PHYSICS

BOOKS - PSEB

Laws of Motion

Exercise

1. Give the magnitude and direction of the net force acting on:- a drop of rain falling down with a constant speed.

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2. Give the magnitude and direction of the net force acting on:- a cork of mass 10 g floating on water.

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3. Give the magnitude and direction of the net force acting on:- a kite skillfully held stationary in the sky.

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4. Give the magnitude and direction of the net force acting on:- a car moving with a constant velocity of $30 km / h$ on a rough road.

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5. Give the magnitude and direction of the net force acting on:- a high-speed electron in space far from all material objects, and free of electric and magnetic fields.

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6. A pebble of mass 0.05 kg is thrown vertically upwards. Give the direction and magnitude of the net force on the pebble:- during its upward motion.

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7. A pebble of mass 0.06 kg is thrown vertically upwards. Give the direction and magnitude of

the net force on the pebble:- during its downward motion.

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8. A pebble of mass 0.07 kg is thrown vertically upwards. Give the direction and magnitude of the net force on the pebble:- at the highest point where it is momentarily at rest. Do your answers change if the pebble was thrown at an angle of 45° with the horizontal direction? Ignore air resistance.

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9. Give the magnitude and direction of the net force acting on a stone of mass 0.1kg:- just after it is dropped from the window of a stationary train, Neglect air resistance throughout.

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10. Give the magnitude and direction of the net force acting on a stone of mass 0.1kg:- just

after it is dropped from the window of a train running at a constant velocity of $36km/h$, Neglect air resistance throughout.

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11. Give the magnitude and direction of the net force acting on a stone of mass 0.1kg:- just after it is dropped from the window of a train accelerating with $1ms^{-2}$, Neglect air resistance throughout.

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12. Give the magnitude and direction of the net force acting on a stone of mass 0.1kg:- lying on the floor of a train which is accelerating with $1ms^{-2}$, the stone being at rest relative to the train.Neglect air resistance throughout.

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13. One end of a string of length t is connected to a particle of mass m and the other to a

small peg on a smooth horizontal table. If the particle moves in a circle with speed v the net force on the particle (directed towards the centre) is : T is the tension in the string. [Choose the correct alternative].

A. T,

B. $T - \frac{mv^2}{l}$

C. $T + \frac{mv^2}{l}$,

D. 0

Answer:

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14. A constant retarding force of 50 N is applied to a body of mass 20 kg moving initially with a speed of $15ms^{-1}$. How long does the body take to stop ?

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15. A constant force acting on a body of mass 3.0 kg changes its speed from $2.0ms^{-1}$to $3.5ms^{-1}$ in 25 s. The direction of the motion

of the body remains unchanged. What is the magnitude and direction of the force ?

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16. A body of mass 5 kg is acted upon by two perpendicular forces 8 N and 6 N. Give the magnitude and direction of the acceleration of the body.

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17. The driver of a three-wheeler moving with a speed of $36 km / h$ sees a child standing in the middle of the road and brings his vehicle to rest in 4.0 s just in time to save the child. What is the average retarding force on the vehicle ? The mass of the three-wheeler is 400 kg and the mass of the driver is 65 kg.

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18. A rocket with a lift-off mass 20,000 kg is blasted upwards with an initial acceleration of $5.0ms^{-2}$. Calculate the initial thrust (force) of the blast.

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19. A body of mass 0.40 kg moving initially with a constant speed of $10ms^{-1}$ to the north is subject to a constant force of 8.0 N directed towards the south for 30 s. Take the instant

the force is applied to be t = 0, the position of the body at that time to be x = 0, and predict its position at t = -5 s, 25 s, 100 s.

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20. A truck starts from rest and accelerates uniformly at $2.0ms^{-2}$. At t = 10 s, a stone is dropped by a person standing on the top of the truck (6 m high from the ground). What are the:- velocity of the stone at t = 11s ? (Neglect air resistance.)

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22. A bob of mass 0.1 kg hung from the ceiling of a room by a string 2 m long is set into oscillation. The speed of the bob at its mean position is $1ms^{-1}$. What is the trajectory of the bob if the string is cut when the bob is:- at one of its extreme positions,

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23. A bob of mass 0.1 kg hung from the ceiling of a room by a string 2 m long is set into

oscillation. The speed of the bob at its mean position is $1ms^{-2}$. What is the trajectory of the bob if the string is cut when the bob is:- at its mean position.

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24. A man of mass 70 kg stands on a weighing scale in a lift which is moving :- upwards with a uniform speed of $10ms^{-1}$, what would be the reading on scale?

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25. A man of mass 70 kg stands on a weighing scale in a lift which is moving :- downwards with a uniform acceleration of $5ms^{-2}$,

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26. A man of mass 70 kg stands on a weighing scale in a lift which is moving :- upwards with a uniform acceleration of $5ms^{-2}$. What would be the readings on the scale in each case?

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27. A man of mass 70 kg stands on a weighing scale in a lift which is moving :- What would be the reading if the lift mechanism failed and it hurtled down freely under gravity ?

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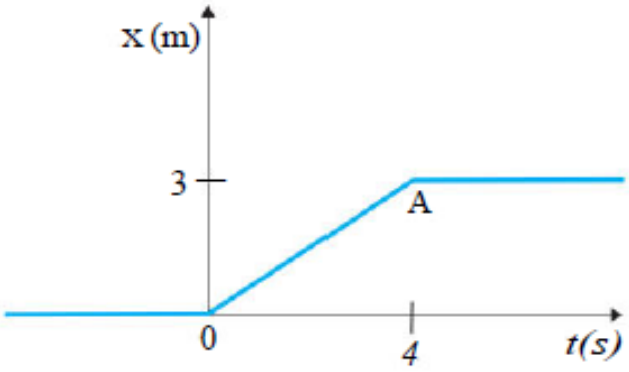
28. Figure shows the position-time graph of a particle of mass 4 kg. What is the:-force on the particle for $t < 0$, $t > 4$ s, $0 < t < 4$s? (Consider

one-dimensional motion only)



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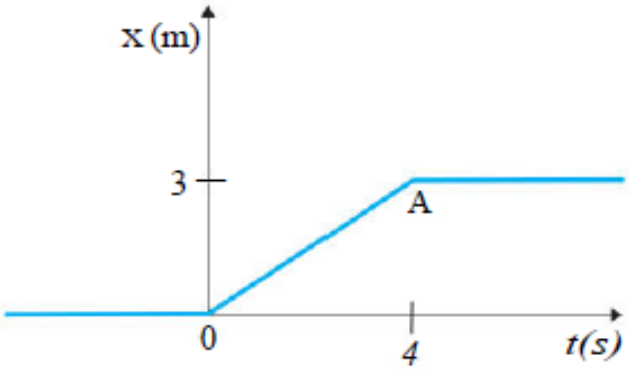
29. Figure shows the position-time graph of a particle of mass 4 kg. What is the:- mpulse at t = 0 and t = 4 s ? (Consider one-dimensional

motion only).



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30. Two bodies of masses 10 kg and 20 kg respectively kept on a smooth, horizontal surface are tied to the ends of a light string, a horizontal force F = 600 N is applied to:- A what is the tension in the string?

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31. Two bodies of masses 10 kg and 20 kg respectively kept on a smooth, horizontal surface are tied to the ends of a light string, a horizontal force F = 600 N is applied to:-B along the direction of string. What is the tension in the string in each case?

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32. Two masses 8 kg and 12 kg are connected at the two ends of a light inextensible string that goes over a frictionless pulley. Find the acceleration of the masses, and the tension in the string when the masses are released.

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33. A nucleus is at rest in the laboratory frame of reference. Show that if it disintegrates into

two smaller nuclei the products must move in opposite directions.

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34. Two billiard balls each of mass 0.05 kg moving in opposite directions with speed $6ms^{-1}$ collide and rebound with the same speed. What is the impulse imparted to each ball due to the other ?

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35. A shell of mass 0.020 kg is fired by a gun of mass 100 kg. If the muzzle speed of the shell is $80ms^{-1}$, what is the recoil speed of the gun ?

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36. A batsman deflects a ball by an angle of 45° without changing its initial speed which is equal to $54km/h$. What is the impulse imparted to the ball ? (Mass of the ball is 0.15 kg.)

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37. A stone of mass 0.25 kg tied to the end of a string is whirled round in a circle of radius 1.5 m with a speed of $40 rev./\min$ in a horizontal plane. What is the tension in the string ? What is the maximum speed with which the stone can be whirled around if the string can withstand a maximum tension of 200 N ?

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38. If, in Exercise 5.21, the speed of the stone is increased beyond the maximum permissible value, and the string breaks suddenly, which of the following correctly describes the trajectory of the stone after the string breaks :- the stone moves radially outwards.

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39. If, in Exercise 5.21, the speed of the stone is increased beyond the maximum permissible value, and the string breaks suddenly, which of

the following correctly describes the trajectory of the stone after the string breaks :- the stone flies off tangentially from the instant the string breaks.

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40. If, in Exercise 5.21, the speed of the stone is increased beyond the maximum permissible value, and the string breaks suddenly, which of the following correctly describes the trajectory of the stone after the string breaks :- the

stone flies off at an angle with the tangent whose magnitude depends on the speed of the particle ?

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41. Explain why:- a horse cannot pull a cart and run in empty space.

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42. Explain why:- passengers are thrown forward from their seats when a speeding bus stops suddenly.

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43. Explain why:- it is easier to pull a lawn mower than to push it.

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44. Explain why:- a cricketer moves his hands backwards while holding a catch.

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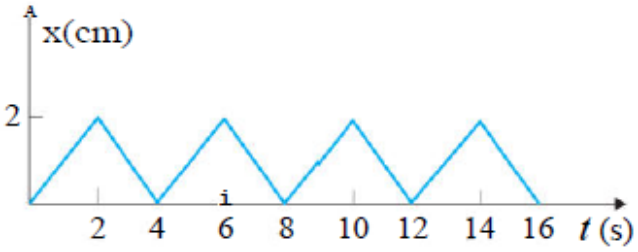
45. Figure 5.17 shows the position-time graph of a body of mass 0.04 kg. Suggest a suitable physical context for this motion. What is the time between two consecutive impulses received by the body ? What is the magnitude

of each impulse ?



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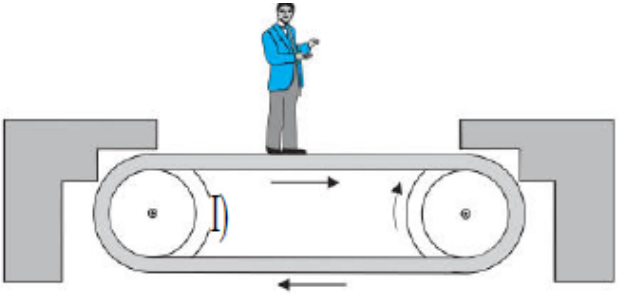
46. Figure 5.18 shows a man standing stationary with respect to a horizontal conveyor belt that is accelerating with $1ms^{-2}$. What is the net force on the man? If the coefficient of static friction between the man's shoes and the belt is 0.2, up to what

acceleration of the belt can the man continue to be stationary relative to the belt ? (Mass of the man = 65 kg.)



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47. A stone of mass mtied to the end of a string revolves in a vertical circle of radius R. The net forces at the lowest and highest

points of the circle directed vertically downwards are : [Choose the correct alternative] T_1 and v_1 denote the tension and speed at the lowest point. T_2 and v_2 denote corresponding values at the highest point.

(a)	$mg - T1$	$mg + T2$
(b)	$mg + T1$	$mg - T2$
(c)	$mg + T1\text{-}(mv2l) \ / \ R$	$mg \sim T2 + \ (mv^{\backslash}) \ / \ R$
(d)	$mg - T_1 - (m v_1^2) \ / \ R$	$mg + T2 + (\mathrm{m\ u2}) \ / \ R$

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48. A helicopter of mass 1000 kg rises with a vertical acceleration of $15ms^{-2}$. The crew and

the passengers weigh 300 kg. Give the magnitude and direction of the:- force on the floor by the crew and passengers,

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49. A helicopter of mass 1000 kg rises with a vertical acceleration of $15ms^{-2}$. The crew and the passengers weigh 300 kg. Give the magnitude and direction of the:- action of the rotor of the helicopter on the surrounding air,

Watch Video Solution

50. A helicopter of mass 1000 kg rises with a vertical acceleration of $15ms^{-2}$. The crew and the passengers weigh 300 kg. Give the magnitude and direction of the:- action of the rotor of the helicopter on the surrounding air,

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51. A stream of water flowing horizontally with a speed of $15ms^{-1}$ gushes out of a tube of cross-sectional area $10^{-2}m^2$, and hits a

vertical wall nearby. What is the force exerted on the wall by the impact of water, assuming it does not rebound ?

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52. Ten one-rupee coins are put on top of each other on a table. Each coin has a mass m Give the magnitude and direction of:- the force on the 7th coin (counted from the bottom) due to all the coins on its top,

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53. Ten one-rupee coins are put on top of each other on a table. Each coin has a mass m Give the magnitude and direction of:- the force on the 7th coin by the eighth coin,

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54. Ten one-rupee coins are put on top of each other on a table. Each coin has a mass m Give the magnitude and direction of:- the reaction of the 6th coin on the 7th coin.

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55. An aircraft executes a horizontal loop at a speed of $720 km/h$ with its wings banked at 15°. What is the radius of the loop ?

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56. A train runs along an unbanked circular track of radius 30 m at a speed of $54 km/h$. The mass of the train is $10^6 kg$. What provides

the centripetal force required for this purpose — Hie engine or the rails ? What is the angle of banking required to prevent wearing out of the rail ?

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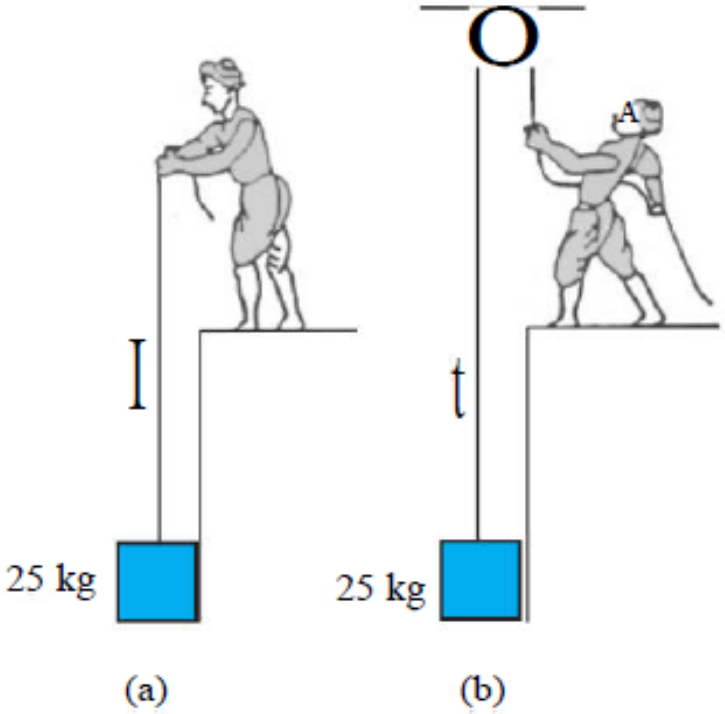
57. A block of mass 25 kg is raised by a 50 kg man in two different ways as shown in Fig. 5.19. What is the action on the floor by the man in the two cases ? If the floor yields to a normal force of 700 N, which mode should the man

adopt to lift the block without the floor yielding ?



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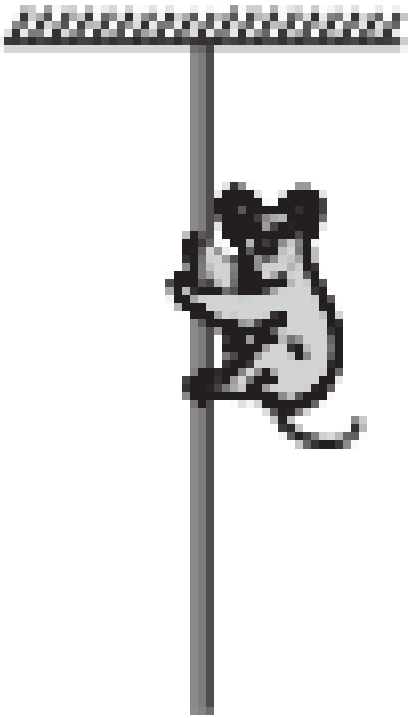
58. A monkey of mass 40kg climbs on a rope (Fig. 5.20) which can stand a maximum tension of 600 N. in which of the following cases will the rope break: the monkey:-



A. (a) climbs up with an acceleration of 6 ms^{-2}

B. (b) climbs down with an acceleration of 4 ms^{-2}

C. (c) climbs up with a uniform speed of 5 ms^{-1}

D. (d) falls down the rope nearly freely under gravity? (Ignore the mass of the rope).

Answer:

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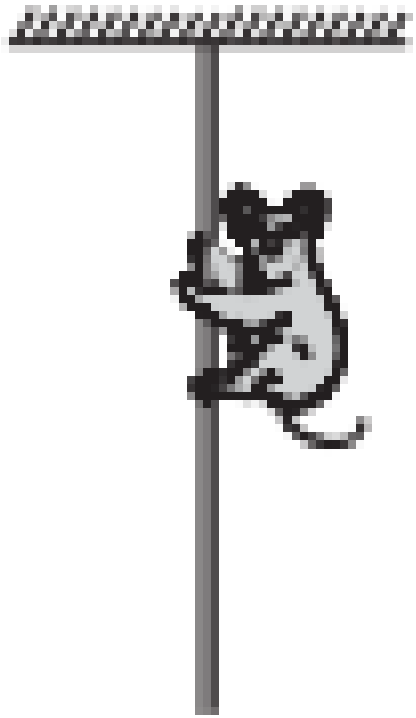
59. A monkey of mass 40kg climbs on a rope (Fig. 5.20) which can stand a maximum tension of 600 N. in which of the following cases will the rope break: the monkey:- climbs down with

an acceleration of $4ms^{-2}$,



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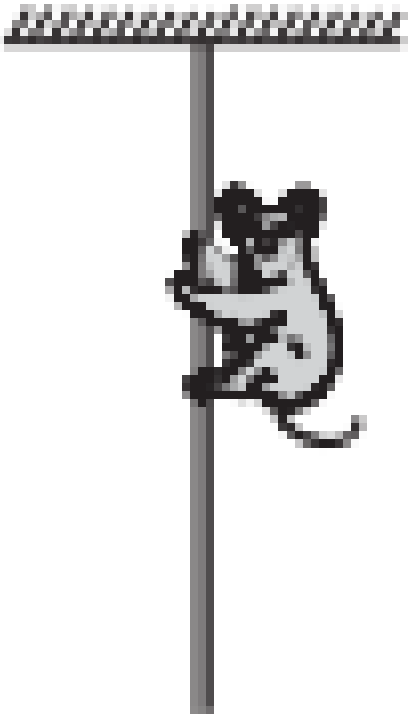
60. A monkey of mass 40kg climbs on a rope (Fig. 5.20) which can stand a maximum tension of 600 N. in which of the following cases will the rope break: the monkey:- climbs up with a uniform speed of $5ms^{-1}$,



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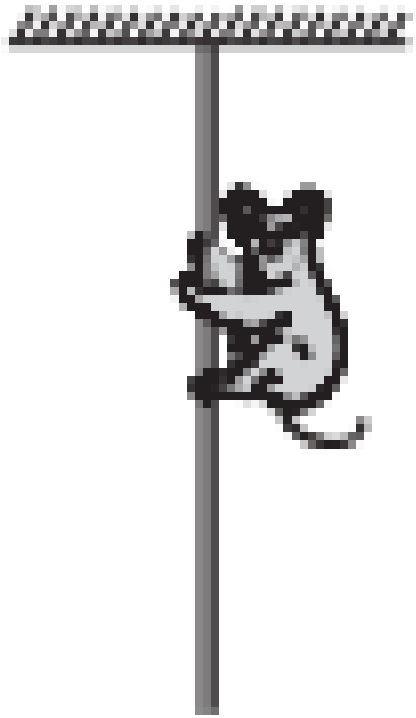

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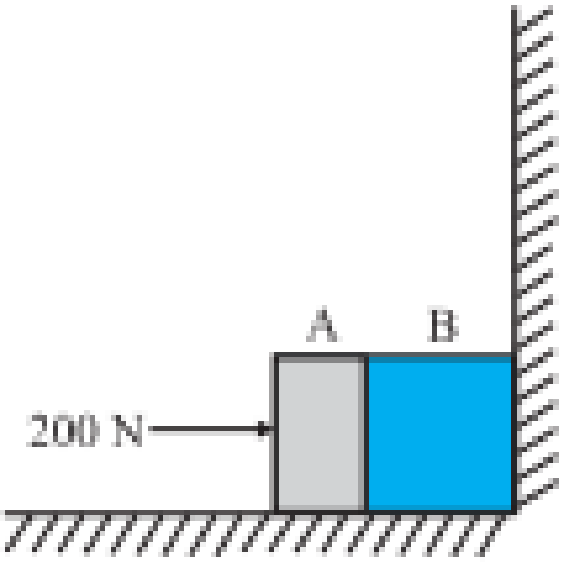
62. Two bodies A and B of masses 5 kg and 10 kg in contact with each other rest on a table against a rigid wall (Fig. 5.21). The coefficient of friction between the bodies and the table is 0.15. A force of 200 N is applied horizontally to A. What are :- the reaction of the partition.



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63. A block of mass 15 kg is placed on a long trolley. The coeffcient os static friction between the block and the trolley is 0.18. The trolley accelerates from rest with $0.5ms^{-2}$ for 20 s and then moves with uniform velocity. Discuss the motion of the block as viewed by:- a stationary observer on the ground.

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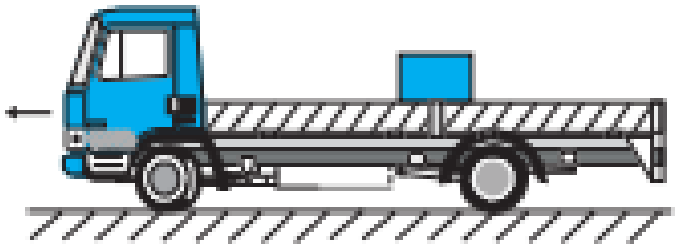
65. The rear side of a truck is open and a box of 40 kg mass is placed 5 m away from the open end as shown in Fig. 5.22. The coeffcient of friction between the box and the surface below it is 0.15. On a straight road, the truck starts from rest and accelerates with $2ms^{-2}$. At what distance from the starting point does the box fall off the truck? (Ignore the size of the box).



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66. A disc revolves with a spped of $33\left(\frac{1}{3}\right) rev/\ \min$, and has a radius of 15 cm. Two coins are placed at 4 cm and 14 cm away from the centre the record. If the co-effcient of friction between the coins and the record is 0.15, which of the coins will revolve with the record?

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67. You may have seen in a circus a motorcyclist driving in vertical loops inside a 'death- well' (a hollow spherical chamber with holes, so the spectators can watch from outside). Explain clearly why the motorcyclist does not drop down when he is at the uppermost point, with no support from below. What is the minimum speed required at the uppermost position to perform a vertical loop if the radius of the chamber is 25 m?

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68. A 70 kg man stands in contact against the ineer wall of a hollow cylindrical drum of radius 3 m rotating about its vertical axis with $200 rev / \min$. The coeffcient of friction between the wall and his clothing is 0.15. What is the minimum rotational speed of the cylinder to enable the man of remain stuck to the wall (without falling) when the floor ids suddenly removed?

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69. A thin circular loop of radius R rotates about its vertical diameter with an angular frequency ω. Show that a small bead on the wire loop rem ains at its lowermost point for $\omega \sqrt{\frac{g}{R}}$ What is the angle made by the radius vector joining the centre to the bead with the vertical downward direction for $\omega = \sqrt{2\frac{g}{R}}$? neglect friction.

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