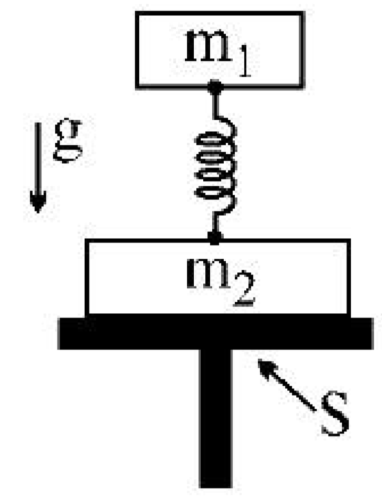
GUIDED REVISION

NEWTON'S LAW

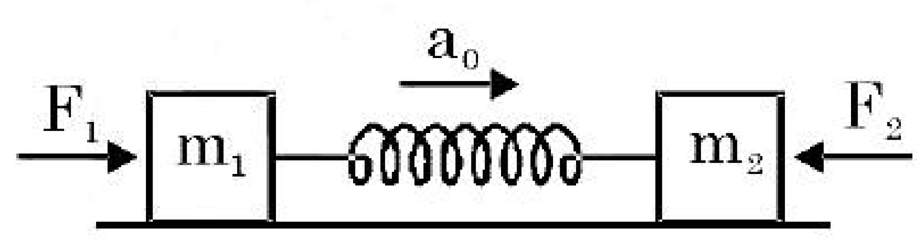
1. The system of two weights with masses m_1 and m_2 are connected with weightless spring as shown. The system is resting on the support S. The support S is quickly removed. The accelerations of each of the weights right after the support S is removed are.



(A) $a_1 = 0, a_2 = \frac{(m_1+m_2)g}{m_2}$ (B) $a_1 = 0, a_2 = \frac{(m_1+m_2)g}{m_1}$

(C) $a_1 = \frac{(m_1+m_2)g}{m_1}, a_2 = 0$ (D) $a_1 = 0, a_2 = 0$

2. Two blocks m_1 and m_2 are connected with a compressed spring and placed on a smooth horizontal surface as shown in figure. Force constant of spring is k. Under the influence of forces F_1 and F_2, at an instant blocks move with common acceleration a_0. At that instant force F_2 is suddenly withdrawn. Mark **CORRECT** option.



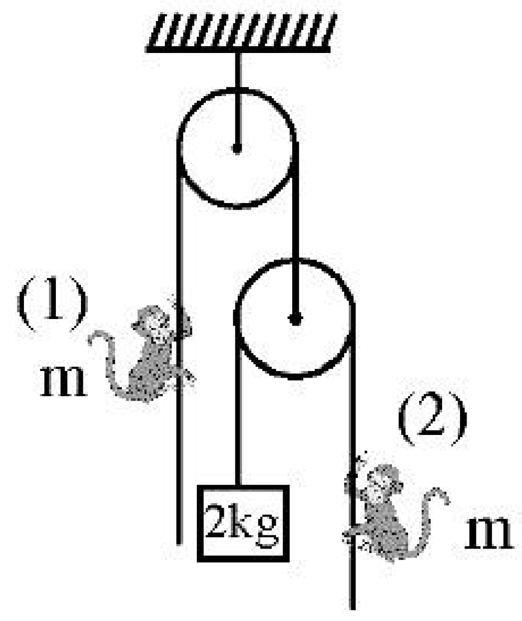
(A) Instantaneous acceleration of m_1 is $a_0 - \frac{F_1}{m_1}$

(B) Instantaneous acceleration of m_2 is $a_2 = a_0 + \frac{F_2}{m_2}$

(C) Instantaneous acceleration of m_1 is $a_1 = a_0$

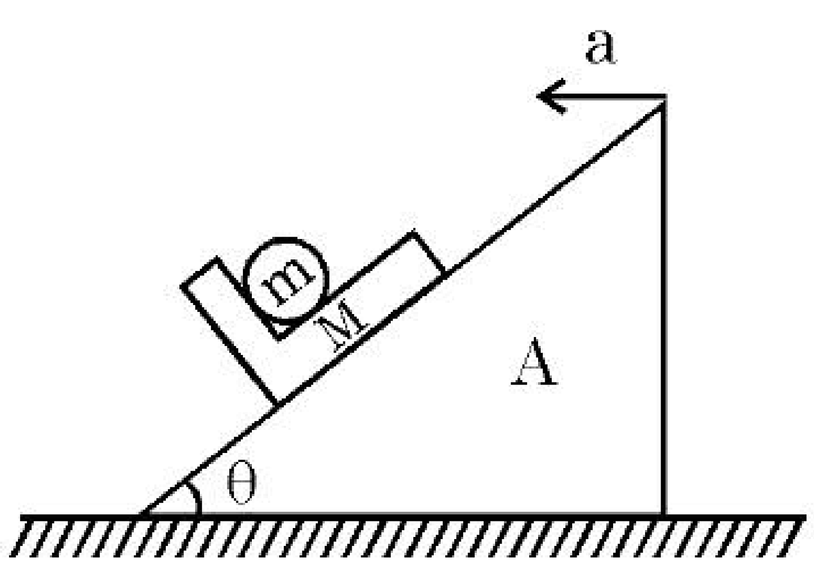
(D) Spring force is $F_{spring} = m_2a_0 + F_2$

3. Two monkeys (1) & (2) of same mass m = 1kg are hanging on the strings such that block of mass 2 kg remains at rest and it is given that monkey (2) is just holding the string. Then which of the following statement(s) are **CORRECT** ($g = 10\ m/s^2$):-



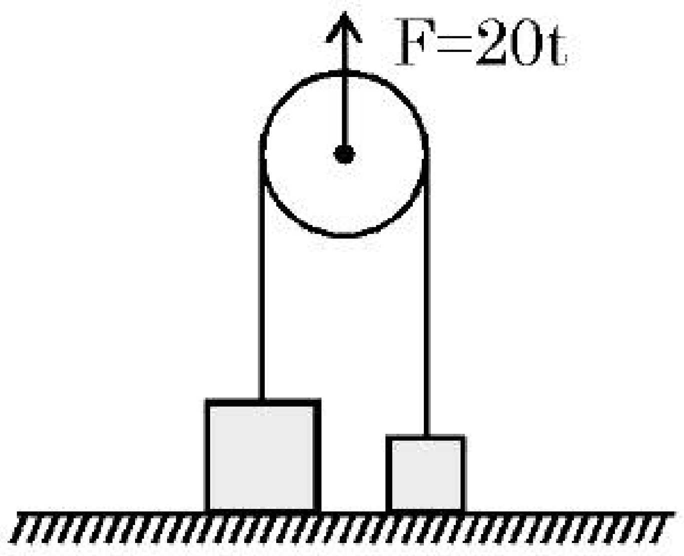
(A) Acceleration of monkey (2) is $10\ m/s^2$ upwards.
(B) Acceleration of monkey (1) is $30\ m/s^2$ upwards.
(C) Acceleration of monkey (1) with respect to his rope is $35\ m/s^2$ upwards.
(D) Acceleration of monkey (2) with respect to his rope is $50\ m/s^2$ upwards.

4. 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)

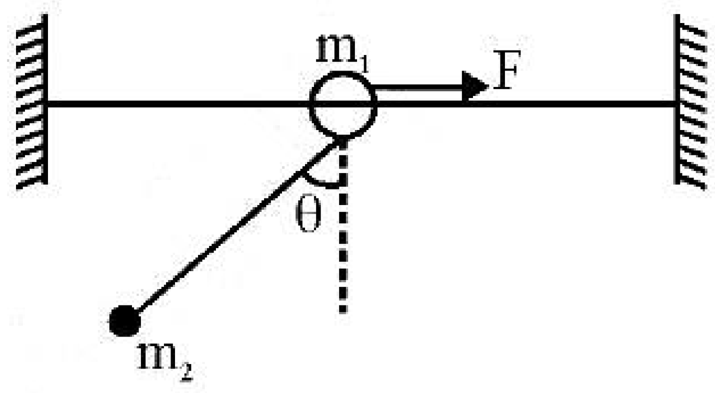


(A) Normal reaction force between m & M is $m(g\cos\theta + a\sin\theta)$
(B) Normal reaction force between A & M is $(M+m)(g\cos\theta + a\sin\theta)$
(C) $a_{M/A} = a_{m/A} = (g\sin\theta - a\cos\theta)$
(D) $a_M = a_m = \sin\theta\sqrt{g^2 + a^2}$

5. Two blocks A and B of mass 1 kg and 2kg respectively are connected by a string, passing over a light frictionless pulley. Both the blocks are resting on a horizontal floor and the pulley is held such that string remains just taut. At moment t=0, a force F=20t newton starts acting on the pulley along vertically upward direction, as in Fig. Calculate (a) velocity of A when B loses contact with the floor (b) height raised by the pulley upto that instant and (c) work done by the force F upto that instant.



6. A horizontal force F is applied on a ring of mass m_1 constrained to move on a horizontal smooth wire. The hanging mass m_2 is connected to ring with a massless rod and it maintains a constant angle with vertical. Mark **CORRECT** option :-



(A) Force on m_1 by wire is less than $(m_1 + m_2)g$

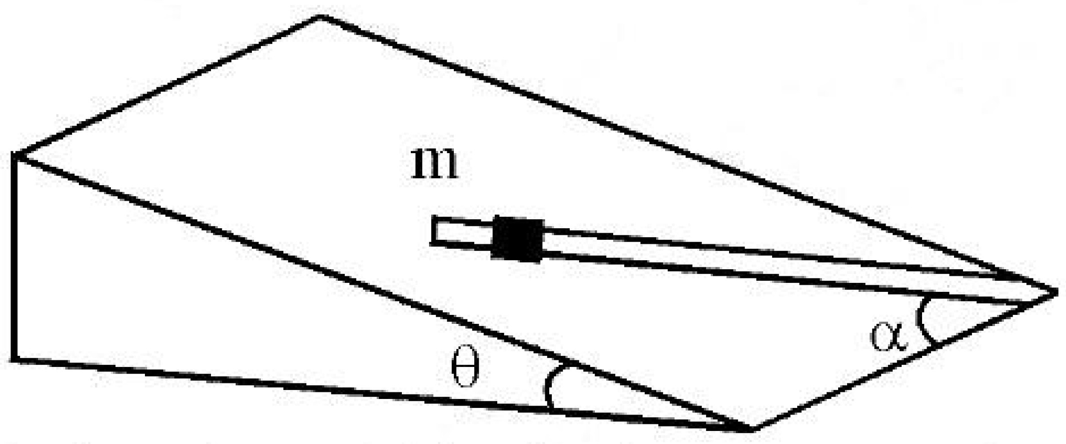
(B) Net force on m_2 is $\frac{m_2F}{m_1+m_2}$

(C) Tension in rod is $m_2g \sec\theta$

(D) $F = (m_1 + m_2)\, g \tan\theta$

FRICTION

7. Figure shows a fixed wedge with a groove in it. A small block lies inside groove just filling it.



(A) If groove is smooth the acceleration of block along groove is g $\sin\theta \sin\alpha$

(B) If friction acts from side walls only the minimum coefficient of friction required to hold block stationary is $\tan\alpha$

(C) If friction acts on base of block only the minimum coefficient of friction required to hold block stationary is $\mu = \tan\theta$.

(D) If groove is smooth the acceleration of block along groove is g $\sin\theta \cos\alpha$.

Paragraph for question no. 8 and 9

Friction is a force that aids us daily, in fact so much so that we don't even pause to appreciate its importance. We would not be able to wear pants or jeans without friction. We would have to live like naked in the jungle. The shirt is supported at our shoulders. But if we stand up the weight of our jeans is to be supported by a vertical force. The surface of our waist and thighs can be approximated to be like curved surface of a vertical cylinder. The force of friction acting between this curved surface and jeans balances the weight of the jeans. To understand this mathematically, let us consider a vertical man whose waist is a rigid cylinder having a circumference of 90 cm. He wears a jeans of mass 500 gm using an elastic massless belt which can be assumed to be on elastic string of force constant 500N/m and circumference 85cm when not extended. The coefficient of friction between waist and jeans is 0.5.

8. What is the friction force acting between the man's waist and jeans?

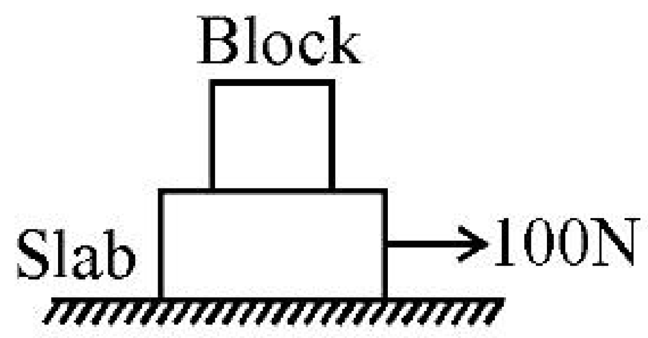
(A) 5N (B) 12.5 N (C) 7.5 N (D) 25 N

9. When the man stands in an elevator going up with a high acceleration, his jeans start sliding down. What can be the minimum acceleration of the elevator?

(A) 147 m/s^2 (B) 288 m/s^2 (C) 87 m/s^2 (D) 24 m/s^2

Paragraph for Questions 10 to 12

In the figure, a horizontal force of 100N is to be applied to a 10kg slab that is initially stationary on a frictionless surface. A 10kg block lies on the top of the slab, there is no information about friction and coefficient of friction between the block and the slab.



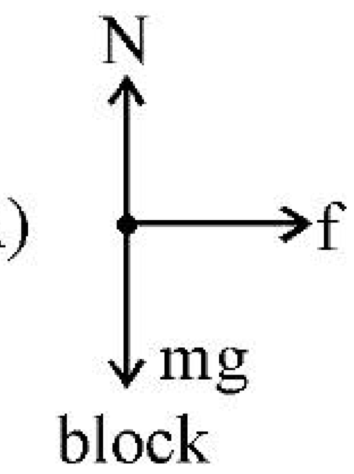
10. What can not be a possible value of the acceleration of the slab ?

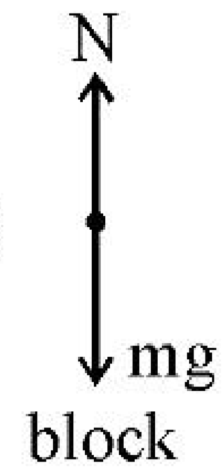
(A) 7 m/s^2 (B) 10 m/s^2 (C) 2 m/s^2 (D) 9 m/s^2

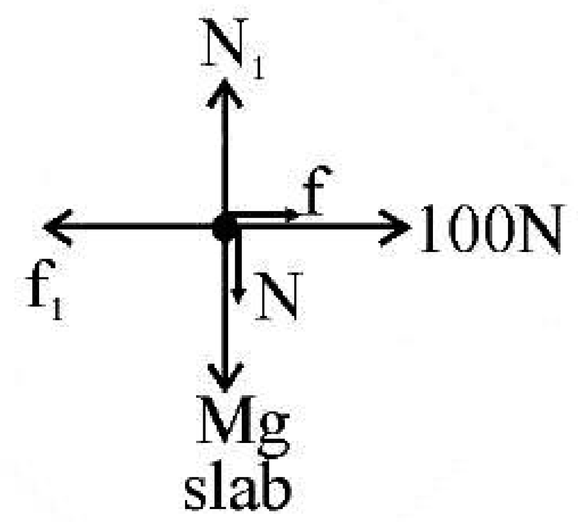
11. What can not be a possible value of the acceleration of the block ?

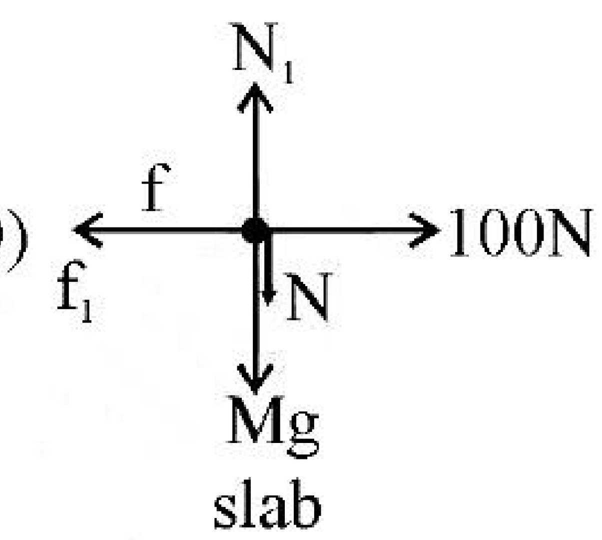
(A) 4 m/s^2 (B) 3 m/s^2 (C) 10 m/s^2 (D) zero

12. If the ground and the top surface of the slab both are rough, which of the following can not be a possible free body diagram ? f is friction between block and slab, N is normal between block and slab, f_1 is friction between slab and ground, N_1 is normal between slab and ground.

(A)


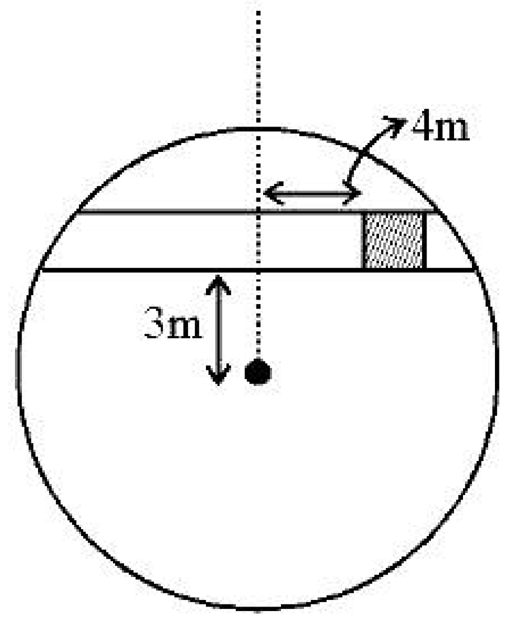
(B)


(C)


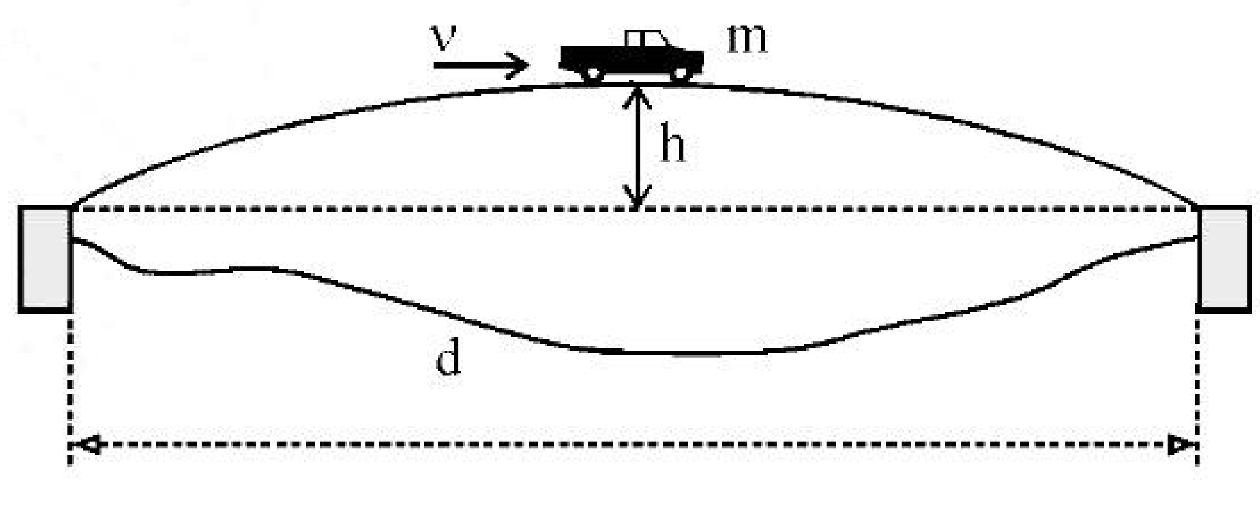
(D)


CIRCULAR MOTION

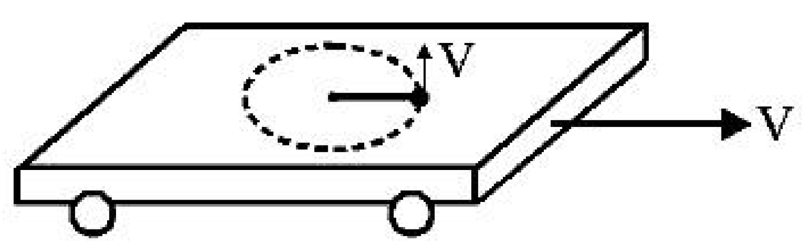
13. A small cubical block of mass 1 kg is placed inside a rough rectangular groove made in a circular rough table as shown in the figure. Coefficient of friction for all the rough surfaces is $\mu = 0.5$. The table starts rotating clockwise with angular acceleration 1 rad/sec^2 in a horizontal plane about its axis. Find the time (in sec) after which the block will start motion with respect to table. Assume the size of block slightly smaller then the width of groove.



14. There is a parabolic-shaped bridge across a river of width 100m. The highest point of bridge is 5m above the level of the banks. A car of mass 1000 kg is crossing the bridge at a constant speed of 20 ms^{-1}. Using the notation indicated in the figure, the force exerted on the bridge by the car when it is : at the highest point of the bridge is (1200x) N. Find x (Ignore air resistance and take g as 10 ms^{-2})



15. On a train moving along east with a constant speed v, a boy revolves a bob with string of length ℓ on smooth surface of a train, with equal constant speed v relative to train. Mark the correct option(s).



(A) Maximum speed of bob is 2 v in ground frame.

(B) Tension in string connecting bob is $\frac{4mv^2}{\ell}$ at an instant.

(C) Tension in string is $\frac{mv^2}{\ell}$ at all the moments.

(D) Minimum speed of bob is zero in ground frame.

16. A car is moving with constant speed on a rough banked road.

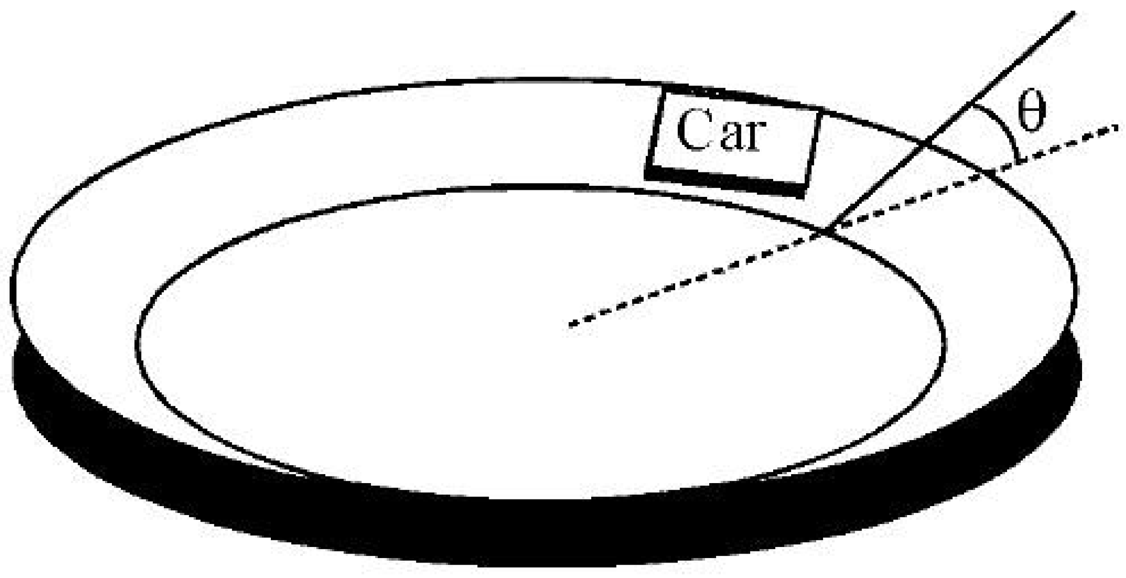
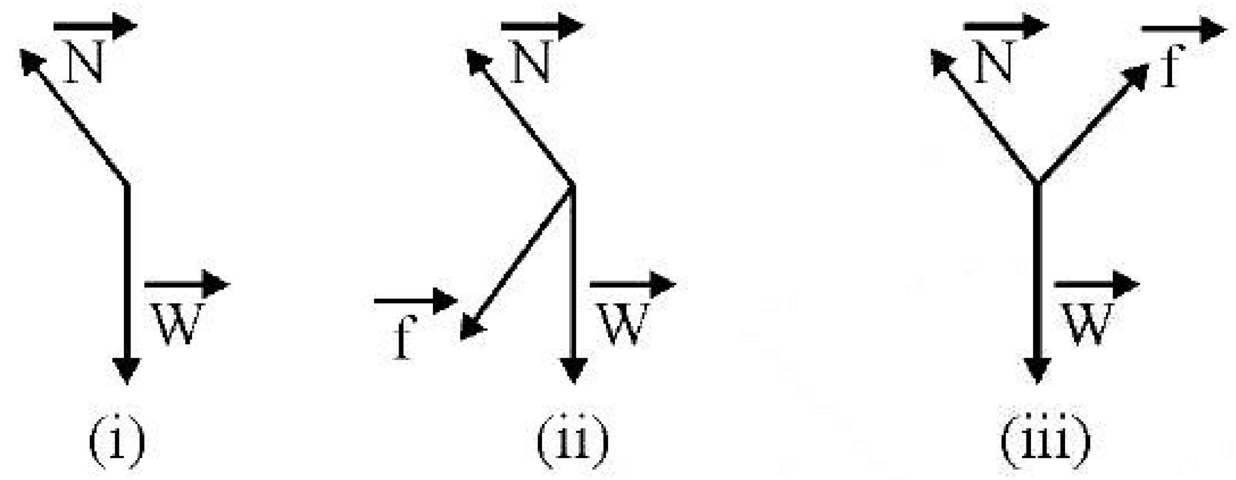


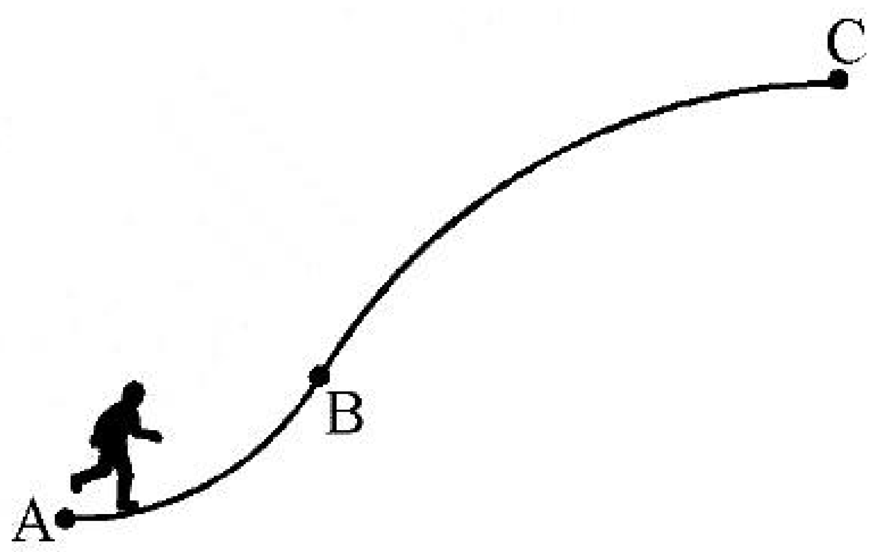
Figure (i), (ii) and (iii) show the free body diagram of car A, B & C respectively:-



(A) Car A has more speed than car C
(B) Car A has less speed than car B
(C) FBD for car A is not possible
(D) If $\mu > \tan\theta$ the FBD for car C is not possible

Paragraph for question nos. 17 to 19

An athelete of mass 80 kg is running on a rough track whose cross-section is shown below. The lower part AB of track is a cylindrical valley of radius 100 m and upper part BC is a cylindrical hill of radius 200 m. The two parts join such that there is no sudden change of slope of the track. The speed of the athelete on the track is always 5m/s. A is the lowest point of the valley, B is the point at which valley ends and hill starts and C is the top of the hill. While moving from A to C, the athelete travels a horizontal distance of 150 m.

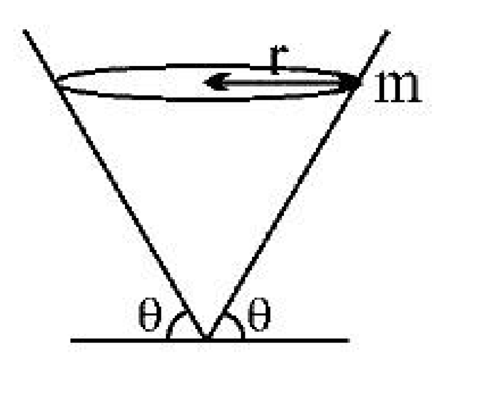


17. Find the time taken by the athelete in going from A to C
(A) 5π sec (B) 10π sec (C) 15π sec (D) 20π sec

18. The correct order of normal force experienced by athelete is :
(A) $N_A > N_B > N_C$ (B) $N_A < N_B < N_C$ (C) $N_A > N_C > N_B$ (D) $N_C > N_A > N_B$

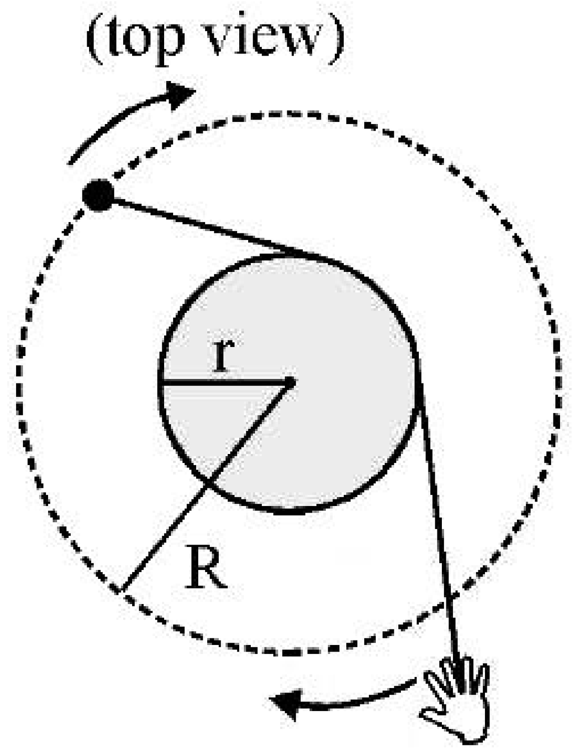
19. The magnitude of friction force experienced by the athelete is :
(A) zero throughout
(B) decreases continuously during motion from A to C
(C) increases continuously from A to C
(D) attains a maximum value at B

20. A ball of mass 'm' is rotating in a circle of radius 'r' with speed v inside a smooth cone as shown in figure. Let N be the normal reaction on the ball by the cone, then choose the correct option.



(A) $N = mg\cos\theta$
(B) $g\sin\theta = \frac{v^2}{r}\cos\theta$
(C) $N\sin\theta - \frac{mv^2}{r} = 0$
(D) none of these

21. A mass m = 1kg, which is free to move on a horizontal frictionless surface, is attached to one end of a massless string that wraps partially around a frictionless vertical pole of radius r (see the top view in figure). You hold on to the other end of the string. At t = 0, the mass has speed v_0 in the tangential direction along the dotted circle of radius R shown. Your task is to pull on the string so that the mass keeps moving along the circular path of radius R. If at any instant 't' force applied by hand on string is f_0 = 2N then find out centripetal acceleration (in m/s^2) of mass. (Given : $R = \frac{2r}{\sqrt{3}}$)



ANSWER KEY			NLM+CIRCULAR MOTION
1. Ans. (A)	**2. Ans. (B,C,D)**	**3. Ans. (A,B,C)**	**4. Ans. (A,B,C,D)**
5. Ans. 5 m/s, 5/6 m, 175/6 J	**6. Ans. (B,C,D)**	**7. Ans. (A,B)**	**8. Ans. (A)**
9. Ans. (A)	**10. Ans. (C)**	**11. Ans. (C)**	**12. Ans. (C)**
13. Ans. 2	**14. Ans. 7**	**15. Ans. (ACD)**	**16. Ans. (A, B)**
17. Ans. (B)	**18. Ans. (C)**	**19. Ans. (D)**	**20. Ans. (B, C)**
21. Ans. 1			