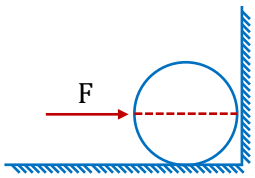
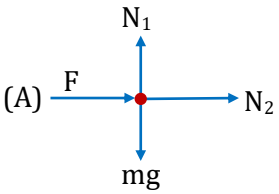
EXERCISE - O

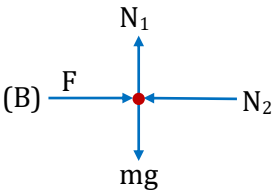
SINGLE CORRECT TYPE QUESTIONS

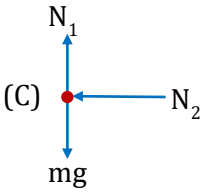
Newtons Laws of Motion

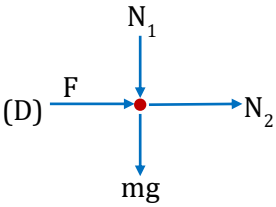
1. A ball of mass m kept at the corner as shown in the figure, is acted by a horizontal force F. The correct free body diagram of ball is



(A) 

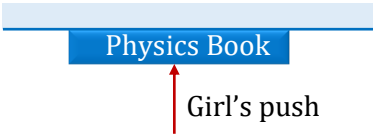
(B) 

(C) 

(D) 

PNL173

2. 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

PNL174

3. 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?

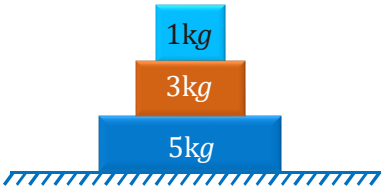
(A) Astronaut B accelerates towards A and A remains stationery.
(B) Both accelerate towards each other with equal accelerations of equal modulus.
(C) Both accelerate towards each other but acceleration of B is greater than that of A.
(D) Both accelerate towards each other but acceleration of B is smaller than that of A.

PNL175

4. 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

PNL075

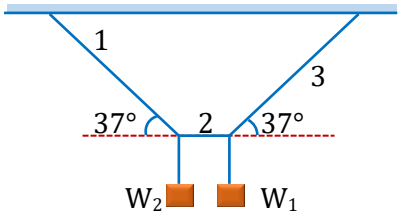
5. All three blocks placed on horizontal surface at rest than net force on the middle block is?



(A) 30 N (B) 40 N (C) 90 N (D) 0N

PNL078

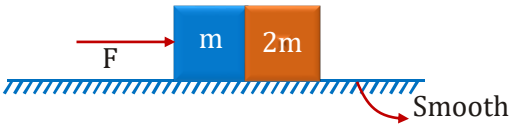
6. In a given figure system is in equilibrium. If W_1 = 300 N. Then W_2 is approximately equal to



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

PNL076

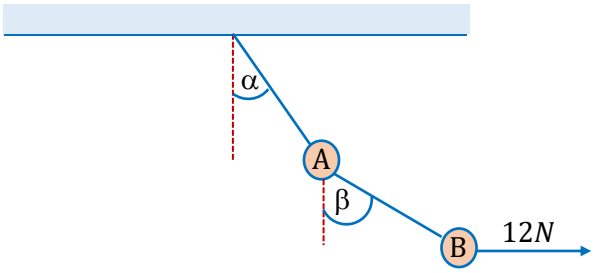
7. Normal force acting between the blocks will be :



(A) $\frac{F}{3}$ (B) $\frac{F}{6}$ (C) $\frac{F}{4}$ (D) $\frac{2F}{3}$

PNL073

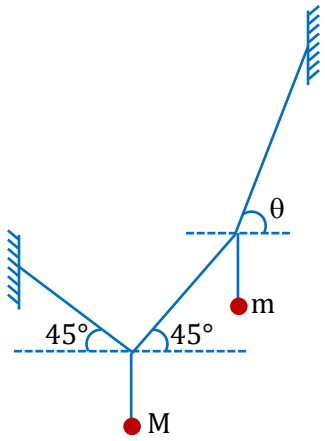
8. Two balls A and B weighing 7 N and 9 N are connected by a light cord. The system is suspended from a fixed support by connecting the ball A with another light cord. The ball B is pulled aside by a horizontal force 12 N and equilibrium is established. Angles α and β respectively are



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

PNL077

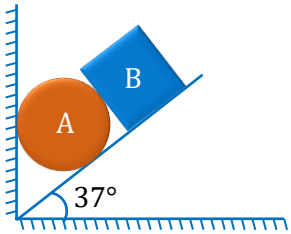
9. Two masses m and M are attached to strings as shown in the figure. In equilibrium tan θ is :



(A) $1 + (2M/m)$ (B) $1 + (2m/M)$ (C) $1 + (M/2m)$ (D) None of these

PNL176

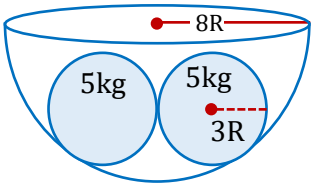
10. A perfect smooth sphere A of mass 2 kg is in contact with a rectangular block B of mass 4 kg and vertical wall as shown in the figure. All surfaces are smooth. Find normal reaction by vertical wall on sphere A



(A) 20 N (B) 25 N (C) 80 N (D) 45 N

PNL080

11. In a hemispherical bowl of radius $8R$, two balls of mass 5 kg are placed in the equilibrium. Radius of the ball is $3R$. Normal contact force between the two balls is given by



(A) $\frac{75}{2}$ (B) $\frac{75}{4}$ (C) $\frac{75}{6}$ (D) 15

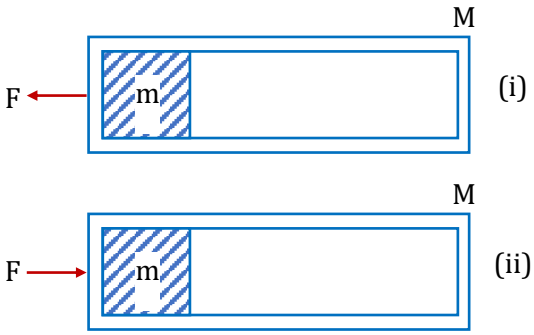
PNL177

12. Three identical blocks each of mass $20kg$ are connected by ideal strings and are being pulled along a horizontal frictionless table by a constant horizontal force F as shown in figure. What is the magnitude of force F if the tension in the string connecting blocks A and B is 60 N ?

(A) 60 N (B) 120 N (C) 180 N (D) 90 N

PNL178

13. A block of mass m is placed in contact with one end of a smooth tube of mass M (see figure). A horizontal force F acts on the tube in each case (i) and (ii). Then mark **incorrect** option :



(A) $a_m = 0$ and $a_M = \frac{F}{M}$ in (i)

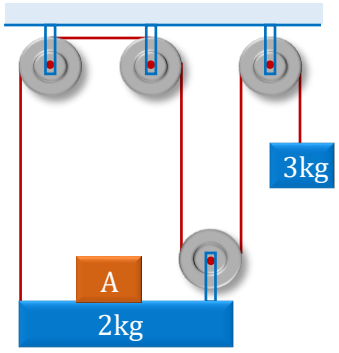
(B) $a_m = a_M = \frac{F}{M+m}$ in (i)

(C) $a_m = a_M = \frac{F}{M+m}$ in (ii)

(D) Force on m is $\frac{mF}{M+m}$ in (ii)

PNL179

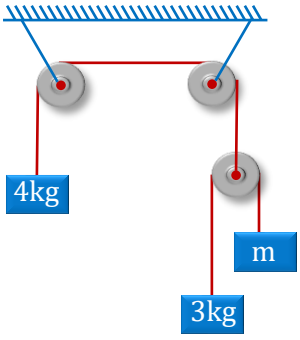
14. The arrangement shown in the figure is in equilibrium. What is the contact force (in N) between the block A and 2 kg block ? ($g = 10\ m/s^2$)



(A) 70 N (B) 100 N (C) 30 N (D) 50 N

PNL126

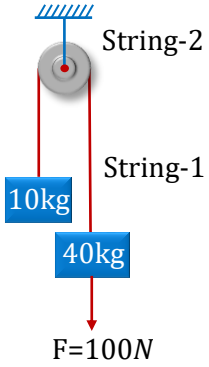
15. What should be the value of "m" so that 4kg block remains at rest :-



(A) 3 kg (B) 4 kg (C) 1.5 kg (D) 2.5 kg

PNL180

16. Mark the **INCORRECT** statement(s) :



Magnitude of acceleration of both blocks is 8 m/s^2

(A) tension in the string is 180 N

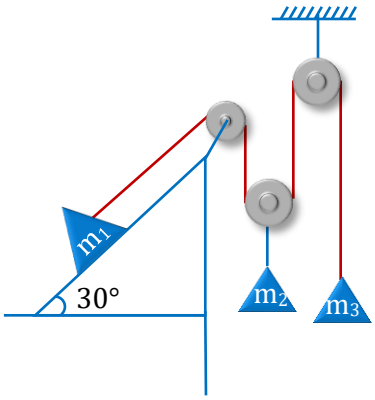
(B) acceleration of mass 10 kg is $8m/s^2$ upward

(C) acceleration of mass 10 kg is $8m/s^2$ downward

(D) acceleration of mass 40 kg is $8m/s^2$ downward

PNL115

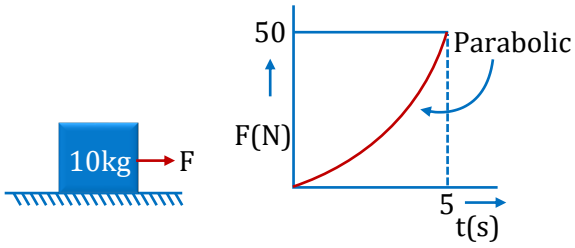
17. All pulleys and strings are massless, for what ratio of $m_1 : m_2 : m_3$ system will be in equilibrium (inclined is frictionless)



(A) 1 : 2 : 1 (B) 2 : 2 : 1 (C) 1 : 2 : 2 (D) 2 : 1 : 2

PNL181

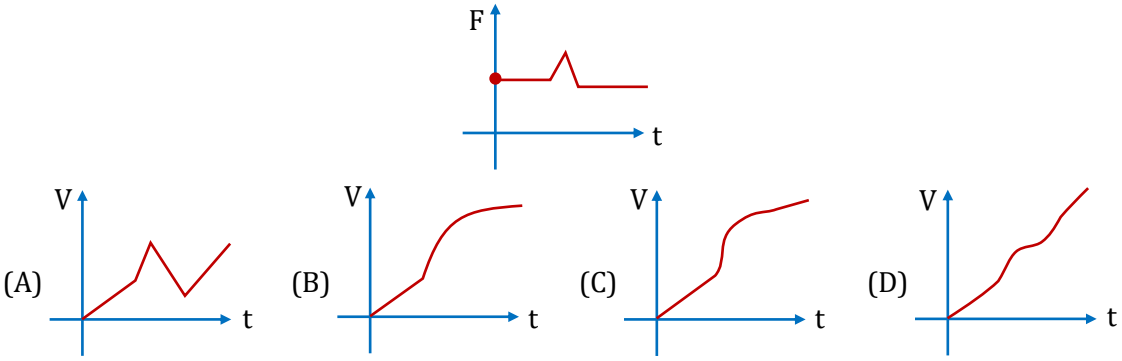
18. A force F is applied to the initially stationary cart. The variation of force with time is shown in the figure. The speed of cart at t = 5 second is :–



(A) 10 m/s (B) 8.33 m/s (C) 2 m/s (D) zero

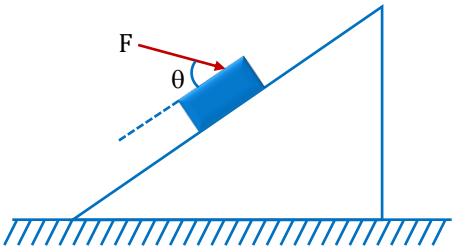
PNL182

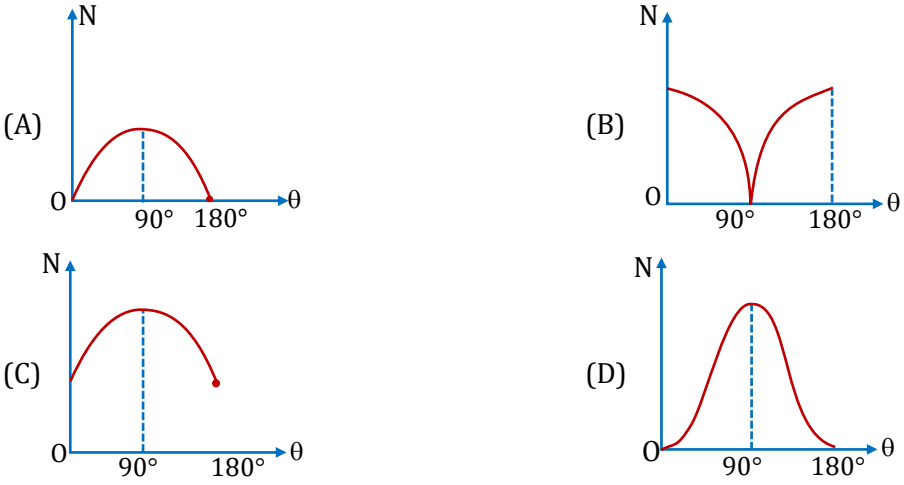
19. Curve between net force vs time is shown.-Initially particle is at rest. Which of the following best represents the resulting velocity - time graph of the particle ?



PNL183

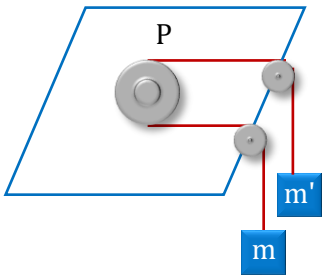
20. In a given figure a block is kept on the fixed wedge. A force of magnitude F is acting on the block such that it makes angle θ with the inclined plane. Now θ is changing from 0 to 180° then graph between normal reaction between block and wedge (N) and θ is :-





PNL184

21. A smooth pulley *P* of mass $M = 2\ kg$ is lying on a smooth table. A light string passes round the pulley and has mass $m = 1kg$ and $m' = 2kg$ attached to its ends, the two portions of the string being perpendicular to the edge of the table so that the masses hang vertically. Acceleration of pulley is–



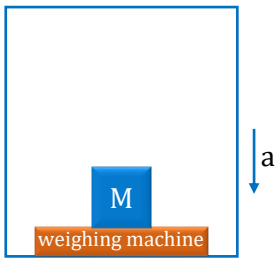
(A) $\frac{g}{2}$ (B) $\frac{2g}{3}$

(C) $\frac{4g}{9}$ (D) $\frac{4g}{7}$

PNL185

22. With what acceleration 'a' shown the elevator descends so that the block of mass M exerts a force of $\frac{Mg}{10}$ on the weighing machine?

[g = acceleration due to gravity]

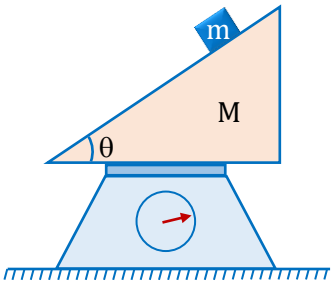


(A) 0.3 g (B) 0.1 g

(C) 0.9 g (D) 0.6 g

PNL186

23. The wedge of mass M sits at rest on a scale as shown in figure. A small block of mass m slides down the frictionless incline of the wedge. The scale reading while the block slides, is

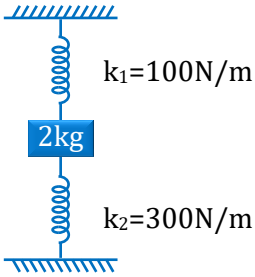


(A) $(m + M)g$ (B) $Mg + mg\cos^2\theta$

(C) $(m + M)g + mg\sin^2\theta$ (D) $(M - m)g + mg\sin^2\theta$

PNL084

24. The block is released from rest with the unstretched positions of springs initially. The acceleration of the block just after released will be (g = 10 m/s^2)

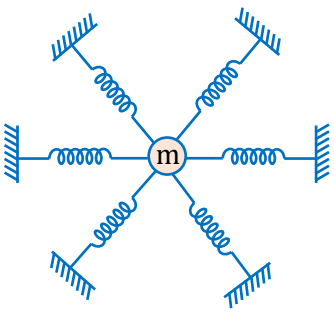


(A) Zero (B) 10 m/s^2 upwards

(C) 10 m/s^2 downward (D) 5 m/s^2 upwards

PNL187

25. A sphere of mass 'm' is kept in equilibrium with the help of several springs as shown in the figure. Measurements show that one of the springs applies a force $\vec{F}$ on the sphere. With what acceleration the sphere will move immediately after this particular spring is cut?



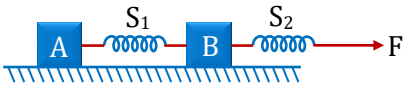
(A) Zero (B) $\frac{\vec{F}}{m}$

(C) $-\frac{\vec{F}}{m}$ (D) Insufficient information

PNL091

26. Two blocks A and B of equal mass 2 kg are arranged as shown with springs S_1 and S_2. Spring S_2 is pulled with force $F = 6\ N$. Acceleration of block B is 4 m/s^2 towards right at an instant. If F is suddenly removed at this instant, the instantaneous acceleration of A and B will be
(Assume no friction)

(A) $a_A = 1\ m/s^2$ towards right and $a_B = 4\ m/s^2$ left
(B) $a_A = 1\ m/s^2$ towards left and $a_B = 4\ m/s^2$ right
(C) $a_A = 1\ m/s^2$ towards left and $a_B = 1\ m/s^2$ right
(D) $a_A = 0$ and $a_B = 4\ m/s^2$ right



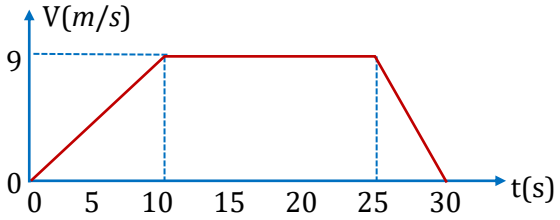
PNL098

27. **Statement–1 :** A reference frame attached to the earth is an inertial frame of reference.
and
Statement–2 : In practical, Newton's laws can be applied in this frame of reference.

(A) Statement–1 is True, Statement–2 is True ; Statement–2 is a correct explanation for Statement-1.
(B) Statement–1 is True, Statement–2 is True ; Statement–2 is not a correct explanation for Statement–1.
(C) Statement–1 is True, Statement–2 is False.
(D) Statement–1 is False, Statement–2 is True.

PNL188

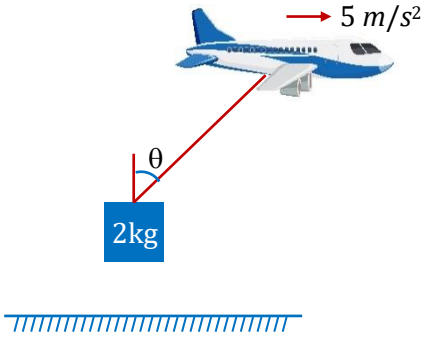
28. A lift is going up. The total mass of the lift and the passengers is 500 kg. The speed of lift varies with time as shown in figure. What will be the tension (in kN) in the rope pulling the lift at $t = 27$s. ($g = 9.8\ m/s^2$)



(A) 2 (B) 4 (C) 6 (D) 8

PNL110

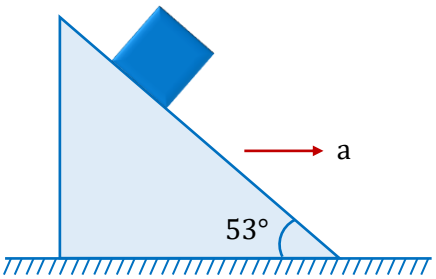
29. An airplane is moving horizontally with constant acceleration 5 m/s^2 with a block of mass 2kg is hanging with it, which is at rest w.r.t. plane find angle θ which string makes with vertical?



(A) $\tan\theta = 2$ (B) $\cot\theta = 2$ (C) $\sin\theta = \frac{1}{2}$ (D) $\cos\theta = \frac{1}{2}$

PNL111

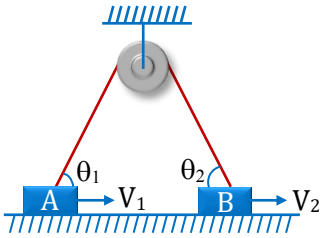
30. If acceleration (in m/s^2) of wedge (rightwards) so that block does not move w.r.t. wedge is $\frac{8n}{3}$. Value of n.



(A) 7 (B) 8 (C) 5 (D) 9

PNL116

31. In the figure shown, blocks A and B move with velocities v_1 and v_2 along horizontal direction. Find the ratio of $\frac{v_1}{v_2}$.

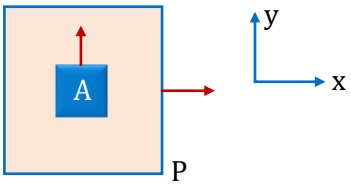


(A) $\frac{\cos\theta_1}{\cos\theta_2}$ (B) $\frac{\cos\theta_2}{\cos\theta_1}$ (C) $\frac{\sin\theta_2}{\sin\theta_1}$ (D) $\frac{\sin\theta_1}{\sin\theta_2}$

PNL128

Friction

32. A block is moving along y–axis with velocity 4 m/s on a plank relative to ground and the plank is moving along x–axis with velocity 3 m/s at any instant of time. The unit vector in direction of friction force acting on block at this moment of time is.

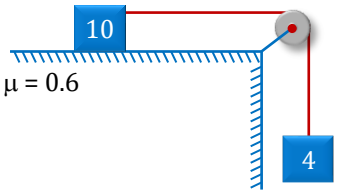


(A) $\frac{3\hat{i}+4\hat{j}}{5}$ (B) $\frac{3\hat{i}-4\hat{j}}{5}$

(C) $\frac{-3\hat{i}+4\hat{j}}{5}$ (D) $\frac{-3\hat{i}-4\hat{j}}{5}$

PNL142

33. For the system of blocks and pulley shown in the figure, acceleration of block is "a" and friction force acting on 10 kg block is F then :-



(A) $F = 60\ N, a = 0\ m/s^2$

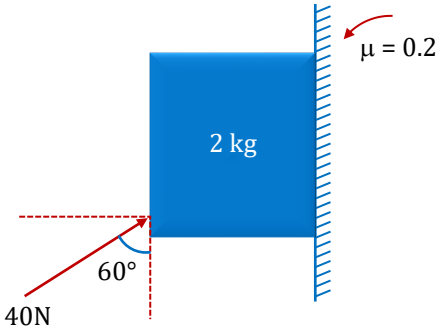
(B) $F = 50\ N, a = \frac{20}{7}\ m/s^2$

(C) $F = 40\ N, a = 0\ m/s^2$

(D) $F = 40\ N, a = \frac{20}{7}\ m/s^2$

PNL141

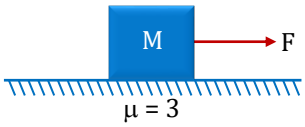
34. A block of mass 2 *kg* is pressed against the vertical wall of coefficient of friction μ = 0.2. The value of friction force acting on the wall is :-



(A) $40\sqrt{3}$ *N* in upward direction
(B) $40\sqrt{3}$ *N* in downward direction
(C) 20 *N* in upward direction
(D) No friction force acts on the block

PNL143

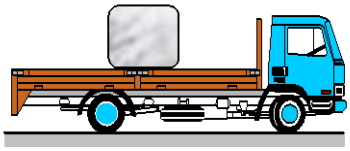
35. A block of mass *M* placed on rough surface of coefficient of friction equal to 3. If *F* is the (4/5) of the minimum force required to just move, find out the force exerted by ground on the block.



(A) 2.6 *Mg*
(B) *Mg*
(C) 4 *Mg*
(D) 3.4 *Mg*

PNL144

36. A truck carries a 2 Ton block on a level horizontal road. The coefficient of static and kinetic frictions between the stone-block and truck-bed are 0.4 and 0.2 respectively. When the truck accelerates at 2 m/s^2, how much friction acts between the stone-block and the truck-bed? [g = 10 m/s^2]



(A) 2000 *N*
(B) 4000 *N*
(C) 8000 *N*
(D) 10000 *N*

PNL189

37. The coefficient of friction between the block and the horizontal surface is μ as shown in figure. The block moves towards right under action of horizontal force *F* (figure-a). Sometime later another force *P* is applied to the block making an angle θ (such that tan θ = μ) with vertical as shown in (figure - b). After application of force *P*, the acceleration of block shall

(A) increase
(B) decrease
(C) remains same
(D) information insufficient for drawing inference.

Fig. (a)

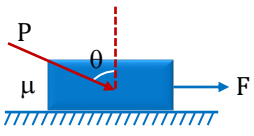
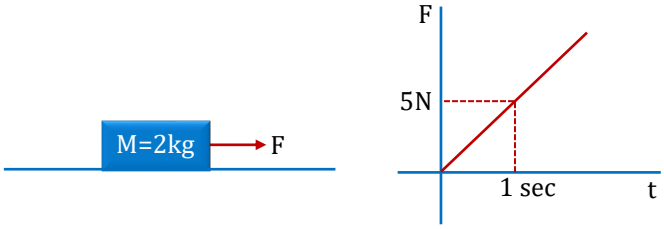


Fig. (b)

PNL146

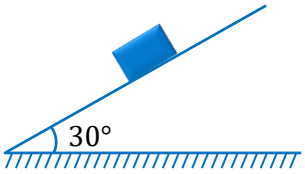
38. A block of mass $2kg$ is at rest on a rough surface, of coefficient of friction 0.5. A force F is applied on the block, variation of force is represented in the figure. Speed of the block at $t = 4$ sec is:



(A) 20 m/s (B) 10 m/s (C) 5 m/s (D) 15 m/s

PNL147

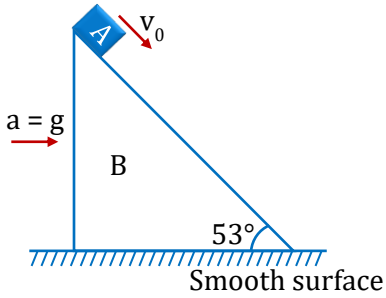
39. Figure shows a block kept on a rough inclined plane. The maximum external force down the incline for which the block remains at rest is $2N$ while the maximum external force up the incline for which the block is at rest is 10 N. The coefficient of static friction μ is



(A) $\frac{\sqrt{3}}{2}$ (B) $\frac{1}{\sqrt{6}}$ (C) $\sqrt{3}$ (D) $\frac{1}{\sqrt{3}}$

PNL150

40. Block A is placed on a rough wedge B which is placed on a smooth surface. The wedge has angle of inclination of 53° and is imparted a horizontal acceleration g towards right. Block A is given an initial velocity v_0 with respect to wedge. Find the coefficient of friction for which block A moves with constant velocity v_0 with respect to wedge. ($g = 10\ m/s^2$)



(A) 2/3 (B) 3/7 (C) 1/7 (D) 1/3

PNL149

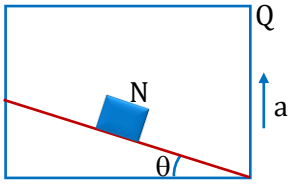
41. A block of mass m is at rest with respect to a rough incline kept in elevator moving up with acceleration a. Which of following statements is /are correct.

(A) The contact force between block and incline is vertical.

(B) The contact force between block and incline is of magnitude $m(g - a)$.

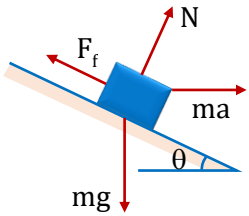
(C) The contact force between block and incline is perpendicular to the incline.

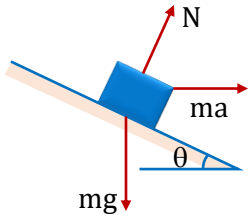
(D) The contact force is of magnitude $mg \cos\theta$.

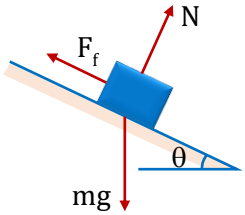


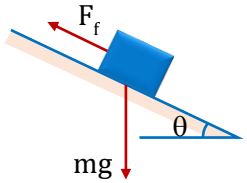
PNL152

42. A block rests on an inclined plane at an angle θ with horizontal and there is friction between the block and the plane. The plane is accelerated to the right. If the block remains at the same position on the plane, which of the following pictures might show the free-body diagram for the block? All observation is drawn for inertial observer (All of the vectors shown are forces).

(A) 

(B) 

(C) 

(D) 

PNL151

43. Base angles of triangular wedge *ABC* are 37° and 90°. A uniform rope is kept over the wedge as shown in two figures. The maximum length of string which can be hanged vertically is x_1 (fig. I) and minimum length is x_2 (fig. II) in equilibrium. If $\frac{x_1}{x_2}=3$, find the value of coefficient of friction between rope and wedge.

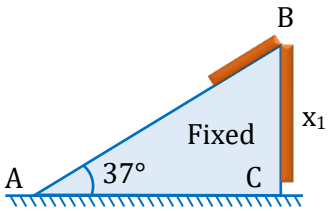


Fig. (i)

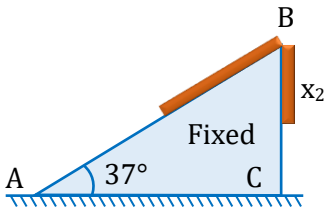
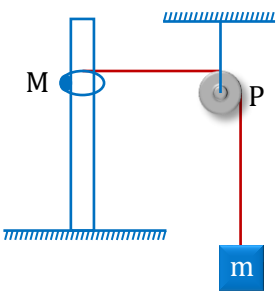


Fig. (ii)

(A) 0.5 (B) 0.4 (C) 0.6 (D) 0.8

PNL154

44. 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

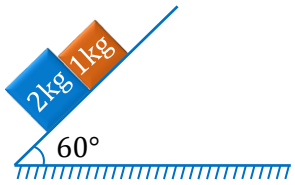
(B) μ*mg* directed up

(C) (*M*–*m*)*g* directed down

(D) μ*mg* directed down

PNL013

45. In the figure shown if friction coefficient of block 1*kg* and 2*kg* with inclined plane is $\mu_1 = 0.5$ and $\mu_2 = 0.4$ respectively, then



(A) both blocks will move together.

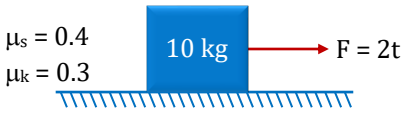
(B) both blocks will move separately.

(C) there is a non-zero contact force between two blocks.

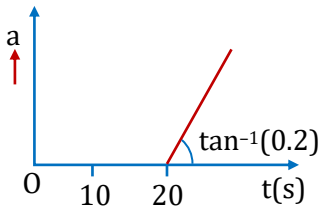
(D) none of these

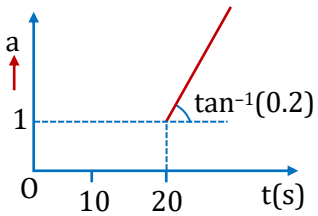
PNL019

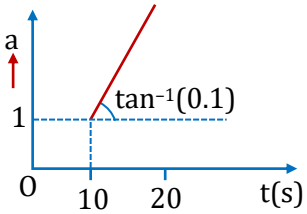
46. For shown situation the acceleration of block is represented by : (Here t is time in second) ($g = 10\ ms^{-2}$)



So, acceleration of block remains same.

(A)


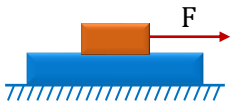
(B)


(C)


(D) None of these

PNL156

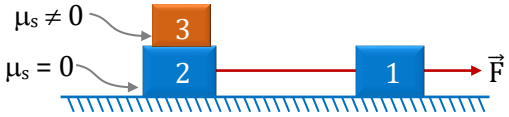
47. In the figure shown, the friction coefficient between the block of mass 1 *kg* and the plank of mass 2 *kg* is 0.4 while that between the plank and floor is 0.1. A constant force '*F*' starts acting horizontally on the upper 1 *kg* block. The acceleration of plank if $F = 10\ N$ is



(A) 2.5 m/s^2 (B) 3.833 m/s^2 (C) 0.5 m/s^2 (D) 1.0 m/s^2

PNL157

48. Three blocks of equal mass *M* are initially at rest on smooth floor. A force is applied to the system so that the three blocks are to move together. Mark the correct option.



(A) The minimum coefficient of friction required is $\frac{F}{3Mg}$.

(B) The minimum coefficient of friction required is $\frac{F}{Mg}$.

(C) The minimum coefficient of friction required is $\frac{F}{2Mg}$.

(D) The minimum coefficient of friction required is $\frac{3F}{2Mg}$.

PNL158

MULTIPLE CORRECT TYPE QUESTIONS

49. Consider a block suspended from a light string as shown in the figure.

Which of the following pairs of forces constitute Newton's third law pair?

(A) Force with which string pulls on the ceiling and the force with which string pulls on block.

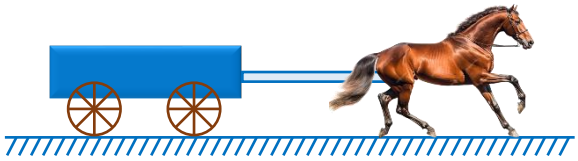
(B) Force with which string pulls on the block and weight of the block.

(C) Force acting on block due to the earth and force the block exerts on the earth.

(D) Force with which block pulls on string and force with which the string pulls on the block.

PNL081

50. A horse is pulling a cart on a rough surface. If we take (horse + cart) as a system, then which of the following statement(s) is/are correct?



(A) Force by horse on cart is an internal force.

(B) Force by ground on horse is an external force.

(C) Force by cart on horse is an internal force.

(D) Force by ground on cart is an external force.

PNL190

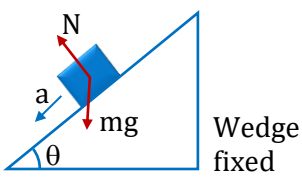
51. For the system shown which of the option(s) are **CORRECT** :

(A) $N \cos\theta = mg$

(B) $N = mg \cos\theta$

(C) $N - mg \cos\theta = ma$

(D) $mg - N \cos\theta = ma \sin\theta$



PNL083

52. A ball is attached from the ceiling with help of three equal taut strings each making equal angle with vertical and equal angle with each other. The ball is under three forces of pull due to the string which are along the length of strings and the force of gravity acting vertically downwards.

(A) resultant of the four forces on the ball can be zero.

(B) resultant of the four forces on the ball can never be zero.

(C) If one string is cut and its force becomes zero, the ball can remain in equilibrium in that position.

(D) If one string is cut and its force becomes zero, the ball can never be in equilibrium in that position.

PNL191

53. A carpenter of mass 50 kg is standing on a weighing machine placed in a lift of mass 20 kg. A light string is attached to the lift. The string passes over a smooth pulley and the other end is held by the carpenter as shown. When carpenter keeps the lift moving upward with constant velocity :-

(g = 10 m/s^2)

(A) the reading of weighing machine is 15 kg

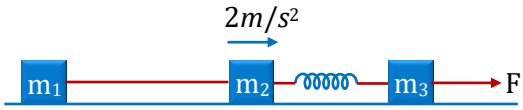
(B) the man applies a force of 350 N on the string

(C) net force on the man is 150 N

(D) Net force on the weighing machine is 150 N

PNL086

54. In the given figure m_1 = 1kg, m_2 = 2kg, m_3 = 3kg, F = 18 N and spring constant is 100 N/m then choose the correct options. (Assume string and spring are ideal)



(A) Acceleration of m_1 is 2 m/s^2

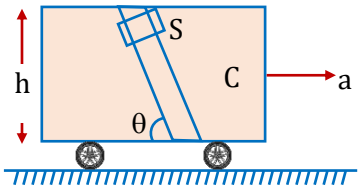
(B) Tension in string is 2N

(C) Force applied by spring on block of mass m_2 is 6N

(D) Acceleration of block of mass m_3 is 4 m/s^2

PNL097

55. A sleeve S of mass m starts sliding down along a smooth inclined rod through a vertical distance h from rest. Cart(C) carrying the rod is moving with constant horizontal acceleration a. If N is the normal force between sleeve and rod, $V_{S/C}$ is the speed of sleeve relative to cart on reaching the lowest point and T is the time taken to reach lowest point then :



(A) $N = m\,(g\cos\theta + a\sin\theta)$

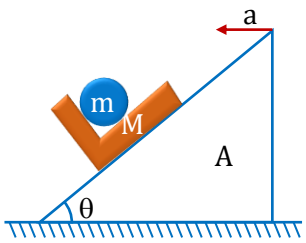
(B) $V_{S/C} = \sqrt{2h(g - a\cot\theta)}$

(C) $V_{S/C} = \sqrt{2h(g - a\tan\theta)}$

(D) $T = \sqrt{\dfrac{2h}{\sin\theta(g\cos\theta - a\sin\theta)}}$

PNL112

56. A ball of mass m is placed on a sledge of mass M. The sledge moves on an inclined plane A of angle of inclination θ. Inclined plane A is moving with constant horizontal acceleration 'a' towards left (Neglect friction everywhere)



(A) Normal reaction force between m and M is $m(g\cos\theta + a\sin\theta)$

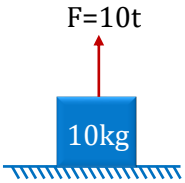
(B) Normal reaction force between A and M is $(M+m)(g\cos\theta + a\sin\theta)$

(C) $a_{M/A} = a_{m/A} = (g\sin\theta - a\cos\theta)$

(D) $a_M = a_m = \sin\theta\sqrt{g^2+a^2}$

PNL120

57. A block of $m = 10\ kg$ is kept on ground. A vertically upward force $F = (10\ t)N$, where t is the time in seconds starts acting on it at $t = 0$ as shown in figure.



(A) Time at which block loose contact from the surface is 10 sec.

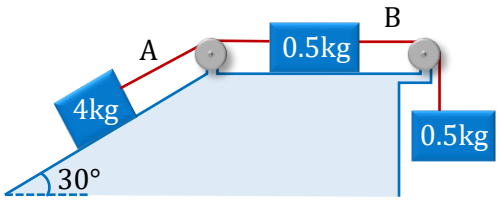
(B) Velocity of block at $t = 20$ sec is 50 m/s.

(C) Velocity of block at $t = 20$ sec is 200 m/s.

(D) Displacement of block in 20 sec is $\frac{500}{3}\ m$.

PNL192

58. System shown in the figure is released from rest.



Which of the following statements is/are true? [$g = 10\ m/s^2$]

(A) Magnitude of acceleration of each block is 3 m/s^2.

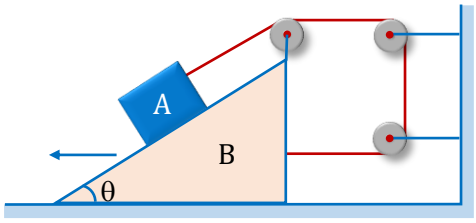
(B) Tension in the cord A is 6.5 N.

(C) Tension in the cord B is 8 N.

(D) Difference of magnitudes of tensions in both the cord is 1.5 N.

PNL193

59. A block A and wedge B connected through a string as shown. The wedge B is moving away from the wall with acceleration 2 m/s^2 horizontally and acceleration of block A is vertically upwards. Then



(A) Acceleration of A with respect to B is 4 m/s^2.

(B) Acceleration of A with respect to B is $2\sqrt{3}\ m/s^2$.

(C) Angle θ is 60°.

(D) Acceleration of A is $2\sqrt{3}\ m/s^2$.

PNL134

60. A block is kept on a rough surface and applied with a horizontal force as shown which is gradually increasing from zero. The coefficient of static and kinetic friction are $\frac{1}{\sqrt{3}}$ then

(A) When F is less than the limiting friction, angle made by net force on the block by the surface is less than 30° with vertical.

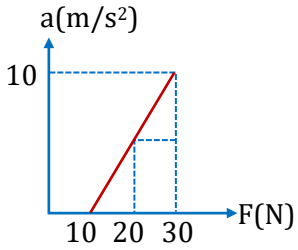
(B) When the block is just about to move, the angle made by net force by the surface on the block becomes equal to 30° with vertical.

(C) When the block starts to accelerate, the angle made by net force by the surface on the block becomes constant and equal to 30° vertical.

(D) The angle made by net force with vertical on the block by the surface, depends on the mass of the block.

PNL062

61. A block placed on a rough horizontal surface is pushed with a force F acting horizontally on the block. The magnitude of F is increased and acceleration produced is plotted in the graph shown.



(A) Mass of the block is 2 kg.

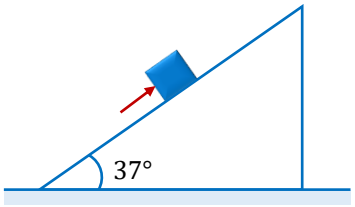
(B) Coefficient of friction between block and surface is 0.5.

(C) Limiting friction between block and surface is 10 N.

(D) When F = 8 N, friction between block and surface is 10 N.

PNL063

62. A block placed on rough inclined plane is pushed with a force F. The coefficient of friction is $\mu = 0.5$ and mass of block is 10 kg.



(A) If F = 30 N, acceleration of block is zero and friction acting on block is 30 N.

(B) If F = 60 N, acceleration of block is zero and friction acting on block is 60 N.

(C) If F = 90 N, acceleration of block is zero and friction acting on block is 30 N.

(D) If F = 120 N, acceleration of block is 2 m/s^2 and friction acting on block is 40 N.

PNL194

COMPREHENSION TYPE QUESTIONS

PARAGRAPH FOR QUESTION NO. 63 TO 66

A uniform rope of mass (m) and length (L) placed on frictionless horizontal ground is being pulled by two forces F_A and F_B at its ends as shown in the figure. As a result, the rope accelerates toward the right.

63. Acceleration (a) of the rope is

(A) zero (B) $a = \frac{F_A+F_B}{m}$ (C) $a = \frac{F_A-F_B}{m}$ (D) $a = \frac{F_B-F_A}{m}$

PNL087

64. Tension (T) at the mid point of the rope is

(A) $T = F_B - F_A$ (B) $T = F_A + F_B$ (C) $T = \frac{1}{2}(F_B - F_A)$ (D) $T = \frac{1}{2}(F_A + F_B)$

PNL088

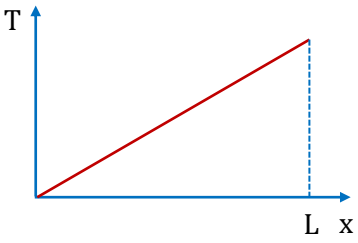
65. Expression (T_x) of tension at a point at distance x from the end A is

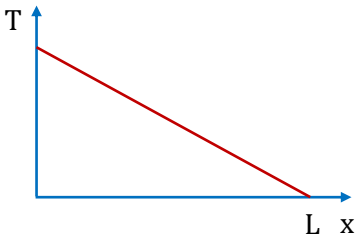
(A) $T_x = \left(\frac{F_B-F_A}{L}\right)x + F_A$ (B) $T_x = \left(\frac{F_B-F_A}{L}\right)x - F_A$

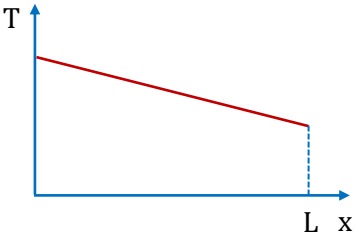
(C) $T_x = \left(\frac{F_B-F_A}{L}\right)x + F_B$ (D) $T_x = \left(\frac{F_B-F_A}{L}\right)x - F_B$

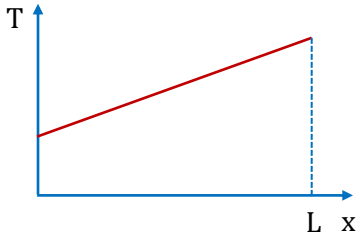
PNL089

66. Which of the following graph best represents variation in tension at a point on the rope with distance x of the point from the end A?

(A)


(B)


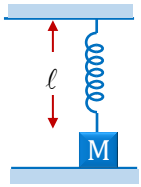
(C)


(D)


PNL090

PARAGRAPH FOR QUESTION NO. 67 TO 69

A block of mass m is placed on a smooth horizontal floor is attached to one end of spring. The other end of the spring is attached to fixed support. When spring is vertical it is relaxed. Now the block is pulled towards right by a force F, which is being increased gradually. When the spring makes angle 53° with the vertical, block leaves the floor.



67. When blocks leaves the table, the normal force on it from table is

(A) mg (B) zero (C) $\frac{4mg}{3}$ (D) $\frac{3mg}{4}$

PNL093

68. Force constant of the spring is :-

(A) $\frac{5mg}{2\ell}$ (B) $\frac{15mg}{8\ell}$ (C) $\frac{5mg}{3\ell}$ (D) $\frac{5mg}{4\ell}$

PNL094

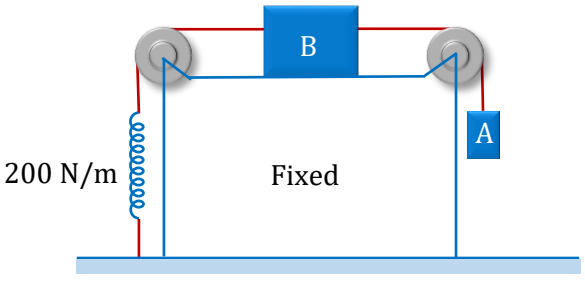
69. When the block leaves the table, the force F is :-

(A) $\frac{3mg}{4}$ (B) $\frac{4mg}{3}$ (C) $\frac{3mg}{5}$ (D) $\frac{4mg}{5}$

PNL095

PARAGRAPH FOR QUESTION NO. 70 TO 72

In the figure shown blocks A and B are of mass 2 kg and 8 kg and they are connected through strings to a spring connected to ground. The blocks are in equilibrium. ($g = 10 m/s^2$)



70. The elongation of the spring is

(A) 1 cm (B) 10 cm (C) 0.1 cm (D) 1m

PNL107

71. Now the block A is pulled downwards by a force gradually increasing to 20 N. The new elongation of spring is :-

(A) 2 cm (B) 4 cm (C) 20 cm (D) 40 cm

PNL108

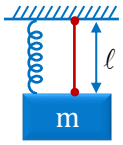
72. Now the force on A is suddenly removed. The acceleration of block B becomes :-

(A) 1.0 m/s (B) 2.0 m/s^2 (C) 3.0 m/s^2 (D) 4.0 m/s^2

PNL109

PARAGRAPH FOR QUESTION NO. 73 TO 75

An object of mass m is suspended in equilibrium using a string of length ℓ and a spring having spring constant K ($< 2\ mg/\ell$) and unstreched length $\ell/2$.



73. Find the tension in the string in newton ?

(A) $mg - \frac{k\ell}{2}$ (B) $mg - k\ell$ (C) $2mg - \frac{k\ell}{2}$ (D) $2mg - k\ell$

PNL100

74. Find the acceleration of block just after cut the string ?

(A) $2g - \frac{k\ell}{2m}$ (B) $g - \frac{k\ell}{2m}$ (C) $2g - \frac{k\ell}{m}$ (D) $g - \frac{k\ell}{m}$

PNL101

75. What happens if $K > 2\ mg/\ell$?

(A) at equilibrium tension in string is negative

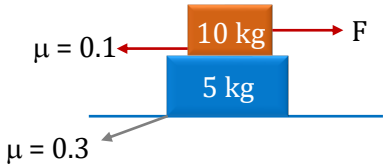
(B) at equilibrium position change in length of spring is greater then $\frac{\ell}{2}$

(C) at equilibrium tension in string is zero.

(D) if we cut the sting, block will accelerate in upward direction.

PNL102

PARAGRAPH FOR QUESTION NO. 76 TO 81



76. When $F = 2N$, the frictional force between 5 kg block and ground is

(A) 2 N (B) 0 (C) 8 N (D) 10 N

PNL160

77. When $F = 2N$, the frictional force between 10 kg block and 5 kg block is

(A) $2N$ (B) $15N$ (C) 10 N (D) None

PNL161

78. The maximum F which will not cause motion of any of the blocks is

(A) 10 N (B) 15 N

(C) data insufficient (D) None

PNL162

79. The maximum acceleration of 5 kg block is :-

(A) 1 m/s^2 (B) 3 m/s^2

(C) 0 (D) None

PNL163

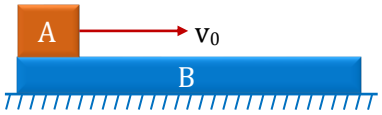
80. The acceleration of 10 kg block when $F = 30$ N is

(A) 2 m/s^2 (B) 3 m/s^2

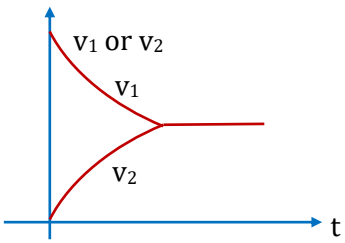
(C) 1 m/s^2 (D) None

PNL164

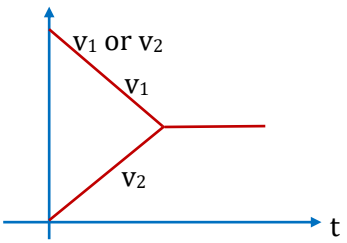
81. A block A is placed over a long rough plank B of same mass as shown in figure. The plank is placed over a smooth horizontal surface. At time $t = 0$, block A is given a velocity v_0 in horizontal direction. Let v_1 and v_2 be the velocities of A and B at time t. Then choose the correct graph between v_1 or v_2 and t.



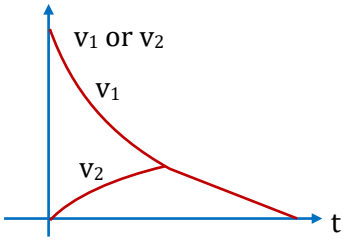
(A)



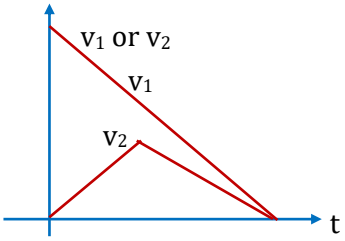
(B)



(C)



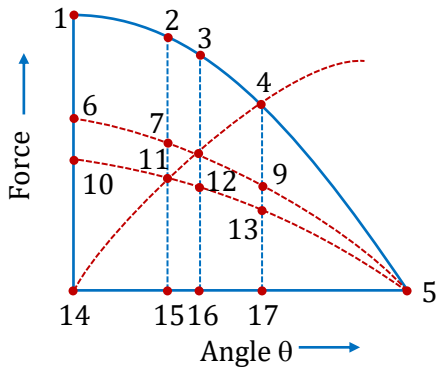
(D)



PNL020

PARAGRAPH FOR QUESTION NO. 82 AND 83

Given graph is a plot of magnitude of normal, limiting friction, kinetic friction and static friction versus angle of inclination θ for the coin lying on book. 17 points are labeled with numbers. The coin slips at a certain angle θ_c. The coefficient of static friction is 0.6, and the coefficient of kinetic friction is 0.4.



82. The magnitude of the normal force on the coin from the book,

(A) 6 (B) 2 (C) 7 (D) 11

PNL170

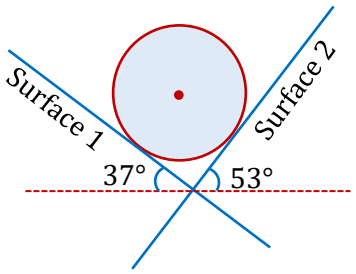
83. θ_C is given by point

(A) 14 (B) 15 (C) 16 (D) 17

PNL171

MATRIX MATCH TYPE QUESTION

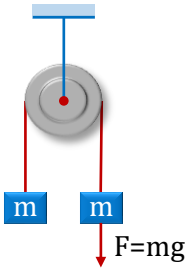
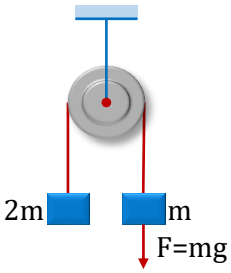
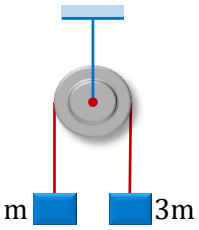
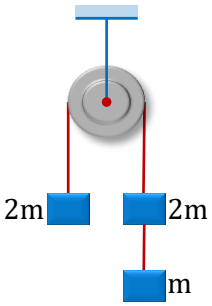
84. A sphere of mass 10 *kg* is placed in equilibrium in a *V* shaped groove plane made of two smooth surfaces 1 and 2 as shown in figure. (g = 10 ms^{-2})



	Column I		Column II
(A)	Normal reaction by Surface 1	(P)	Zero
(B)	Normal reaction by surface 2	(Q)	60 *N*
(C)	Force on sphere by Earth	(R)	80 *N*
(D)	Net force on sphere	(S)	100 *N*
		(T)	120 *N*

PNL079

85. Match the situations in column I to the accelerations of blocks in the column II (acceleration due to gravity is g and F is an additional force applied to one of the blocks ?

Column I		**Column II**	
(A)		(P)	$\frac{g}{5}$
(B)		(Q)	$\frac{g}{3}$
(C)		(R)	$\frac{g}{2}$
(D)		(S)	$\frac{2g}{3}$
		(T)	zero

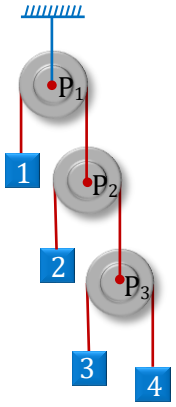
PNL195

86. Velocity of three particles A, B and C varies with time t as, $\vec{v}_A = (2t\hat{\imath} + 6\hat{\jmath})\ m/s$; $\vec{v}_B = (3\hat{\imath} + 4\hat{\jmath})\ m/s$ and $\vec{v}_C = (6\hat{\imath} - 4t\hat{\jmath})\ m/s$. Regarding the pseudo force match the following table

	Column I		**Column II**
(A)	On A as observed by B	(P)	Along positive x-direction
(B)	On B as observed by C	(Q)	Along negative x-direction
(C)	On A as observed by C	(R)	Along positive y-direction
(D)	On C as observed by A	(S)	Along negative y-direction
		(T)	Zero

PNL119

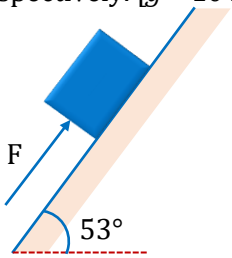
87. In the figure shown, acceleration of 1 is x (upwards). Acceleration of pulley P_3, w.r.t. pulley P_2 is y (downwards) and acceleration of 4 w.r.t. to pulley P_3 is z (upwards). Then



	Column I		Column II
(A)	Absolute acceleration of 2	(P)	$(y - x)$ downwards
(B)	Absolute acceleration of 3	(Q)	$(z - x - y)$ upwards
(C)	Absolute acceleration of 4	(R)	$(x + y + z)$ downwards
		(S)	None

PNL123

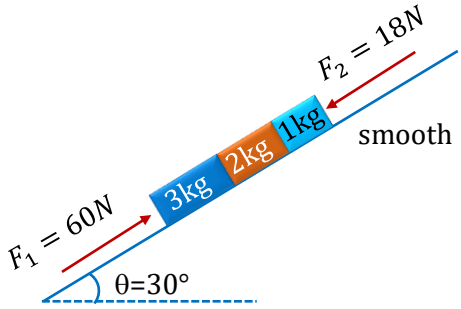
88. A 50 kg box is held at rest on a slope of inclination 53° above the horizontal. It is released and immediately pushed by a force F up the slope. Coefficients of static and kinetic friction between the slope and the box are 0.5 and 0.4 respectively. [$g = 10\ m/s^2$]



	Column-I (Magnitude of force F)		Column-II (Friction force)
(A)	50 N	(P)	Zero newton
(B)	150 N	(Q)	150 N up the slope
(C)	250 N	(R)	50 N up the slope
(D)	350 N	(S)	120 N up the slope
		(T)	400 N up the slope

PNL153

89. In the diagram shown in figure ($g = 10\ m/s^2$)



	Column I		Column II
(A)	Acceleration of 2 kg block in m/s^2	(P)	8
(B)	Net force on 3 kg block in newton	(Q)	25
(C)	Normal reaction between 2 kg and 1 kg in newton	(R)	2
(D)	Normal reaction between 3 kg and 2 kg in newton	(S)	45
		(T)	None

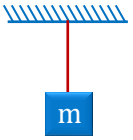
PNL196

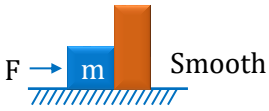
EXERCISE - S

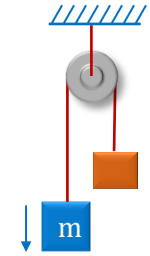
Newtons Laws of Motion

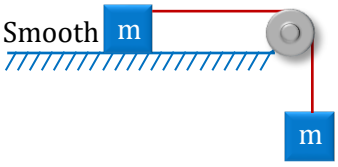
1. Draw free body diagram of block of mass *m*.

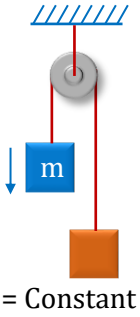
(a) 

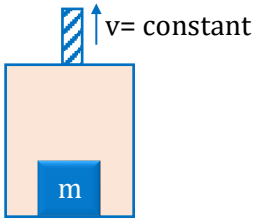
(b) 

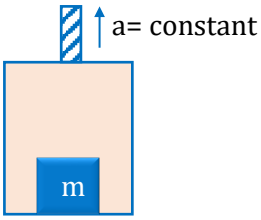
(c) 

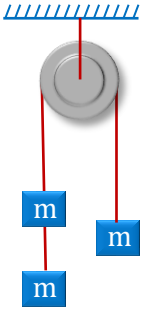
(d) 

(e) 

(f) 

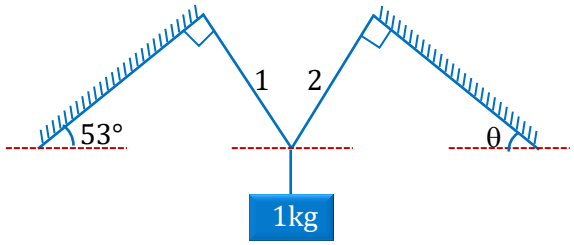
(g) 

(h) 

(i) 

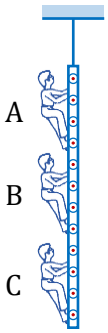
PNL072

2. In the given figure, what is the minimum possible tension (N) in the string 2 ?



PNL082

3. A ladder is hanging from ceiling as shown in figure. Three men A, B and C of masses 40 kg, 60 kg, and 50 kg are climbing the ladder. Man A is going up with retardation 2 m/s^2, C is going up with an acceleration of 1 m/s^2 and man B is going up with a constant speed of 0.5 m/s. Find the tension in the string supporting the ladder. [g = 9.8 m/s^2]

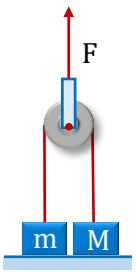


PNL197

4. A 40 kg monkey climbs a rope that passes over an ideal pulley. The other end of the rope is attached to a 60 kg weight placed on the ground. What is the maximum upward acceleration the monkey can have without lifting the weight? If he climbs the rope with upward acceleration $2g$, with what acceleration the weight will rise up?

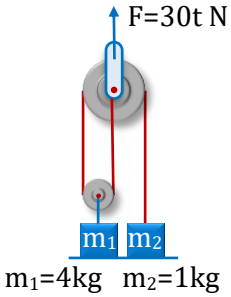
PNL085

5. In the system shown, pulley and strings are ideal. The vertically upward pull F is being increased gradually, find magnitude of F and acceleration of the 5 kg block at the moment the 10 kg block leaves the floor.



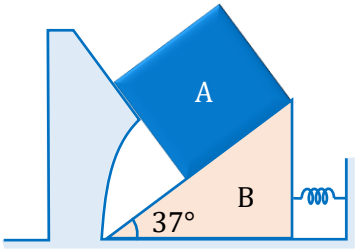
PNL125

6. Force F is applied on upper pulley. If $F = 30t$ N where t is time in second. Find the time when m_1 loses contact with floor.



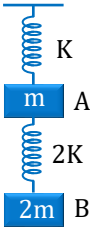
PNL198

7. In the figure shown, all surfaces are smooth and block A and wedge B have mass 10 kg and 20 kg respectively. Find normal reaction between block A and B, spring force and normal reaction of ground on block B. ($g = 10\ m/s^2$).



PNL092

8. Find the initial acceleration of blocks A and B if the



(a) Upper spring is cut

(b) Lower spring is cut

PNL099

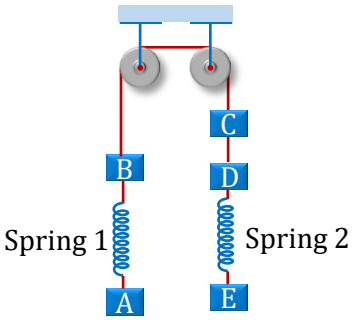
9. The system shown in the figure is initially in equilibrium. A is of mass $2m$ and B, C, D and E are of mass m. Certain actions are performed on the system. Every action has been taken individually when the system is intact. Find the direction and magnitude of acceleration of the blocks after each of the following actions has been taken:

(i) Spring 1 is cut

(ii) Spring 2 is cut

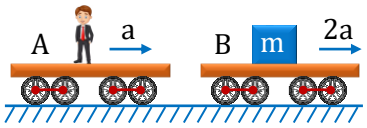
(iii) String between C and D is cut.

(iv) String between B and C is cut.



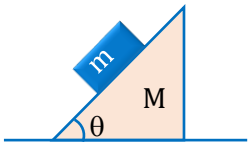
PNL106

10. Two trolley *A* and *B* are moving with accelerations *a* and 2*a* respectively in the same direction. To an observer in trolley A, the magnitude of pseudo force acting on a block of mass *m* on the trolley *B* is



PNL118

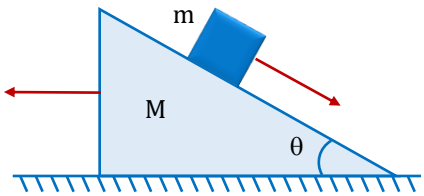
11. A block of mass *m* lies on wedge of mass *M* as shown in figure.



With what minimum acceleration must the wedge be moved towards right horizontally so that block *m* falls freely.

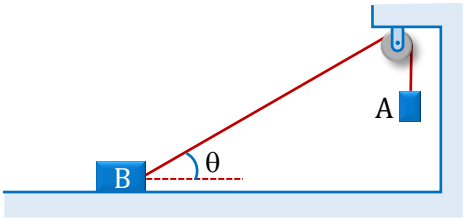
PNL117

12. All the surfaces shown in figure are assumed to be frictionless. The block of mass m slides on the prism which in turn slides backward on the horizontal surface. Find the acceleration of the smaller block with respect to the prism.



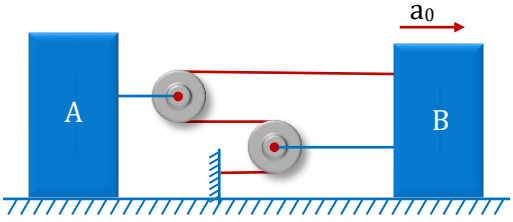
PNL199

13. The block *A* is moving downward with constant velocity v_0. Find the velocity of the block *B*, when the string makes an angle θ with the horizontal



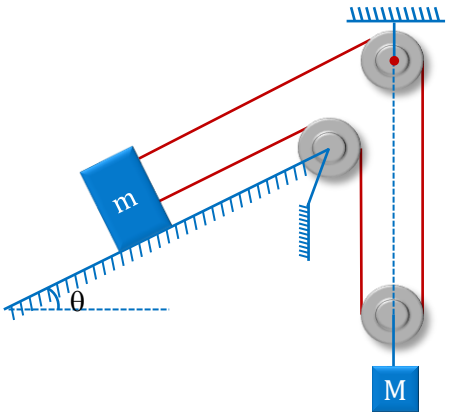
PNL121

14. Calculate the relative acceleration of *A* w.r.t. *B* if *B* is moving with acceleration a_0 towards right.



PNL122

15. In the figure shown all strings and pulleys are massless. If all surfaces are smooth and mass of the blocks are $M = 15\ kg$ and $m = 10\ kg$ then find the acceleration of mass m (in m/s^2)
(Given angle of incline $\theta = 30°$)

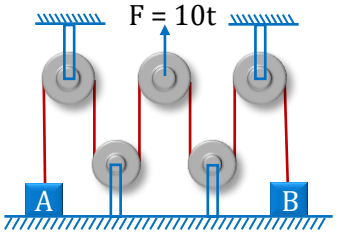


PNL124

16. A box of mass m is placed on a smooth horizontal platform as shown in the figure. The platform is made to move in direction 30° above the horizontal with acceleration a so that the contact force between the box and the platform becomes $3mg/2$. Find the magnitude of the acceleration (m/s^2).

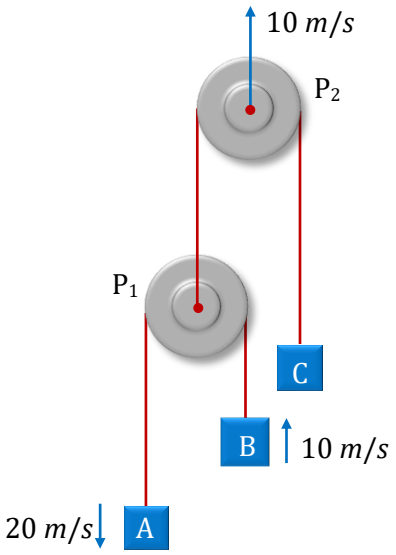
PNL069

17. In the arrangement shown $m_A = 1kg$ and $m_B = 2kg$ while all the pulleys and strings are massless and frictionless. At $t = 0$, a force $F = 10t$ starts acting over central pulley in vertical direction. Where B losses contact with floor the velocity of A is $(5n)\ m/s$. Find out the value of 'n'.



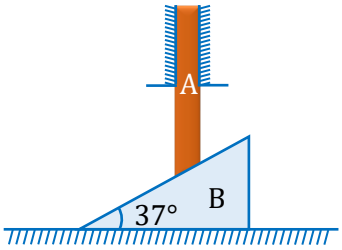
PNL129

18. Velocities of blocks A, B and pulley p_2 are shown in figure. Find velocity of pulley p_1 and block C.



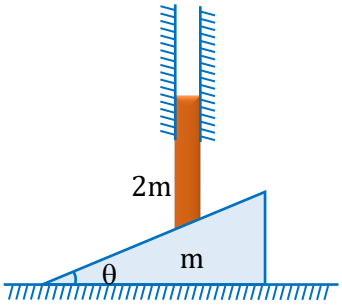
PNL130

19. Find the acceleration of rod *A* and wedge *B* in the arrangement shown in figure if the mass of rod is equal to that of the wedge and the friction between all contact surfaces is negligible and rod *A* is free to move downwards only. Take angle of wedge as 37°.



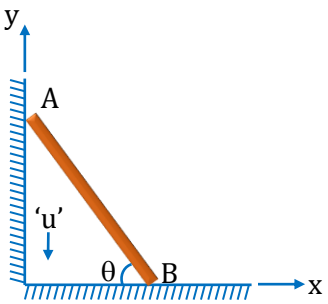
PNL133

20. A rod of mass 2*m* moves vertically downward on the surface of wedge of mass as shown in figure. Find the relation between velocity of rod and that of the wedge at any instant.



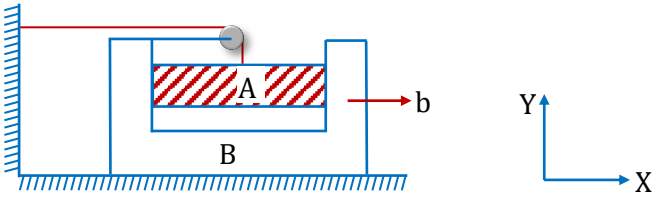
PNL132

21. The velocity of end '*A*' of rigid rod placed between two smooth vertical walls is '*u*' along vertical direction. Find out the velocity of end '*B*' of that rod, rod always remains in contact with the vertical wall.



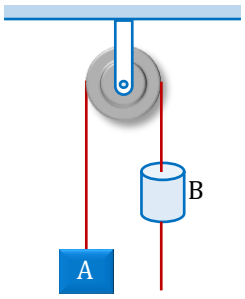
PNL136

22. Find the acceleration of *A* in term of *b.*



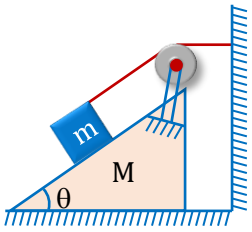
PNL137

23. A 2 *kg* block *A* is attached to one end of a light string that passes over an ideal pulley and a 1 *kg* sleeve *B* slides down the other part of the string with an acceleration of 5 m/s^2 with respect to the string. Find the acceleration of the block, acceleration of sleeve and tension in the string.
[$g = 10\ m/s^2$]



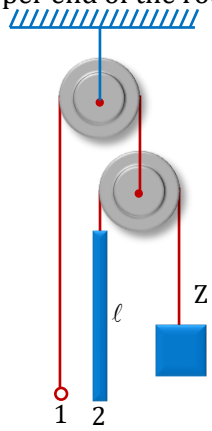
PNL200

24. For the arrangement shown in figure when the system is released, find the acceleration of wedge. Pulley and string are ideal and friction is absent.



PNL135

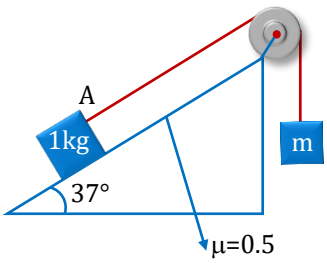
25. In the arrangement shown in figure the mass of ball is $\eta = 1.8$ times as great as that of rod 2. The length of the latter is $l = 100\ cm$. The masses of the pulleys and the threads, as well as the friction, are negligible. The ball is set on the same level as the lower end of the rod and then released. How soon will the ball be opposite the upper end of the rod?



PNL201

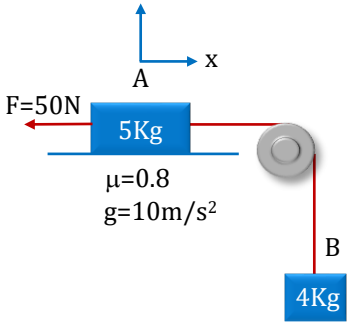
Friction

26. In the figure, what should be mass m so that block *A* slides up with a constant velocity?



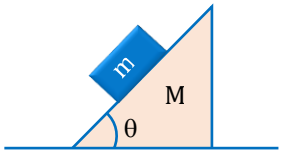
PNL202

27. Find the acceleration of the blocks and magnitude & direction of frictional force between block *A* and table, if block *A* is pulled towards left with a force of 50 *N*.



PNL203

28. A block of mass *m* lies on wedge of mass *M* as shown in figure. Find the minimum friction coefficient required between wedge *M* and ground so that it does not move while block *m* slips down on it.

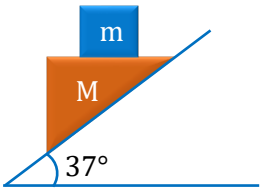


PNL172

29. You pour a quantity of flour of volume $V = 72\ cm^3$ onto a board, where it forms a conical pile. The coefficient of static friction between flour grains is $\mu_s = \sqrt{\pi}$. Find the maximum height (in *cm*) of the pile.

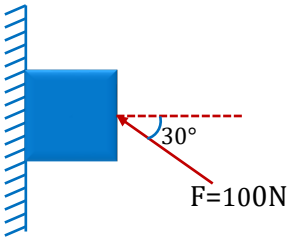
PNL169

30. Block *M* slides down on frictionless incline as shown. The minimum friction coefficient so that *m* does not slide with respect to *M* is $\frac{n}{4}$, find the value of *n*.



PNL030

31. A force of 100 *N* is applied on a block of mass 3 *kg* as shown in figure. The coefficient of friction between the wall and the surface of the block is 1/4. Calculate frictional force acting on the block.

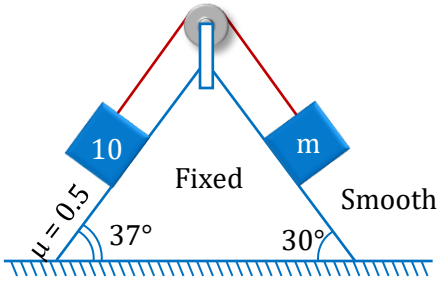


PNL204

32. A block is moving on an inclined plane making an angle 45° with the horizontal and the coefficient of friction is μ. The force required to just push it up the inclined plane is 3 times the force required to just prevent it from sliding down. If we define $N = 10\mu$, then *N* is

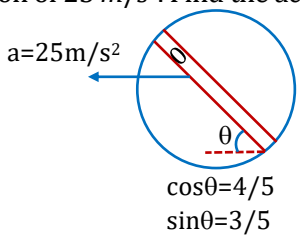
PNL205

33. Find minimum value of m so that 10 kg block moves up the inclined plane.



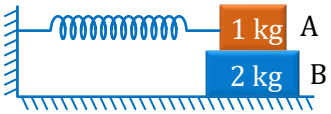
PNL155

34. A circular disc with a groove along its diameter is placed horizontally. A block of m ass 1 kg is placed as shown. The co-efficient of friction between the block and all surface of groove in contact is $\mu = 2/5$. The disc has an acceleration of 25 m/s^2. Find the acceleration of the block with respect to disc.



PNL206

35. In the arrangement shown coefficient of friction between the two blocks A and B is 0.6 and ground is frictionless. Force constant of spring is 900 N/m. Find the maximum elongation of spring (in cm) such that the blocks do not slip over each other when released.



PNL168

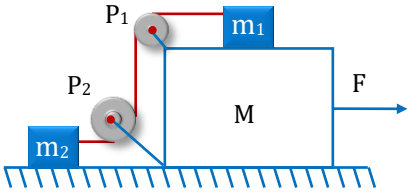
36. Coefficient of friction between 5 kg and 10 kg block is 0.5. If friction between them is 20 N. What is the value of force being applied on 5 kg. The floor is frictionless.

PNL165

37. In the figure masses m_1, m_2 and M are 20 kg, 5 kg and 50 kg respectively. The co-efficient of friction between M and ground is zero. The co-efficient of friction between m_1 and M and that between m_2 and ground is 0.3. The pulleys and the string are massless. The string is perfectly horizontal between P_1 and m_1 and also between P_2 and m_2. The string is perfectly vertical between P_1 and P_2. An external horizontal force F is applied to the mass M. Take $g = 10$ m/s^2.

(i) Draw a free-body diagram for mass M, clearly showing all the forces.

(ii) Let the magnitude of the force of friction between m_1 and M be f_1 and that between m_2 and ground be f_2. For a particular F it is found that $f_1 = 2f_2$. Find f_1 and f_2. Write down equations of motion of all the masses. Find F, tension in the string and accelerations of the masses.



PNL207

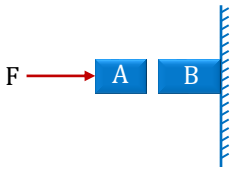
EXERCISE - JEE (Main) PYQ

1. A block of mass m is placed on a surface with a vertical cross section given by $y = \frac{x^3}{6}$. If the coefficient of friction is 0.5, the maximum height above the ground at which the block can be placed without slipping is :- **[JEE (Main) 2014]**

(1) $\frac{1}{3}m$ (2) $\frac{1}{2}m$ (3) $\frac{1}{6}m$ (4) $\frac{2}{3}m$

PNL031

2. Given in the figure are two blocks A and B of weight $20N$ and $100N$, respectively. These are being pressed against a wall by a force F as shown. If the coefficient of friction between the blocks is 0.1 and between block B and the wall is 0.15, the frictional force applied by the wall on block B is :- **[JEE (Main) 2015]**



(1) 120 N (2) 150 N (3) 100 N (4) 80 N

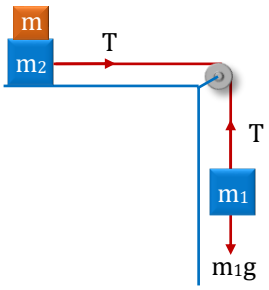
PNL032

3. A rocket is fired vertically from the earth with an acceleration of $2g$, where g is the gravitational acceleration. On an inclined plane inside the rocket, making an angle θ with the horizontal, a point object of mass m is kept. The minimum coefficient of friction μ_{min} between the mass and the inclined surface such that the mass does not move is: **[JEE (Main) 2016]**

(1) 2 tan θ (2) 3 tan θ (3) tan θ (4) tan 2θ

PNL033

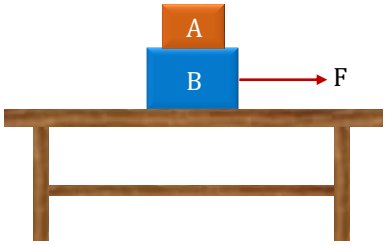
4. Two masses $m_1 = 5\ kg$ and $m_2 = 10\ kg$, connected by an inextensible string over a frictionless pulley, are moving as shown in the figure. The coefficient of friction of horizontal surface is 0.15. The minimum weight m that should be put on top of m_2 to stop the motion is :- **[JEE (Main) 2018]**



(1) 27.3 kg (2) 43.3 kg (3) 10.3 kg (4) 18.3 kg

PNL034

5. Two blocks A and B of masses $m_A = 1\ kg$ and $m_B = 3$ kg are kept on the table as shown in figure. The coefficient of friction between A and B is 0.2 and between B and the surface of the table is also 0.2. The maximum force F that can be applied on B horizontally, so that the block A does not slide over the block B is : (Take $g = 10\ m/s^2$) **[JEE (Main) 2019]**



(1) $16N$ (2) $40N$ (3) $12N$ (4) $8N$

PNL035

6. A ball is thrown upward with an initial velocity V_0 from the surface of the earth. The motion of the ball is affected by a drag force equal to $m\gamma\upsilon^2$ (where m is mass of the ball, υ is its instantaneous velocity and γ is a constant). Time taken by the ball to rise to its zenith is **[JEE (Main) 2019]**

(1) $\frac{1}{\sqrt{\gamma g}}\sin^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$ (2) $\frac{1}{\sqrt{\gamma g}}\tan^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$

(3) $\frac{1}{\sqrt{2\gamma g}}\tan^{-1}\left(\sqrt{\frac{2\gamma}{g}}V_0\right)$ (4) $\frac{1}{\sqrt{\gamma g}}\ln\left(1+\sqrt{\frac{\gamma}{g}}V_0\right)$

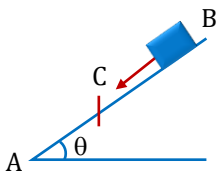
PNL036

7. A spring whose unstretched length is l has a force constant k. The spring is cut into two pieces of unstretched lengths l_1 and l_2 where, $l_1 = nl_2$ and n is an integer. The ratio k_1/k_2 of the corresponding force constants, k_1 and k_2 will be : **[JEE (Main) 2019]**

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

PNL037

8. A small block starts slipping down from a point B on an inclined plane AB, which is making an angle θ with the horizontal section BC is smooth and the remaining section CA is rough with a coefficient of friction μ. It is found that the block comes to rest as it reaches the bottom (point A) of the inclined plane. If $BC = 2AC$, the coefficient of friction is given by $\mu = k\tan\theta$). The value of k is _____. **[JEE (Main) 2020]**



PNL038

9. An insect is at the bottom of a hemispherical ditch of radius $1m$. It crawls up the ditch but starts slipping after it is at height h from the bottom. If the coefficient of friction between the ground and the insect is 0.75, then h is : ($g = 10\ ms^{-2}$) **[JEE (Main) 2020]**

(1) 0.80 m (2) 0.60 m (3) 0.45 m (4) 0.20 m

PNL039

10. A mass of 10 kg is suspended by a rope of length 4 m, from the ceiling. A force F is applied horizontally at the mid-point of the rope such that the top half of the rope makes an angle of 45° with the vertical. Then F equals: (Take $g = 10\ ms^{-2}$ and the rope to be massless) **[JEE (Main) 2020]**

(1) 100 N (2) 90 N (3) 75 N (4) 70 N

PNL040

11. A particle of mass M originally at rest is subjected to a force whose direction is constant but magnitude varies with time according to the relation

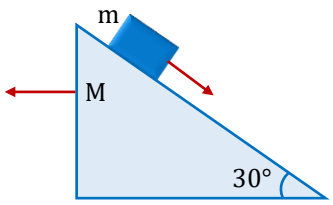
$$F = F_0\left[1-\left(\frac{t-T}{T}\right)^2\right]$$

Where F_0 and T are constants. The force acts only for the time interval $2T$. The velocity v of the particle after time $2T$ is : **[JEE (Main) 2021]**

(1) $2F_0T/M$ (2) $F_0T/2M$ (3) $4F_0T/3M$ (4) $F_0T/3M$

PNL041

12. A block of mass m slides on the wooden wedge, which in turn slides backward on the horizontal surface. The acceleration of the block with respect to the wedge is : Given $m = 8\ kg$, $M = 16\ kg$ Assume all the surfaces shown in the figure to be frictionless. **[JEE (Main) 2021]**



(1) $\frac{4}{3}g$ (2) $\frac{6}{5}g$ (3) $\frac{3}{5}g$ (4) $\frac{2}{3}g$

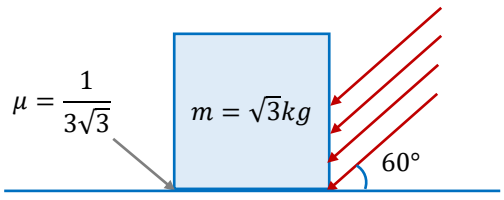
PNL042

13. The coefficient of static friction between a wooden block of mass 0.5 kg and a vertical rough wall is 0.2. The magnitude of horizontal force that should be applied on the block to keep it adhere to the wall will be _____N. [$g = 10\ ms^{-2}$] **[JEE (Main) 2021]**

PNL043

14. As shown in the figure, a block of mass $\sqrt{3}\ kg$ is kept on a horizontal rough surface of coefficient of friction $\frac{1}{3\sqrt{3}}$. The critical force to be applied on the vertical surface as shown at an angle 60° with horizontal such that it does not move, will be $3x$. The value of x will be

[$g = 10\ m/s^2$; $\sin 60° = \frac{\sqrt{3}}{2}$; $\cos 60° = \frac{1}{2}$] **[JEE (Main) 2021]**



PNL044

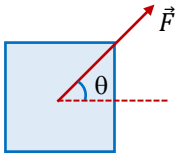
15. A block of mass m slides along a floor while a force of magnitude F is applied to it at an angle θ as shown in figure. The coefficient of kinetic friction is μ_K. Then, the block's acceleration 'a' is given by: (g is acceleration due to gravity) **[JEE (Main) 2021]**

(1) $-\frac{F}{m}\cos\theta-\mu_K\left(g-\frac{F}{m}\sin\theta\right)$

(2) $\frac{F}{m}\cos\theta-\mu_K\left(g-\frac{F}{m}\sin\theta\right)$

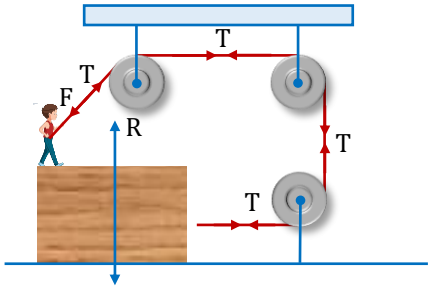
(3) $\frac{F}{m}\cos\theta-\mu_K\left(g+\frac{F}{m}\sin\theta\right)$

(4) $\frac{F}{m}\cos\theta+\mu_K\left(g-\frac{F}{m}\sin\theta\right)$



PNL045

16. A boy of mass 4 kg is standing on a piece of wood having mass 5 kg. If the coefficient of friction between the wood and the floor is 0.5, the maximum force that the boy can exert on the rope so that the piece of wood does not move from its place is _____N. (Round off to the Nearest Integer) [Take $g = 10ms^{-2}$] **[JEE (Main) 2021]**

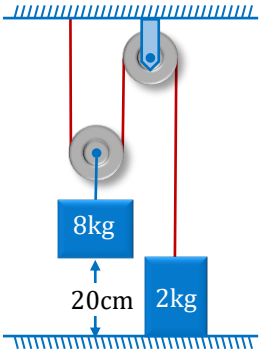


PNL046

17. When a body slides down from rest along a smooth inclined plane making an angle of 30° with the horizontal, it takes time T. When the same body slides down from the rest along a rough inclined plane making the same angle and through the same distance, it takes time αT, where is α constant greater than 1. The co-efficient of friction between the body and the rough plane is $\frac{1}{\sqrt{x}}\left(\frac{\alpha^2-1}{\alpha^2}\right)$ where x = ... **[JEE (Main) 2021]**

PNL047

18. The boxes of masses 2 kg and 8 kg are connected by a massless string passing over smooth pulleys. Calculate the time taken by box of mass 8 kg to strike the ground starting from rest. (Use $g = 10\ m/s^2$) **[JEE (Main) 2021]**

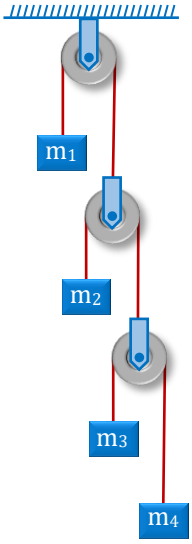


(1) 0.34 s (2) 0.2 s (3) 0.25 s (4) 0.4 s

PNL048

19. In the arrangement shown in figure a_1, a_2, a_3 and a_4 are the accelerations of masses m_1, m_2, m_3 and m_4 respectively. Which of the following relation is true for this arrangement?

[JEE (Main) 2022]

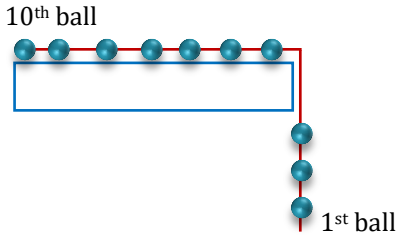


(1) $4a_1 + 2a_2 + a_3 + a_4 = 0$ (2) $a_1 + 4a_2 + 3a_3 + a_4 = 0$

(3) $a_1 + 4a_2 + 3a_3 + 2a_4 = 0$ (4) $2a_1 + 2a_2 + 3a_3 + a_4 = 0$

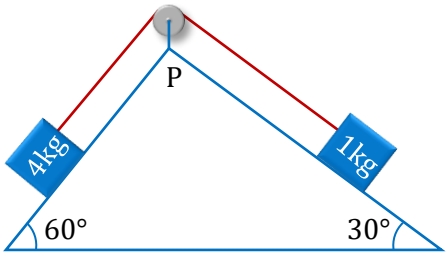
PNL049

20. A system to 10 balls each of mass 2 *kg* are connected via massless and unstretchable string. The system is allowed to slip over the edge of a smooth table as shown in figure. Tension on the string between the 7th and 8th ball is_____*N* when 6th ball just leaves the table. **[JEE (Main) 2022]**



PNL050

21. As per given figure, a weightless pulley *P* is attached on a double inclined frictionless surface. The tension in the string (massless) will be (if $g = 10\ m/s^2$) **[JEE (Main) 2023]**

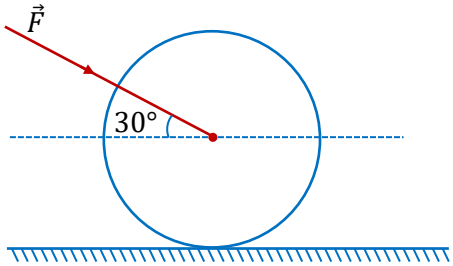


(1) $(4\sqrt{3}+1)N$ (2) $4(\sqrt{3}+1)N$ (3) $4(\sqrt{3}-1)N$ (4) $(4\sqrt{3}-1)N$

PNL208

22. As shown in figure, a 70 kg garden roller is pushed with a force of $\vec{F} = 200N$ at an angle of 30° with horizontal. The normal reaction on the roller is (Given g = 10 ms^{-2})

[JEE (Main) 2023]

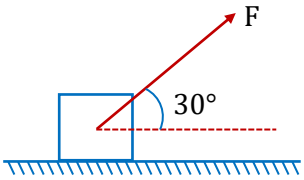


(1) $800\sqrt{2}N$ (2) $600N$ (3) $800N$ (4) $200\sqrt{3}N$

PNL209

23. As shown in the figure a block of mass 10 kg lying on a horizontal surface is pulled by a force F acting at an angle 30°, with horizontal. For μ_s = 0.25, the block will just start to move for the value of F: [Given g = 10 ms^{-2}]

[JEE (Main) 2023]

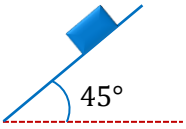


(1) 33.3 N (2) 25.2 N (3) 20 N (4) 35.7 N

PNL210

24. Consider a block kept on an inclined plane (inclined at 45°) as shown in the figure. If the force required to just push it up the incline is 2 times the force required to just prevent it from sliding down, the coefficient of friction between the block and inclined plane (μ) is equal to :

[JEE (Main) 2023]



(1) 0.33 (2) 0.60 (3) 0.25 (4) 0.50

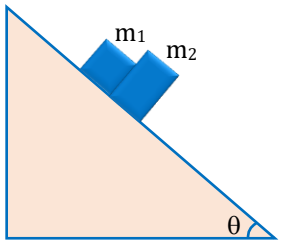
PNL211

EXERCISE - JEE (Advanced) PYQ

1. A block of mass $m_1 = 1kg$ another mass $m_2 = 2kg$, are placed together (see figure) on an inclined plane with angle of inclination θ. Various values of θ are given in List-I. The coefficient of friction between the block m_1 and the plane is always zero. The coefficient of static and dynamic friction between the block m_2 and the plane are equal to μ = 0.3. In List-II expressions for the friction on block m_2 are given. Match the correct expression of the friction in List-II with the angles given in List-I and choose the correct option. The acceleration due to gravity is denoted by g.

[**Useful information :** tan (5.5°) ≈ 0.1 ; tan(11.5°) ≈ 0.2 ; tan (16.5°) ≈ 0.3]

[JEE (Advanced) 2014]



	List–I		**List–II**
(P)	θ = 5°	(1)	$m_2 g \sin\theta$
(Q)	θ = 10°	(2)	$(m_1 + m_2) g \sin\theta$
(R)	θ = 15°	(3)	$\mu m_2 g \cos\theta$
(S)	θ = 20°	(4)	$\mu(m_1 + m_2) g \cos\theta$

Code:

(A) P-1, Q-1, R-1, S-3
(B) P-2. Q-2, R-2, S-3
(C) P-2, Q-2, R-2, S-4
(D) P-2, Q-2, R-3, S-3

PNL071

2. A particle of mass m is moving in the xy-plane such that its velocity at a point (x, y) is given as $\vec{v} = \alpha(y\hat{x} + 2x\hat{y})$, where α is a non-zero constant. What is the force $\vec{F}$ acting on the particle ?

[JEE (Advanced) 2023]

(A) $\vec{F} = 2m\alpha^2(x\hat{x} + y\hat{y})$
(B) $\vec{F} = m\alpha^2(y\hat{x} + 2x\hat{y})$
(C) $\vec{F} = 2m\alpha^2(y\hat{x} + x\hat{y})$
(D) $\vec{F} = m\alpha^2(x\hat{x} + 2y\hat{y})$

PNL212

JEE (Main) Practice Paper

This paper is for yourself practice and assessment the discussion of this paper is optional though you can see PDF solutions or video solutions or solutions in hardcopy whichever is provided.

SECTION–A

- This section contains **TWENTY** questions.
- Each question has **FOUR** options (1), (2), (3) and (4). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:

Full Marks : +4, if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0, if none of the bubbles is darkened.
Negative Marks : –1 in all other cases.

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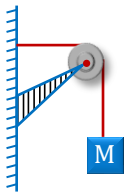
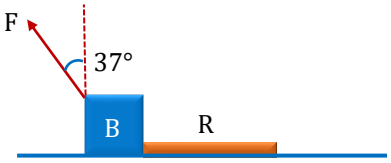
1. A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given



(1) $\sqrt{2}\,Mg$ (2) $\sqrt{2}mg$ (3) $\sqrt{(M+m)^2+m^2}g$ (4) $\sqrt{(M+m)^2+M^2}g$

PNL001

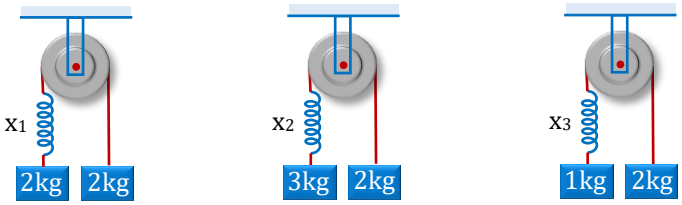
2. A block B is tied to one end of a uniform rope R as shown. The mass of block is 2 kg and that of rope is 1 kg. A force F = 15 N is applied at angle 37° with vertical. The tension at the mid-point of rope is



(1) 1.5 N (2) 2 N (3) 3 N (4) 4.5 N

PNL002

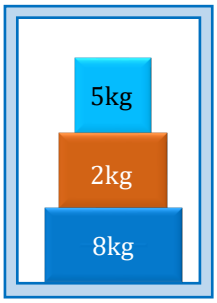
3. Same spring is attached with 2 kg, 3 kg and 1 kg blocks in three different cases as shown. If x_1, x_2 and x_3 be the extensions in the spring in these three cases, when acceleration of both the blocks have same magnitude, then



(1) $x_2 > x_3 > x_1$ (2) $x_2 > x_1 > x_3$ (3) $x_3 > x_1 > x_2$ (4) $x_1 > x_2 > x_3$

PNL003

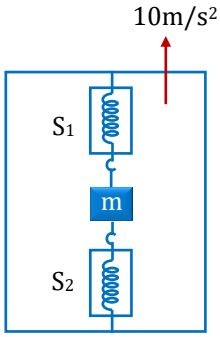
4. Three boxes are placed in a lift. When acceleration of the lift is 4 m/s^2, the net force on the 8 kg box is closest to



(1) 80 N (2) 48 N (3) 40 N (4) 32 N

PNL006

5. Reading shown in two spring balances S_1 and S_2 is 90 kg and 30 kg respectively when lift is accelerating upwards with acceleration 10 m/s^2. The mass is stationary with respect to lift. Then the mass of the block will be :



(1) 60 kg (2) 30 kg (3) 120 kg (4) None of these

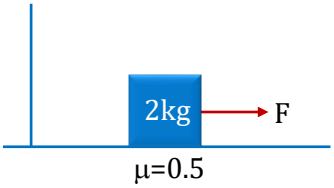
PNL007

6. On one rainy day, a sports car starts moving with a constant acceleration of 7.5 m/s^2. If a toy monkey is suspended from the ceiling of the car by a string, then at what angle the string is inclined with the vertical?

(1) 37° (2) 53° (3) 45° (4) Can't be determined

PNL113

7. A block is placed on a rough horizontal surface. The coefficient of friction between block and surface is 0.5. A time dependent force $F = -t^2 + 6t$ is acting on the block for time $t = 0$ to $t = 6$ sec as shown in figure. Then which statement is incorrect ?



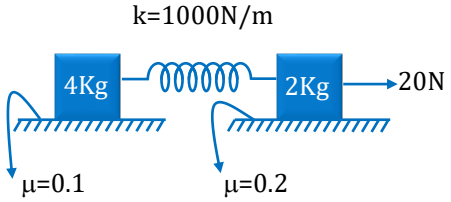
(1) At time $t = 3$ sec the friction force is maximum.
(2) Block will not move in time 0 to 6 sec.
(3) Maximum friction acting on block is 10 N.
(4) Maximum friction acting on block is 9 N.

PNL148

8. A lift is going upward when suddenly cable supporting the lift breaks. From a reference frame attached to the lift, pseudo force acting on an object will have direction (After the cable broke) :-
(1) Vertically downward when lift goes upward and vertically upward when lift goes downward.
(2) Always vertically upward
(3) Always vertically downward
(4) Vertically upward when lift goes upward and vertically downward when lift goes downward.

PNL114

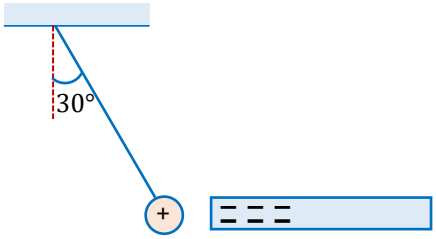
9. In the figure as shown if $2kg$ block is moving at an acceleration of $2m/s^2$ towards right, find the elongation in spring and acceleration of $4kg$ block at this instant. Take $g = 10\ m/s^2$.

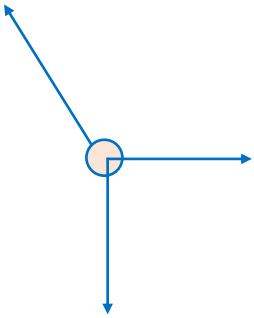


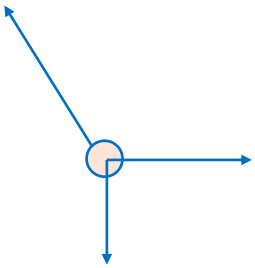
(1) $0.012m, 2m/s^2$ (2) $0.42m, 1m/s^2$ (3) $0.012m, 1m/s^2$ (4) $0.02m, 2m/s^2$

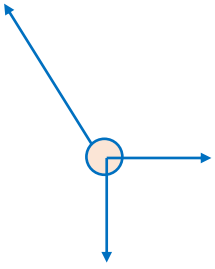
PNL213

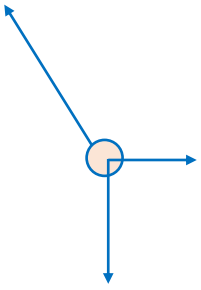
10. A small electrically charged sphere is suspended vertically from a thread. An oppositely charged rod is brought close to the sphere such that the sphere is in equilibrium displaced from the vertical by an angle of 30°. Which one of the following best represents the free body diagram for the sphere?



(1) 

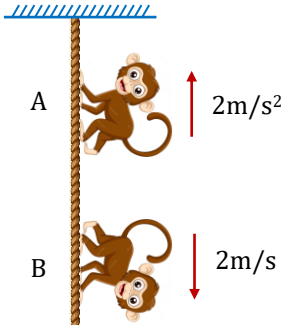
(2) 

(3) 

(4) 

PNL074

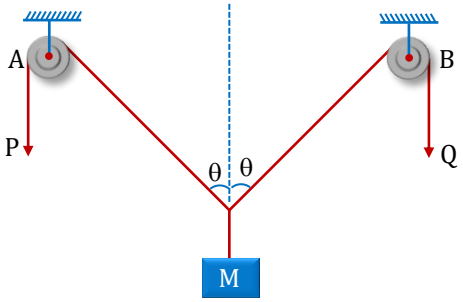
11. Two monkeys of masses 10 *kg* and 8 *kg* are moving along a vertical light rope, the former climbing up with an acceleration of 2 m/s^2, while the latter coming down with a uniform velocity of 2 *m/s*. Find tension in the rope at the fixed support.



(1) 180 *N* (2) 200 *N* (3) 80 *N* (4) 216 *N*

PNL008

12. In the arrangement shown in fig. the ends *P* and *Q* of an unstretchable string move downwards with uniform speed *U*. Pulleys *A* and *B* are fixed. Mass *M* moves upwards with a speed.



(1) 2 *U* cos θ (2) *U* cos θ (3) 2 *U*/cos θ (4) *U*/cos θ

PNL009

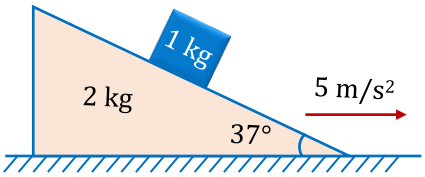
13. As shown in figure a wedge of mass 2*kg* is resting on frictionless floor. A block of mass 1*kg* is kept on the wedge and the wedge is given an acceleration of 5 m/sec^2 towards right. Then :

(1) Block will remain stationary w.r.t wedge.

(2) The block will have an acceleration of 2 m/sec^2 w.r.t the wedge.

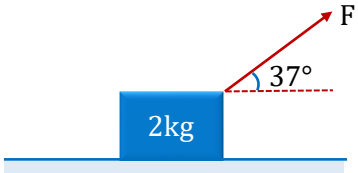
(3) Normal reaction on the block is 8*N*.

(4) Net force acting on the wedge is 4*N*.



PNL010

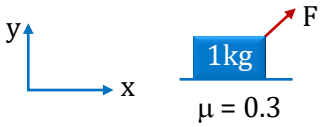
14. A block of mass 2 *kg* is kept on a rough horizontal floor and pulled with a force *F*. If the coefficient of friction is 0.5. then the minimum force required to move the block is :-



(1) 10 *N* (2) $\frac{100}{11}N$ (3) $\frac{100}{8}N$ (4) 20 *N*

PNL011

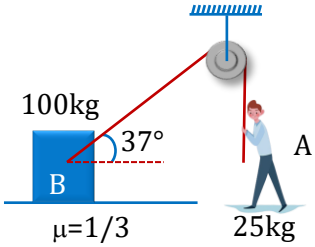
15. A force $\vec{F} = \hat{\imath} + 4\hat{\jmath}$ acts on block as shown. The force of friction acting on the block is :



(1) $-1\hat{\imath}$ (2) $-1.8\hat{\imath}$ (3) $-2\hat{\imath}$ (4) $-2.5\hat{\imath}$

PNL012

16. 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 mass 25 *kg* can climbs on rope without making block move is :



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

PNL014

17. The rear side of a truck is open and a box of mass 20 *kg* is placed on the truck 4 *m* away from the open end, m = 0.15 *kg* and g = 10 m/s^2. The truck starts from rest with an acceleration of $2m/s^2$ on a straight road. The distance moved by the truck when box falls down from the truck is :-

(1) 4 *m* (2) 8 *m* (3) 16 *m* (4) 32 *m*

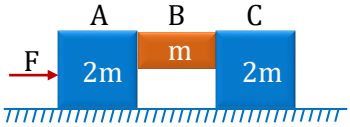
PNL015

18. 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

(1) $\frac{9}{20}$ (2) $\frac{7}{5}$ (3) $\frac{7}{12}$ (4) $\frac{5}{7}$

PNL016

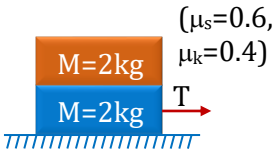
19. The system is pushed by a force *F* as shown in figure. All surfaces are smooth except between *B* and *C*. Friction coefficient between *B* and *C* is μ. Minimum value of *F* to prevent block *B* from downward slipping is :-



(1) $\left(\frac{3}{2\mu}\right)mg$ (2) $\left(\frac{5}{2\mu}\right)mg$ (3) $\left(\frac{5}{2}\right)\mu mg$ (4) $\left(\frac{3}{2}\right)\mu mg$

PNL017

20. The coefficient of static and kinetic friction between the two blocks and also between the lower block and the ground are $\mu_S = 0.6$ and $\mu_K = 0.4$. Find the value of tension T applied on the lower block at which the upper block begins to slip relative to lower block.



(1) 25 N (2) 30 N (3) 40 N (4) 45 N

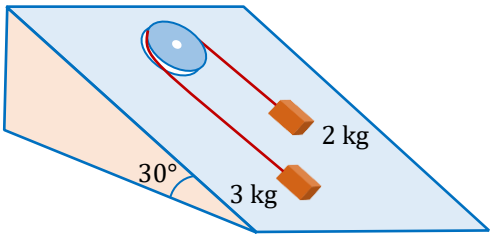
PNL018

SECTION–B

- This section will have **TEN questions**. Candidate can choose to attempt any 5 questions out of these 10 questions. In case if candidate attempts more than 5 questions, first 5 attempted questions will be considered for marking.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value (Answer should be rounded off to the nearest integer).
- Answer to each question will be evaluated according to the following marking scheme:

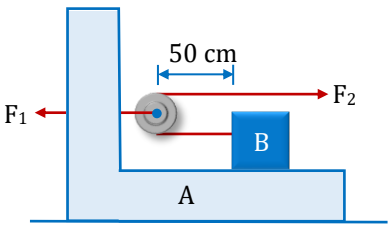
Full Marks	:	+4, if only correct answer is given.
Zero Marks	:	0, if no answer is given.
Negative Marks	:	–1 for incorrect answer.

1. Two blocks of masses 2.0 kg and 3.0 kg are connected by light inextensible string. The string passes over an ideal pulley pivoted to a fixed axle on a smooth incline plane as shown in the figure. When the blocks are released, find magnitude of their accelerations (m/s^2).



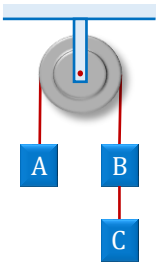
PNL021

2. A 1kg block B rests as shown on a bracket A of same mass. Constant forces $F_1 = 20N$ and $F_2 = 8N$ start to act at time $t = 0$ when the distance of block B from pulley is 50cm. Time (s) when block B reaches the pulley is $\frac{1}{n}$, find the value of n.



PNL022

3. In the system shown, the blocks A, B and C are of weight $4W$, W and W respectively. The system set free. The tension in the string connecting the blocks B and C is ($W = 30N$)

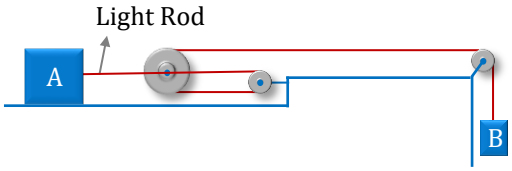


PNL023

4. A train has 10 wagons each of mass 1000 kg attached to it. They are being pulled by force 10^4 N. The force exerted on last four wagons is N × 10^3 N. Value of N is –

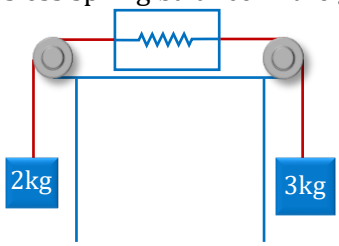
PNL214

5. If block A has a velocity of 0.6 m/s to the right, the velocity (m/s) of block B is $\frac{n}{5}$, find the value of n.



PNL024

6. Find the reading (N) of the massless spring balance in the given condition

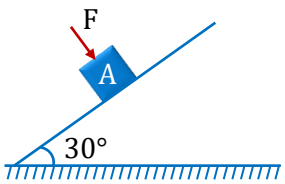


PNL025

7. A thin rod of length 1 m is fixed in a vertical position inside a train, which is moving horizontally with constant acceleration 4 m/s^2. A bead can slide on the rod, and friction coefficient between them is 1/2. If the bead is released from rest at the top of the rod, then the time (in second) when it will reach at the bottom is $\frac{n}{2}$, find the value of n. [$g = 10\ m/s^2$]

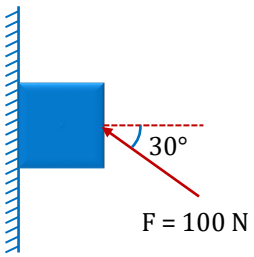
PNL026

8. A block of mass $m = 2\ kg$ is resting on a rough inclined plane of inclination 30° as shown in figure. The coefficient of friction between the block and the plane is μ = 0.5. The minimum force F which should be applied perpendicular to the inclined plane on the block, so that block does not slip on the plane is $\frac{n}{25}$, find the value of n. ($g = 10 m/s^2$)



PNL027

9. A force of 100 N is applied on a block of mass 3 kg as shown in figure. The coefficient of friction between the wall and the surface of the block is 1/4. Calculate frictional force (in N) acting on the block.



PNL028

10. A block of mass 1 kg is horizontally thrown with a velocity of 10 m/s on a stationary long plank of mass 2 kg whose surface has $\mu = 0.5$. Plank rests on frictionless surface. The time (in second) when block comes to rest *w.r.t.* plank is $\frac{n}{3}$, find the value of n.

PNL029

JEE (Advanced) Practice Paper

This paper is for yourself practice and assessment the discussion of this paper is optional though you can see PDF solutions or video solutions or solutions in hardcopy whichever is provided.

SECTION–I

- This section contains **FIVE** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:

Full Marks : +3 if only the bubble corresponding to the correct option is darkened.

Zero Marks : 0 if none of the bubbles is darkened.

Negative Marks : –1 in all other cases.

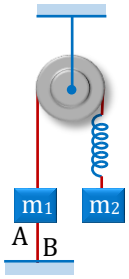
---

1. The upper half of an inclined 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 bottom, if the coefficient of friction for the lower half is given by -

(A) $2 \sin \phi$ (B) $2 \cos \phi$ (C) $2 \tan \phi$ (D) $\tan \phi$

PNL215

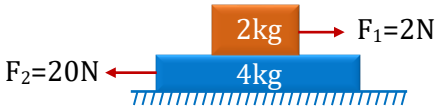
2. In a given figure two masses m_1 and m_2 ($m_2 > m_1$) are at rest in equilibrium position. Find the tension in string AB



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

PNL052

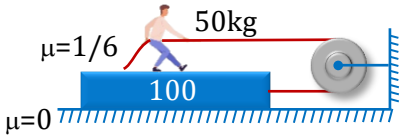
3. In the arrangement shown in figure, coefficient of friction between the two blocks is $\mu = 1/2$. The force of friction acting between the two blocks is :-



(A) 8 N (B) 10 N (C) 6 N (D) 4 N

PNL053

4. A man of mass 50 *kg* is pulling on a plank of mass 100 *kg* kept on a smooth floor as shown with force of 100 *N*. If both man and plank move together, find force of friction acting on man.

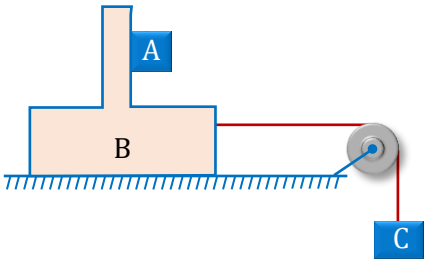


(A) $\frac{100}{3}$ *N* towards left (B) $\frac{100}{3}$ *N* towards right

(C) $\frac{250}{3}$ *N* towards left (D) $\frac{250}{3}$ *N* towards right

PNL054

5. In the arrangement shown in the figure, mass of the block *B* and *A* is $2m$ and m respectively. Surface between *B* and floor is smooth. The block *B* is connected to the block *C* by means of a string-pulley system. If the whole system is released, then find the minimum value of mass of block *C* so that *A* remains stationary w.r.t. *B*. Coefficient of friction between *A* and *B* is μ.



(A) $\frac{m}{\mu}$ (B) $\frac{2m+1}{\mu+1}$ (C) $\frac{3m}{\mu-1}$ (D) $\frac{6m}{\mu+1}$

PNL055

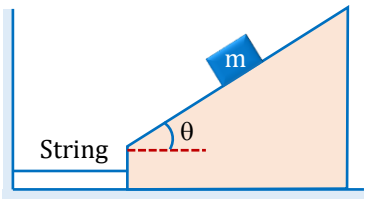
SECTION-II

- This section contains **EIGHT** questions.
- Each question has **FOUR** options for correct answer(*s*). **ONE OR MORE THAN ONE** of these four option(*s*) is (are) correct option(*s*).
- For each question, choose the correct option(*s*) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks	: +4	if only (all) the correct option(*s*) is (are) chosen.
Partial Marks	: +3	if all the four options are correct but ONLY three options are chosen.
Partial Marks	: +2	if three or more options are correct but ONLY two options are chosen, both of which are correct options.
Partial Marks	: +1	if two or more options are correct but ONLY one option is chosen and it is a correct option.
Zero Marks	: 0	if none of the options is chosen (i.e. the question is unanswered).
Negative Marks	: –2	in all other cases.

For Example : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(*s*) (second option in this case), with or without selection of any correct option(*s*) will result in –2 marks.

6. Refer the system shown in the figure. Block is sliding down the wedge. All surfaces are frictionless. Find correct statement(s)

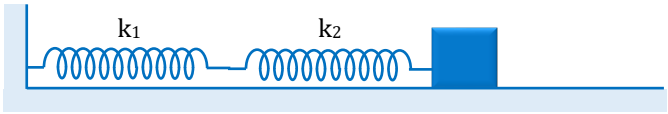


(A) Acceleration of block is $g \sin \theta$ (B) Acceleration of block is $g \cos \theta$

(C) Tension in the string is $mg \cos 2\theta$ (D) Tension in the string is $mg \sin \theta.\cos \theta$

PNL056

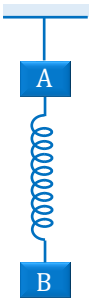
7. The mass in the figure can slide on a frictionless surface. When the mass is pulled out, spring 1 is stretched a distance x_1 and spring 2 is stretched a distance x_2. The spring constants are k_1 and k_2 respectively. Total magnitude of spring force pulling back on the mass is



(A) k_1x_1 (B) k_2x_2 (C) $(k_1x_1 + k_2x_2)$ (D) $0.5\ (k_1 + k_2)\ (x_1 + x_2)$

PNL057

8. In the given figure both the blocks have equal mass. When the thread is cut, which of the following statements give correct description immediately after the thread is cut?



(A) Relative to the block A, acceleration of block B is $2g$ upwards.

(B) Relative to the block B, acceleration of block A is $2g$ downwards.

(C) Relative to the ground, accelerations of the blocks A and B are both g downwards.

(D) Relative to the ground, accelerations of the blocks A and B are $2g$ downwards and zero respectively.

PNL058

9. A block is kept on a rough horizontal surface as shown. Its mass is 2 kg and coefficient of friction between block and surface (μ) = 0.5. A horizontal force F is acting on the block. When

(A) $F = 4\ N$, acceleration is zero.

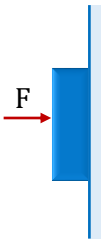
(B) $F = 4\ N$, friction is 10 N and acceleration is 3 m/s^2.

(C) $F = 14\ N$, acceleration is 2 m/s^2.

(D) $F = 14\ N$, friction is 14 N.

PNL059

10. A block of mass 1 *kg* is held at rest against a rough vertical surface by pushing by a force *F* horizontally. The coefficient of friction is 0.5. When



(A) $F = 40\ N$, friction on the block is 20 *N*.
(B) $F = 30\ N$, friction on the block is 10 *N*.
(C) $F = 20\ N$, friction on the block is 10 *N*.
(D) Minimum value of force *F* to keep block at rest is 20 *N*.

PNL060

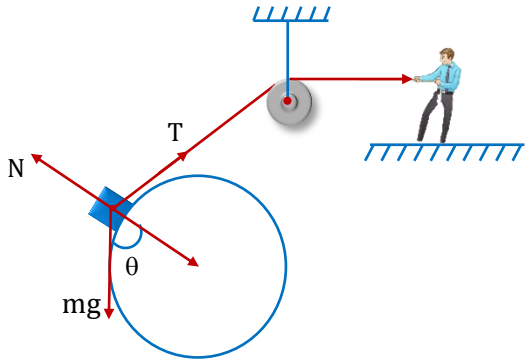
11. A block is released from rest from a point on a rough fixed inclined plane of inclination 37°. The coefficient of friction is 0.5.
(A) The time taken to slide down 9 *m* on the plane is 3 *s*.
(B) The velocity of block after moving 4 *m* is 4 *m*/*s*.
(C) The block travels equal distances in equal intervals of time.
(D) The velocity of block increases linearly.

PNL061

12. A block is placed over a plank. The coefficient of friction between the block and the plank is $\mu = 0.2$. Initially both are at rest, suddenly the plank starts moving with acceleration $a_0 = 4\ m/s^2$. The displacement of the block in 1*s* is ($g = 10\ m/s^2$)
(A) displacement of plank is 2 *m* (B) displacement of block is 1 *m*
(C) displacement of plank is 4 *m* (D) displacement of block is 2 *m*

PNL064

13. Block on the sphere shown in figure is in equilibrium (it implies that net force is zero). If sphere applies a force (*N*) of 3*N* on the block in the direction perpendicular to the surface of the sphere and weight of the block (*mg*) is 5 *N* vertically downward. The force applied by the string on the block (*T*) and angle θ if it acts tangentially is -



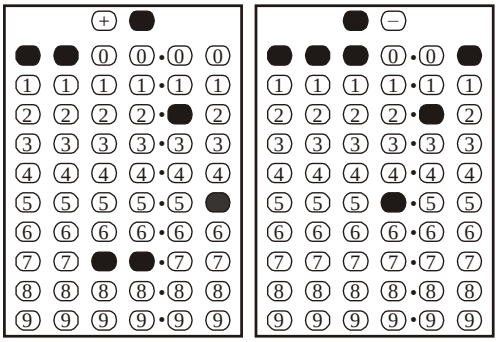
(A) 4 (B) 5 (C) 37° (D) 53°

PNL216

SECTION-III

- This section contains **FIVE** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, –0.33, –.30, 30.27, –127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darken the corresponding bubbles in the ORS.

  For Example : If answer is –77.25, 5.2 then fill the bubbles as follows:



- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks : +3 if ONLY the correct numerical value is entered as answer.

  Zero Marks : 0 in all other cases.

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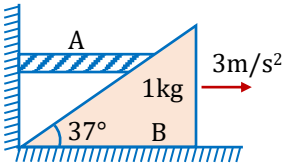
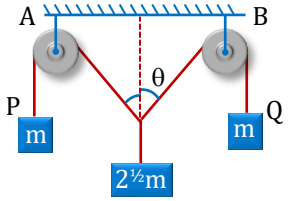
14. Find force in newton which mass *A* exerts on mass *B* if *B* is moving towards right with 3 m/s^2. (All surfaces are smooth)



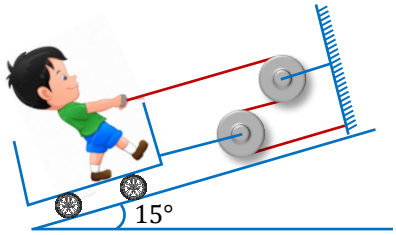
PNL066

15. The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ (in degrees) should be



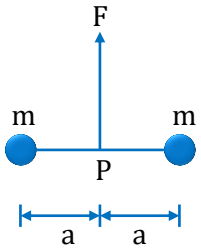
PNL067

16. A trolley is being pulled up an incline plane by a man sitting on it (as shown in figure). He applies a force of 250 *N*. If the combined mass of the man and trolley is 100 *kg*, the acceleration (m/s^2) of the trolley will be [sin 15° = 0.26]



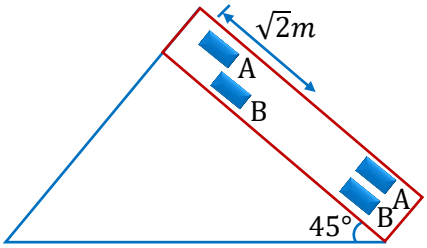
PNL070

17. Two particles of mass m each are tied at the ends of a light string of length $2a$. The whole system is kept on a frictionless horizontal surface with the string held tight so that each mass is at a distance a from the center P (as shown in the figure). Now, the mid-point of the string is pulled vertically upwards with a small but constant force F. As a result, the particles move towards each other on the surface. The magnitude of acceleration, when the separation between them is $\frac{F}{Pm}\frac{Qx}{\sqrt{a^2-x^2}}$, $P + Q$ is equal to -



PNL217

18. Two blocks A and B equal masses are placed on rough inclined plane as shown in figure. When will the two blocks come on the same line on the inclined plane if they are released simultaneously. Initially the block A is $\sqrt{2}m$ behind the block B. Coefficient of kinetic friction for the blocks A and B are 0.2 and 0.3 respectively (g = 10 m/s^2)



PNL218

ANSWER KEY

EXERCISE - O

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	B	C	C	D	D	D	D	C	B	D
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	A	C	B	A	C	C	B	B	C	C
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	D	C	B	C	C	C	D	B	B	C
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	B	B	C	D	A	B	C	C	A	C
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	A	C	A	A	B	B	C	A	CD	ABCD
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	BD	AD	AB	ABCD	AB	ABCD	ABD	AD	ACD	ABCD
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	ABC	ACD	D	D	A	D	B	A	B	B
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	C	B	A	B	C	A	A	A	C	A

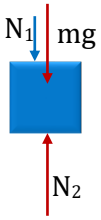
Que.	81	82	83	84	85
Ans.	B	B	C	(A-R), (B-Q), (C-S), (D-P)	(A-R), (B-T), (C-R), (D-P)

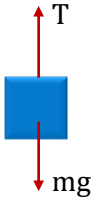
Que.	86	87	88
Ans.	(A-T), (B-R), (C-R), (D-Q)	(A-S), (B-R), (C-Q)	(A-S), (B-S), (C-Q), (D-R)

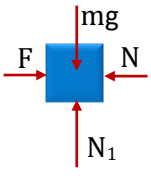
Que.	89
Ans.	(A-R), (B-T), (C-Q), (D-T)

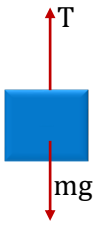
EXERCISE - S

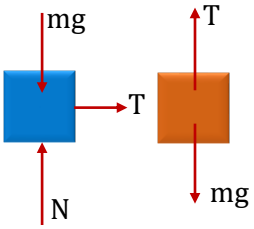
1.

(a) 

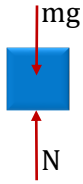
(b) 

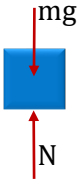
(c) 

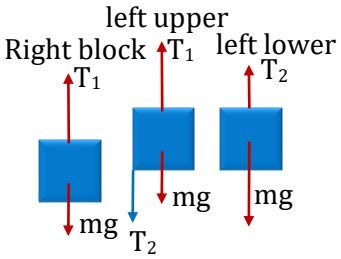
(d) 

(e) 

(f) 

(g) 

(h) 

(i) 

2. 8 **3.** 1440 N **4.** $0.5\,g, g$

5. 200 N, 10 m/s^2 **6.** 2 sec **7.** 80 N, 48 N, 264 N

8. (a) $3g\downarrow, 0$ (b) $2g\uparrow, g\downarrow$

9. (i) $a_A = g\downarrow, a_B = \frac{2g}{3}\uparrow, a_c = \frac{2g}{3}\downarrow, a_D = \frac{2g}{3}\downarrow, a_E = 0$

(ii) $a_A = 0, a_B = \frac{g}{3}\downarrow, a_C = \frac{g}{3}\uparrow, a_D = \frac{g}{3}\uparrow, a_E = g\downarrow,$

(iii) $a_A = 0, a_B = g\downarrow, a_C = g\uparrow, a_D = 2g\downarrow, a_E = 0$

(iv) $a_A = 0, a_B = 3g\downarrow, a_C = \frac{3g}{2}\downarrow, a_D = \frac{3g}{2}\downarrow, a_E = 0$

10. ma **11.** $a = g\cot\theta$ **12.** $\frac{(M+m)g\sin\theta}{M+m\sin^2\theta}$

13. $v_0/\cos\theta$ **14.** $\frac{a_0}{2}$ **15.** 4

16. 10 **17.** 2

18. $V_{P_1} = 5\ m/s$ downward, $V_C = 25\ m/s$ upward **19.** $a_A = \frac{9g}{25}, a_B = \frac{12g}{25}$

20. $u = v\tan\theta$ (u is velocity of rod, v is the velocity of wedge) **21.** $u\tan\theta$

22. $b\hat{i} + b\hat{j}$ **23.** 5 m/s^2 downwards, 0 m/s^2, 10 N

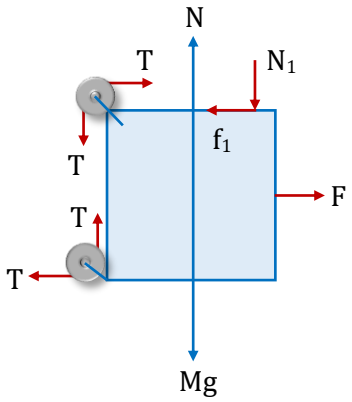
24. $a = \frac{mg\sin\theta}{M+2m(1-\cos\theta)}$ **25.** $t = \sqrt{2\ell(4+\eta)/3g(2-\eta)} = 1.4s$

26. 1 kg **27.** $10\hat{i}$ **28.** $\mu_{min} = \frac{m\sin\theta\cos\theta}{m\cos^2\theta + M}$

29. 6 **30.** 3 **31.** 20 N vertically downward

32. 5 **33.** 20 kg **34.** $10 m/s^2$

35. 1 **36.** 30 N

37. (i) 

(ii) $a = 3/5\ m/s^2$, $T = 18\ N$, $F = 60N$

EXERCISE - JEE (Main) PYQ

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	3	1	3	1	1	2	3	3	4	1
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	25	3	2	30	3	4	1	36
Que.	21	22	23	24						
Ans.	2	3	2	1						

EXERCISE - JEE (Advanced) PYQ

Que.	1	2
Ans.	D	A

JEE (Main) Practice Paper

Section-A	Q.	1	2	3	4	5	6	7	8	9	10
	A.	4	1	2	4	2	1	3	2	1	4
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	2	4	2	2	1	2	3	1	2	3
Section-B	Q.	1	2	3	4	5	6	7	8	9	10
	A.	1	2	40	4	9	24	1	67	20	4

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Section-I	Q.	1	2	3	4	5			
	A.	C	D	A	A	C			
Section-II	Q.	6	7	8	9	10	11	12	13
	A.	AD	AB	ABD	AC	BCD	ABD	AB	AD
Section-III	Q.	14	15	16	17	18			
	A.	5	45	4.9	3	2			

Important Notes