushed by a force F as shown in figure. All surfaces are smooth except between B and C. Friction coefficient between B and C is μ. Minimum value of F to prevent block B from downward slipping is:-



(A) $\left(\frac{3}{2\mu}\right)mg$ (B) $\left(\frac{5}{2\mu}\right)mg$ (C) $\left(\frac{5}{2}\right)\mu mg$ (D) $\left(\frac{3}{2}\right)\mu mg$

Q 55. A weightless inextensible rope rests on a stationary wedge forming an angle α with the horizontal. One end of the rope is fixed to the wall at the point *A*. A small load is attached to the rope at the point *B*, the wedge starts moving to the right with constant acceleration '*a*'. What is the acceleration of the load when it is still on the wedge?



(A) 2a sin α (B) 2a cos α

(C) 2a sin $\frac{\alpha}{2}$ (D) 2a cos $\frac{\alpha}{2}$

Answer Key

Q.1) B	Q.2) D	Q.3) A	Q.4) C	Q.5) D
Q.6) C	Q.7) B	Q.8) C	Q.9) C	Q.10) D
Q.11) C	Q.12) B	Q.13) A	Q.14) C	Q.15) A
Q.16) C	Q.17) D	Q.18) B	Q.19) C	Q.20) D
Q.21) A	Q.22) A	Q.23) B	Q.24) C	Q.25) B
Q.26) C	Q.27) D	Q.28) D	Q.29) B	Q.30) B
Q.31) C	Q.32) A	Q.33) D	Q.34) A	Q.35) B
Q.36) C	Q.37) C	Q.38) A	Q.39) A	Q.40) A
Q.41) B	Q.42) B	Q.43) B	Q.44) D	Q.45) B
Q.46) B	Q.47) B	Q.48) A	Q.49) A	Q.50) B
Q.51) A	Q.52) B	Q.53) D	Q.54) B	Q.55) C