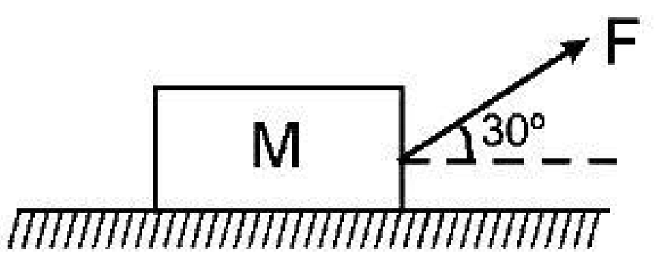
DPP No. 5

SYLLABUS : NEWTONS LAWS OF MOTION + FRICTION

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

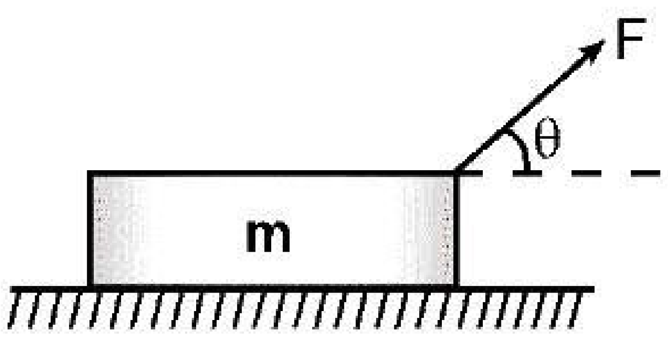
(A) 0.75 (B) 0.33 (C) 0.25 (D) 0.80

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



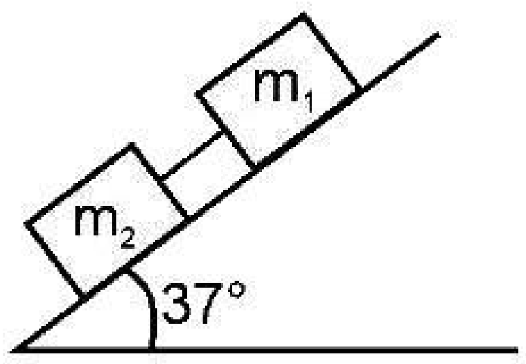
(A) 5.73 m/sec^2 (B) 8.0 m/sec^2 (C) 3.17 m/sec^2 (D) 10.0 m/sec^2

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



(A) $\frac{F\cos\theta}{m}$ (B) $\frac{\mu F\sin\theta}{M}$ (C) $\frac{F}{m}(\cos\theta + \mu\sin\theta) - \mu g$ (D) none of these

4. Two blocks $m_1 = 4kg$ and $m_2 = 2kg$, connected by a weightless rod on a plane having inclination of 37^0 as shown in figure. The coefficients of dynamic friction of m_1 and m_2 with the inclined plane are $\mu = 0.25$. Then the common acceleration of the two blocks and the tension in the rod are:



(A) 4 m/s^2, T = 0 (B) 2 m/s^2, T = 5 N (C) 10 m/s^2 ,T = 10 N (D) 15 m/s^2, T = 9N

5. A small mass slides down an inclined plane of inclination θ with the horizontal. The co-efficient of friction is $\mu = \mu_0 x$ where x is the distance through which the mass slides down and $\mu_{0,}$ a constant. Then the speed is maximum after the mass covers a distance of

(A) $\frac{\cos\theta}{\mu_0}$ (B) $\frac{\sin\theta}{\mu_0}$ (C) $\frac{\tan\theta}{\mu_0}$ (D) $\frac{2\tan\theta}{\mu_0}$

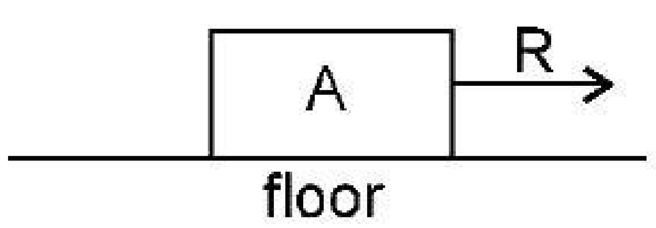
6. A given object takes n times as much time to slide down 45° rough incline as it takes to slide down a perfectly smooth 45° incline. The coefficient of kinetic friction between the object and the incline is given by _______.

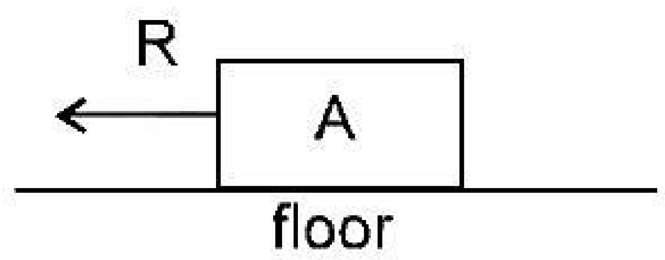
(A) $\mu = 2 - \frac{1}{n^2}$ (B) $\mu = 1 - \frac{2}{n^2}$ (C) $\mu = 1 + \frac{1}{n^2}$ (D) $\mu = 1 - \frac{1}{n^2}$

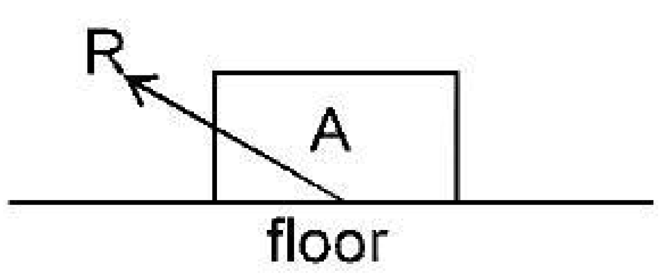
7. A block is shot with an initial velocity $5ms^{-1}$ on a rough horizontal plane. Find the distance covered by the block till it comes to rest. The coefficient of kinetic friction between the block and plane is 0.1.

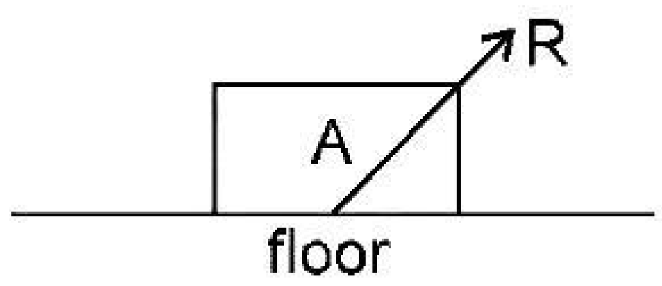
(A) 5.5m (B) 10.5m (C) 12.5m (D) 12 m

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

(A) 

(B) 

(C) 

(D) 

9. A block of mass 4 kg is kept on ground. The co-efficient of friction between the block and the ground is 0.80. An external force of magnitude 30 N is applied parallel to the ground. The resultant force exerted by the ground on the block is :

(A) 40 N (B) 30 N (C) 0 N (D) 50 N

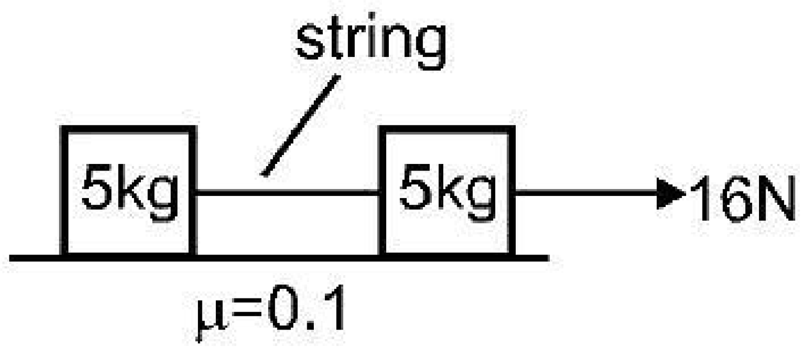
10. A block of mass 1 kg lies on a horizontal surface in a truck. The coefficient of static friction between the block and the surface is 0.6 If the acceleration of the truck is $5 m/s^2$, the frictional force acting on the block is :

(A) 5 N (B) 6 N (C) 10 N (D) 15 N

11. A block of mass 2 kg rests on a rough inclined plane making an angle of 30^0 with the horizontal. The coefficient of static friction between the block and the plane is 0.7. The frictional force on the block is :

(A) 9.8 N (B) $0.7 \times 9.8\sqrt{3}$ N (C) 9.8×7 N (D) 0.8×9.8 N

12. Two blocks of same mass are kept on a horizontal rough surface as shown in the figure. Coefficient of friction between the blocks and surface is 0.1. A force of 16 N is applied on one block as shown in figure. Find the tension (in Newton) in the string.

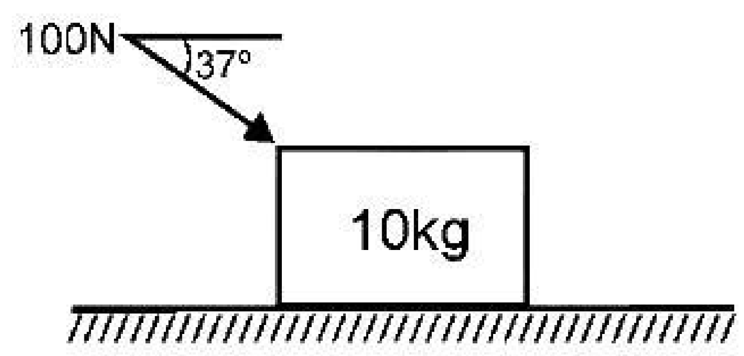


(A) 2 (B) 4 (C) 6 (D) 8

13. The angle between the resultant contact force and the normal force exerted by a body on the other is called the angle of friction. Show that, if λ be the angle of friction and μ the coefficient of static friction, $\lambda \leq \tan^{-1}\mu$

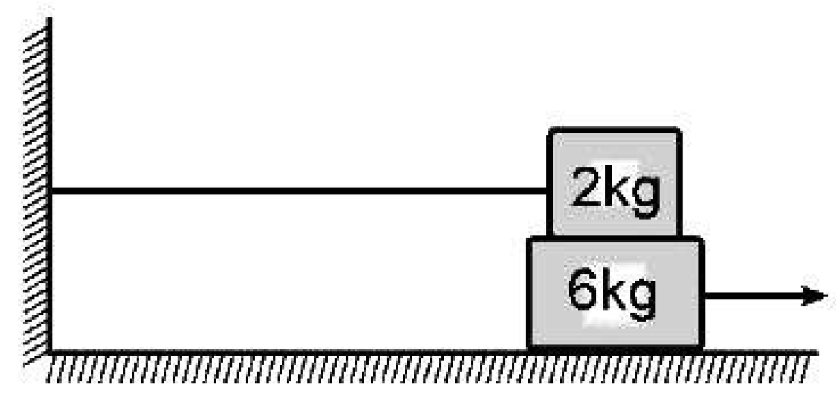
(A) $\lambda \leq \tan^{-1}\mu$ (B) $\lambda > \tan^{-1}\mu$ (C) $\lambda \leq \tan^{1}\mu$ (D) None of these

14. In the figure shown calculate the angle of friction. The block does not slide. Take g = 10 m/s^2.



(A) $\theta = \tan^{1}\frac{1}{2}$ (B) $\theta = \tan^{-1}\frac{1}{2}$ (C) $\theta = \tan^{-1} 2$ (D) None of these

15. With reference to the figure shown, if the coefficient of friction at the surfaces is 0.42, then the force required to pull out the 6.0 kg block with an acceleration of 1.50 m/s^2 will be:

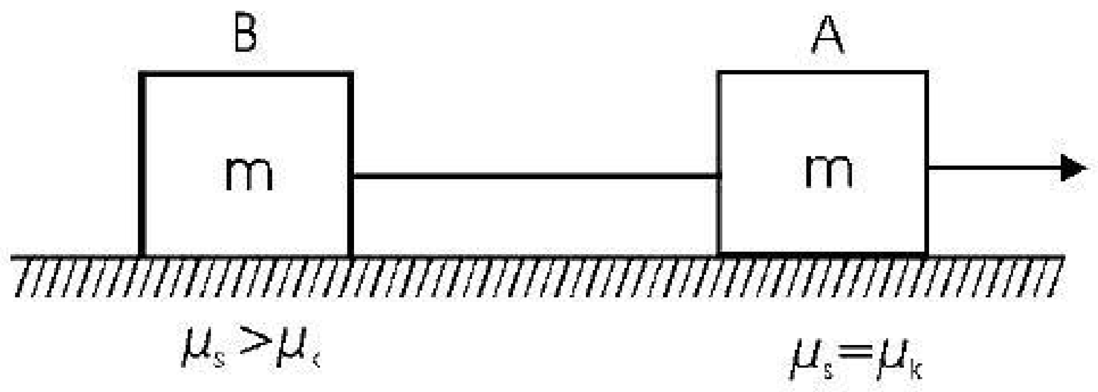


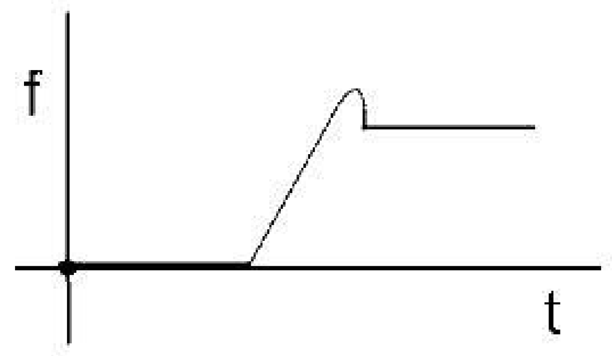
(A) 36 N (B) 24 N (C) 84 N (D) 51 N

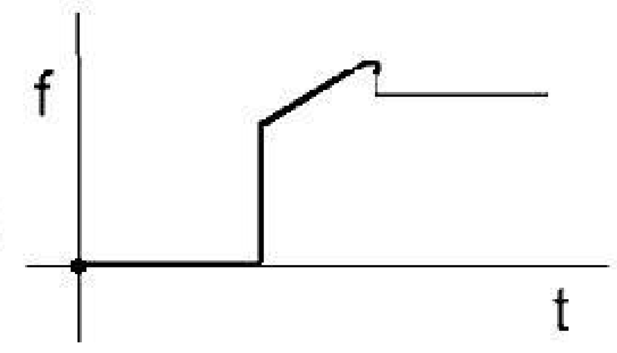
16. A 60 kg body is pushed horizontally with just enough force to start it moving across a floor and the same force continues to act afterwards. The coefficient of static friction and sliding friction are 0.5 and 0.4 respectively. The acceleration of the body is :

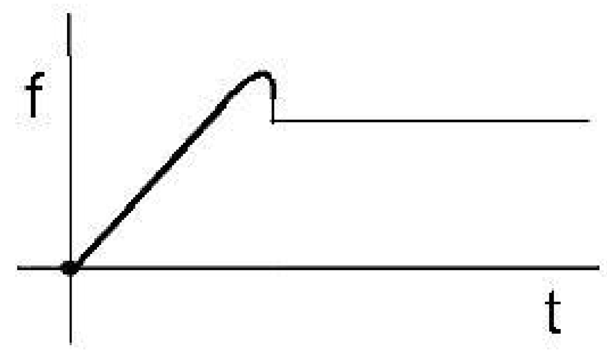
(A) 6 m/s^2 (B) 4.9 m/s^2 (C) 3.92 m/s^2 (D) 1 m/s^2

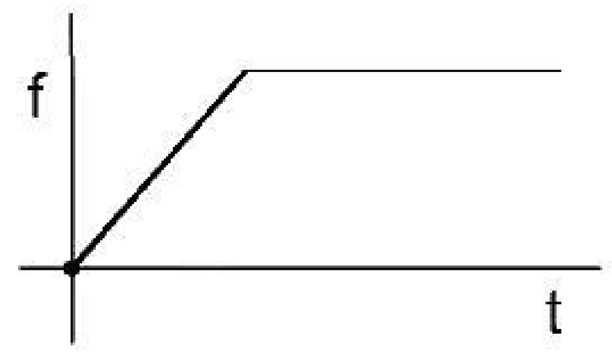
17. A force F = t is applied to block A as shown in figure. The force is applied at t = 0 seconds when the system was at rest and string is just straight without tension. Which of the following graphs gives the friction force between B and horizontal surface as a function of time 't'.



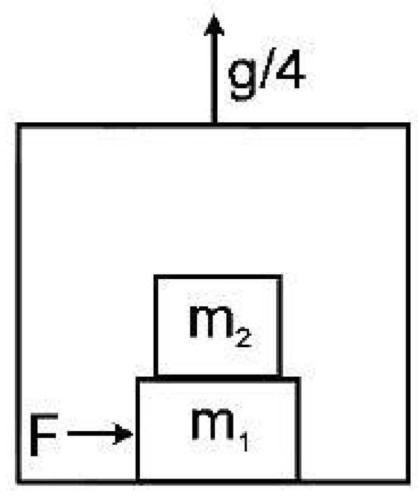
(A)


(B)


(C)


(D)


18. A plank of mass m_1 = 8 kg with a bar of mass m_2 = 2 kg placed on its rough surface, lie on a smooth floor of elevator ascending with an acceleration g/4. The coefficient of friction is μ = 1/5 between m_1 and m_2. A horizontal force F = 30 N is applied to the plank. Then the acceleration of bar and the plank in the reference frame of elevator are:



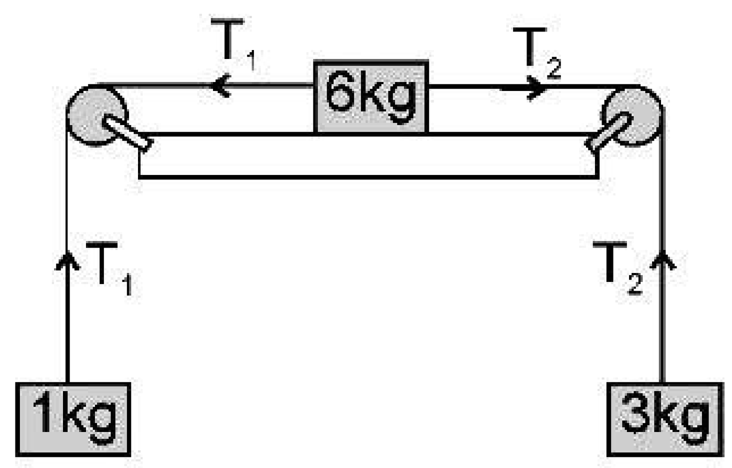
(A) 3.5 m/s^2, 5 m/s^2

(B) 5 m/s^2, $\frac{50}{8}$ m/s^2

(C) 2.5 m/s^2, $\frac{25}{8}$ m/s^2

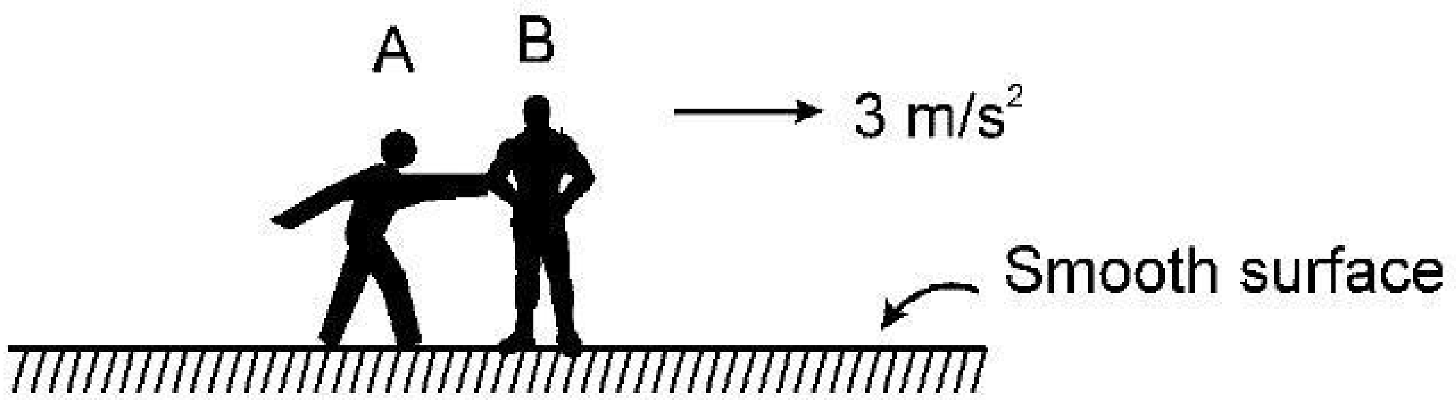
(D) 4.5 m/s^2, 4.5m/s^2

19. Three masses of 1 kg , 6 kg and 3 kg are connected to each other with threads and are placed on table as shown in figure. What is the acceleration with which the system is moving ? Take g = 10m s^{-2} .



(A) Zero (B) 1 m s^{-2} (C) 2 m s^{-2} (D) 3 m s^{-2}

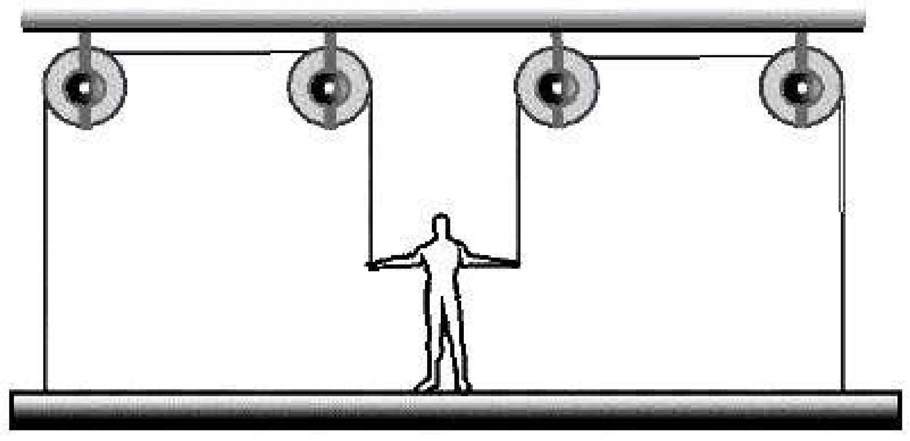
20. Man 'A' of mass 60 kg pushes the other man 'B' of mass 75 kg due to which man 'B' starts moving with acceleration 3 m/s^2. Calculate the acceleration of man 'A' at that instant.



(A) $\frac{15}{4}$ m/s^2 , same direction. (B) $\frac{10}{4}$ m/s^2 , opposite direction.

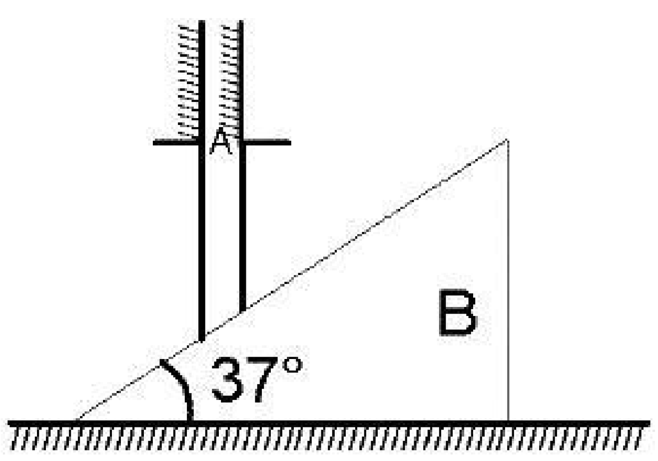
(C) $\frac{15}{4}$ m/s^2 , opposite direction. (D) $\frac{4}{15}$ m/s^2 , opposite direction.

21. A painter of mass M stands on a platform of mass m and pulls himself up by two ropes which hang over pulley as shown. He pulls each rope with the force F and moves upward with uniform acceleration 'a'. Find 'a'



(A) $a = \frac{2F}{M+m} - g$. (B) $a = \frac{8F}{M+m} - g$. (C) $a = \frac{12F}{M+m} - g$. (D) $a = \frac{4F}{M+m} - g$.

22. Find the acceleration of rod A and wedge B in the arrangement shown in figure if the mass of rod equal that of the wedge and the friction between all contact surfaces is negligible. Take angle of wedge as 37^o.



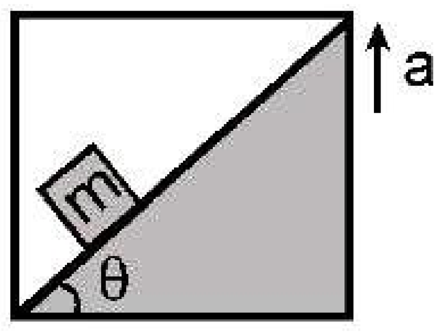
(A) $a_A = \frac{3g}{25}$,$a_B = \frac{12g}{25}$ (B) $a_A = \frac{9g}{25}$,$a_B = \frac{25g}{12}$

(C) $a_A = \frac{9g}{25}$,$a_B = \frac{12g}{25}$ (D) $a_A = \frac{11g}{3}$,$a_B = \frac{12g}{25}$

23. An object kept on a smooth inclined plane of inclination θ with horizontal can be kept stationary relative to the incline by giving a horizontal acceleration to the inclined plane, equal to :

(A) g sin θ (B) g cos θ (C) g tan θ (D) none of these.

24. In the adjoining figure, a wedge is fixed to an elevator moving upwards with an acceleration 'a'. A block of mass 'm' is placed over the wedge. Find the acceleration of the block with respect to wedge. Neglect friction.



(A) (g + a) sin θ (B) (g – a) sin θ (C) (g + a) cos θ (D) (g – a) cos θ

25. A balloon of gross weight w newton is falling vertically downward with a constant acceleration a(<g). The magnitude of the air resistance is : (Neglecting buoyant force)

(A) w (B) $w\left(1+\frac{a}{g}\right)$ (C) $w\left(1-\frac{a}{g}\right)$ (D) $w\frac{a}{g}$

ANSWER KEY

1.	(A)	**2.**	(A)	**3.**	(C)	**4.**	(A)	**5.**	(C)
6.	(D)	**7.**	(C)	**8.**	(C)	**9.**	(D)	**10.**	(A)
11.	(A)	**12.**	(D)	**13.**	(A)	**14.**	(B)	**15.**	(D)
16.	(D)	**17.**	(A)	**18.**	(C)	**19.**	(C)	**20.**	(C)
21.	(D)	**22.**	(C)	**23.**	(C)	**24.**	(A)	**25.**	(C)