EXERCISE-III (Conceptual Questions) **Build Up Your Understanding**

BASIC QUESTION RELAED TO CONCEPT OF FORCE AND NEWTON'S LAWS OF MOTIN

1. A particle is in a straight line motion with uniform velocity. A force is not required :-
(1) To increase the speed (2) To decrease the speed
(3) To maintain the same speed (4) To change the direction

2. Essential characteristic of equilibrium is :-
(1) Momentum equals zero (2) Acceleration equals zero
(3) K.E. equals zero (4) Velocity equals zero

3. When a constant force is applied to a body, it moves with uniform :-
(1) Acceleration (2) Velocity (3) Speed (4) Momentum

4. A 5 kg mass is accelerated from rest to 60 m/s in 1 s. What force acts on it : -
(1) 5×60 N (2) $(5/60) \times 981$ N (3) $60^2 \times 52$ N (4) $(5/2) \times 60^2 \times 981$N

5. A body of mass 40 g is moving with a constant velocity of 2 cm/s on a horizontal frictionless table. The force on the body (in dynes) is :-
(1) Zero (2) 39200 (3) 160 (4) 80

6. A body of mass 2 kg moving on horizontal surface with an initial velocity of 4 m/s comes to rest after 2 s. If one wants to keep this body moving on the same surface with a velocity of 4 m/s, the force required is:-
(1) 8 N (2) 4 N (3) Zero (4) 2 N

7. The distance x covered in time t by a body having initial velocity v_0 and having a constant acceleration a is given by $x = v_0t + \left(\frac{1}{2}\right)at^2$. This result follow from:-
(1) Newton's first law (2) Newton's second law
(3) Newton's third law (4) None of these

8. Working of rocket or jet is based on :-
(1) Newton's law (2) Newton's II law (3) Newton's III law (4) All the three laws

9. When a horse pulls a wagon, the force that causes the horse to move forward is the force
(1) He exerts on the wagon (2) The wagon exerts on him
(3) The ground exerts on him (4) He exerts on the ground

10. A man is at rest in the middle of a pond on perfectly smooth ice. He can get himself to the shore by making use of Newton's :-
(1) First law (2) Second law (3) Third law (4) Law of gravitation

11. A material body A of mass m_1 exerts a force on another material body B of mass m_2. If the acceleration of B be a_2, the magnitude of the acceleration of A is :-
(1) Zero (2) m_2a_2/m_1 (3) m_1a_2/m_2 (4) a_2

12. If the force of gravity suddenly disappears:
(1) The mass of all bodies will become zero
(2) The weight of all bodies will become zero
(3) Both mass and weight of all bodies will become zero
(4) Neither mass nor weight of all bodies will become zero

13. Two bodies of masses 4 kg and 5 kg are acted upon by the same force. If the acceleration of lighter body is 2 m/s^2, then the acceleration of the heavier body is:-
(1) 4.2 m/s^2 (2) 3.6 m/s^2 (3) 2.4 m/s^2 (4) 1.6 m/s^2

14. Action and reaction :- (For a given system)
(a) Act on the two different objects (b) Have opposite directions
(c) Have equal magnitudes (d) Have zero resultant
(1) a, b, c (2) b, c, d (3) All of the above (4) None of the above

15. An object with a mass 10 kg moves at a constant velocity of 10 m/s. A constant force then acts for 4 second on the object giving it a speed of 2 m/s in opposite direction. The acceleration produced is :-
(1) 3 m/s^2 (2) –3 m/s^2 (3) 0.3 m/s^2 (4) –0.3 m/s^2

16. The velocity acquired by a mass m in travelling a certain distance d stating from rest under the action of a constant force is directly proportional to :-
(1) $\sqrt{m}$ (2) m^o (3) $\frac{1}{\sqrt{m}}$ (4) m

17. Weight is defined as :-
(1) Force of attraction exerted by the earth (2) Mass of a body
(3) Nature of a body (4) None of these

18. A ship of mass 3×10^7 kg initially at rest is pulled by a force of 5×10^4N through a distance of 3m. Neglecting friction, the speed of the ship at this moment is :
(1) 3.0 m/s (2) 1.5 m/s (3) 0.1 m/s (4) 2 m/s

19. In Newton's second Law $\vec{F} = m\vec{a}$ (for constant mass m), $\vec{a}$ is the acceleration of the mass m with respect to
(1) any observer (2) any inertial observer
(3) an observer at rest only (4) an observer moving with uniform speed only

20. The ratio of gravitational mass to inertial mass is equal to :
(1) $\frac{1}{2}$ (2) 2 (3) 1 (4) None of these

MOMENTUM, IMPULSE, RATE OF CHANGE OF MOMENTUM AND AVERAGE FORCE RELATED PROBLEMS

21. A balloon of mass M is descending with a constant acceleration g/3. When a mass m is released from the balloon it starts rising with the same acceleration g/3. The value of m is (Assuming that its volume does not change) :-

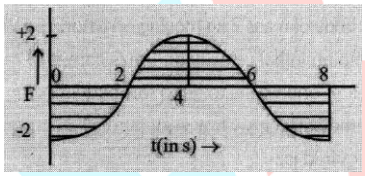
(1) $\frac{M}{2}$ (2) $\frac{M}{4}$ (3) 4M (4) 2M

22. gravel is dropped onto a conveyer belt at a rate of 0.5 kg/s. The extra force required in newton to keep the belt moving at 2 m/s is :-
(1) 1 M (2) 2 N (3) 4 N (4) 0.5 N

23. A block of metal weighing 2 kg is resting on a frictionless plane. It is struck by a jet releasing water at a rate of 1 kg/s with a speed of 5 m/s. The initial acceleration of the block will be :-
(1) 2.5 m/s^2 (2) 5 m/s^2 (3) 10 m/s^2 (4) 15 m/s^2

24. A ball weighing 10 g hits a hard surface vertically with a speed of 5 m/s and rebounds with the same speed. The ball remains in contact with the surface for (0.01) s. The average force exerted by the surface on the ball is :-
(1) 100 N (2) 10 N (3) 1 N (4) 0.1 N

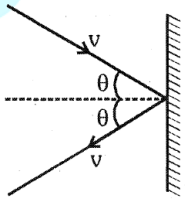
25. Force-time graph for the motion of a body is shown in fig. Change in linear momentum between 0 to 8 s is :-



(1) Zero (2) 4 N-s (3) 8 N-s (4) None

26. Newton's II law of motion connects :
(1) Momentum and acceleration
(2) Change of momentum and velocity
(3) Rate of change of momentum and external force
(4) Rate of change of force and momentum

27. A water jet, whose cross sectional are is 'a' strikes a wall making an angle 'θ' with the normal and rebounds elastically. The velocity of water of density 'd' is v. Force exerted on wall is :-



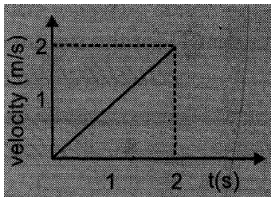
(1) $2 av^2d \cos\theta$ (2) $2 av^2d \sin\theta$ (3) $2 avd \cos\theta$ (4) $2 avd \cos\theta$

28. When we kick a stone, we get hurt. Due to which of the following properties of stone does it happens?
(1) Inertia (2) Velocity (3) Reaction (4) Momentum

29. A player catches a ball of 200 g moving with a speed of 20 m/s. If the time taken to complete the catch is 0.5 s, the force exerted on the player's hand is :-
(1) 8 N (2) 4 N (3) 2 N (4) 0

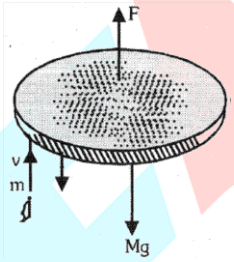
30. A tennis ball is dropped on the floor from a height of 20 m. It rebounds to a height of 5 m. The ball was in contact with the floor for 0.01s. What was its average acceleration during the contact? ($g = 10 m/s^2$)
(1) 3000 m/s^2 (2) 2000 m/s^2 (3) 1000 m/s^2 (4) 500 m/s^2

31. For a body of 50 kg mass, the velocity-time graph is shown in figure. The force acting on the body is :



(1) 25 N (2) 50 N (3) 12.5 N (4) 100 N

32. A disc of mass 1.0 kg is kept floating horizontally in air by firing bullets of mass 0.05 kg each vertically at it, at the rate of 10 per second. If the bullets rebound with the same speed the speed with which these are fired will be-



(1) 0.098 m/s (2) 0.98 m/s (3) 9.8 m/s (4) 98.0 m/s

33. A satellite in force free space sweeps stationary interplanetary dust at a rate $(dM/dt) = +\alpha v$. Here v is the velocity. The acceleration of satellite of mass M is:-
(1) $-2\alpha v^2/M$ (2) $-3\alpha v^2/M$ (3) $-\alpha v^2/M$ (4) $-\alpha v^2$

34. If force $F = 500 - 100t$, then impulse as a function of time will be :-
(1) $500t - 50t^2$ (2) $50t - 10$ (3) $50 - t^2$ (4) $100t^2$

35. For a Rocket propulsion velocity of exhaust gases relative to rocket is 2 km/s. If mass of rocket system is 1000 kg, then the rate of fuel consumption for a rocket to rise up with an acceleration 4.9 m/s^2 will be :-
(1) 12.25 kg/s (2) 17.5 kg/s (3) 7.35 kg/s (4) 5.2 kg/s

36. If the force on a rocket moving in force free space with an exhaust velocity of gases 300m/sec is 210 N, then the rate of combustion of the fuel, is :-
(1) 0.7 kg/s (2) 1.4 kg/s (3) 2.7 kg/s (4) 10.7 kg/s

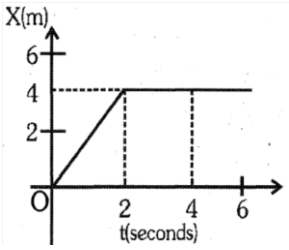
37. A rocket of mass 120 kg. is fired in a gravity free space is ejecting gases with velocity 600 m/s at the rate of 1 kg/s. What will be the initial acceleration of the rocket ?
(1) 1 m/s^2 (2) 5 m/s^2 (3) 10 m/s^2 (4) 15 m/s^2

38. n bullet strike per second elastically on a wall and rebound. What will be the force exerted on the wall by bullets if mass of each bullet is m :-

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

39. A monkey of mass 20 kg is holding a vertical rope. The rope will not break when a mass of 25 kg is suspended from it but will break if the mass exceeds 25 kg what is the maximum acceleration with which the monkey can climb up along the rope? ($g = 10\ m/s^2$)
(1) $5\ m/s^2$ (2) $10\ m/s^2$ (3) $25\ m/s^2$ (4) $2.5\ m/s^2$

40. In the figure given below, the position-time graph of a particle of mass 0.1 kg is shown. The impulse at t = 2 sec is –



(1) 0.2 kg-m/s (2) –0.2 kg-m/s (3) 0.1 kg-m/s (4) –0.4 kg-m/s

41. A person is standing in an elevator. In which situation he finds his weight less ?
(1) when the elevator moves upward with constant acceleration
(2) when the elevator moves downward with constant acceleration
(3) when the elevator moves upward with uniform velocity
(4) when the elevator moves downward with uniform velocity

42. A force of 10 N acts on a body of mass 20 kg for 10 seconds. The change in its momentum is
(1) 50 kg-m/s (2) 100 kg-m/s (3) 300 kg-m/s (4) 1000 kg-m/s

43. A rocket of mass 1000 kg is to be projected vertically upwards. The gases are exhausted vertically downwards with velocity 100 m/s with respect to the rocket. What is the minimum rate of burning fuel, so as to just lift the rocket upwards against the gravitational attraction? (Take $g = 10\ m/s^2$)
(1) 50 kg/s (2) 100 kg/s (3) 200 kg/s (4) 400 kg/s

44. A 150 g tennis ball coming at a speed of 40 m/s is hit straight back by a bat to speed of 60 m/s. The magnitude of the average force F on the ball, when it is in contact for 5 ms with the bat is:
(1) 2500 N (2) 3000 N (3) 3500 N (4) 4000 N

45. Ten one-rupee coins are put on top of each other on a table. Each coin has a mass m. Which of the following statements is not true ?
(1) The force on the 6^{th} coin (counted from the bottom) due to all the coins on its top is equal to 4mg (downwards).
(2) The force on the 6^{th} coin due to the 7^{th} coin 4mg (downwards)
(3) The reaction of the 6^{th} coin on the 7^{th} coin 4mg (upwards).
(4) The total force on the 10^{th} coin is 9mg (downwards)

46. A 140 g ball, in horizontal flight with a speed of 39.0 m/s, is struck by a bat. After leaving the bat, the ball travels in the opposite direction with speed $v_2 = 39.0$ m/s. If the impact time At for the ball-bat collision is 1.20 ms, what average force acts on the ball?

(1) 1308 N (2) 1090 N (3) 9100 N (4) 980 N

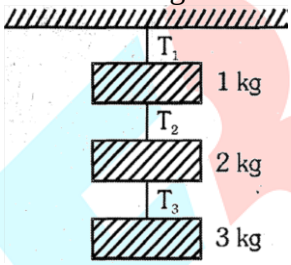
FREE BODY DIAGRAM, EQUILIBRIUM OF CONCURRENT FROCES-LAMI'S THEOREM

47. A cork of mass 10 g is floating on water. Net force on the cork is :-
(1) 10 N (2) 10^{-3}N (3) 10^{-2} N (4) Zero

48. Two persons hold a rope of negligible weight tightly at its ends so that it is horizontal. A 15 kg weight is attached to the rope at the mid point which is now no longer remains horizontal. The minimum tension required to completely straighten the top is
(1) 15 kg (2) 15/2 kg (3) 5 kg (4) Infinitely large

49. A boy of mass 40 kg is hanging from a horizontal branch of a tree. The tension in his arms is minimum when the angle between the arms is :-
(1) 0º (2) 90° (3) 120° (4) 180°

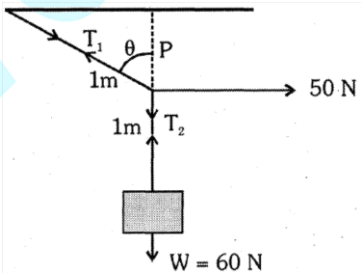
50. Find the tension T_2 for the system shown in fig.



(1) 1g N (2) 2g N (3) 5g N (4) 6g N

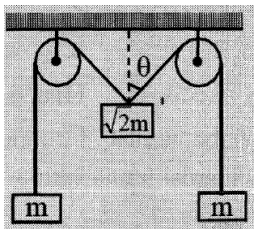
51. Ten one rupees coins are put on top of each other on a table. Each coin has a mass 'm' kg., then the force on the 7th coin (counted from the bottom) due to all the coins on its top :-
(1) 3 mg (2) 7 mg (3) 2 mg (4) 5 mg

52. A mass of 6 kg is suspended by a rope of length 2 m from a ceiling. A force of 50 N is applied in horizontal direction at the mid point of the rope. What is the angle between the rope and the vertical in equilibrium :-



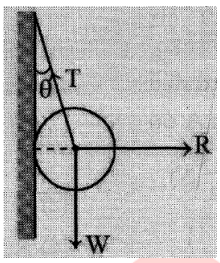
(1) $\tan^{-1}\left(\frac{4}{5}\right)$ (2) $\tan^{-1}\left(\frac{5}{4}\right)$ (3) $\tan^{-1}\left(\frac{5}{6}\right)$ (4) None

53. The pulleys and strings shown in the fig. are smooth and are of negligible mass. For the system to remain in equilibrium, the angle θ should be



(1) 0^o (2) 30^o (3) 45^o (4) 60^o

54. A metal sphere is hung by a string fixed to a wall. The forces acting on the sphere are shown in fig. Which of the following statements is correct ?



(a) $\vec{R}+\vec{T}+\vec{W}=0$ (b) $T^2 = R^2 + W^2$ (c) T = R + W (d) R = W tan θ

(1) a, b, c (2) b, c, d (3) a, b, d (4) a, b, c, d

55. A block of mass 4 kg is suspended through two light spring balances A and B in series. Then A and B will read respectively.

(1) 4 kg and zero kg (2) zero kg and 4 kg (3) 4 kg and 4 kg (4) 2 kg and 2 kg

56. Two masses m_1 and m_2 are joined by a spring as shown. The system is dropped to the ground from a certain height. The spring will be :-

(1) Stretched when $m_2 > m_1$
(2) compressed when $m_2 < m_1$
(3) neither compressed nor stretched only when $m_1 = m_2$
(4) neither compressed nor stretched regardless of the values of m_1 and m_2.

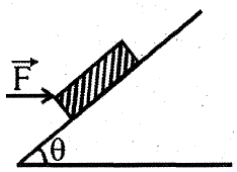
57. A man weighs 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5 m/s^2. What would be the reading on the scale? (g = 10 m/s^2)

(1) Zero (2) 400 N (3) 800 N (4)1200 N

58. A block of mass m is placed on a smooth wedge of inclination θ. The whole system is accelerated horizontally so that the block does not slip on the wedge. The force exerted by the wedge on the block (g is acceleration due to gravity) will be :-

(l) mg sinθ (2) mg (3) mg/cosθ (4) mg cosθ

59. The figure shows a horizontal force $\vec{F}$ acting on a block of mass M on an inclined plane (angle θ). What is the normal reaction on the block ?



(1) $mg\sin\theta + F\cos\theta$ (2) $mg\sin\theta - F\cos\theta$
(3) $mg\cos\theta - F\sin\theta$ (4) $mg\cos\theta + F\sin\theta$

60. A man, of mass 60 kg, is riding in a lift. The weights of the man, when the lift is accelerating upwards and downwards at 2 m/s^2 are respectively : (Taking g = 10 m/s^2)
(1) 720 N and 480 N (2) 480 N and 720 N
(3) 600 N and 600 N (4) none of these

FRAME OF REFERENCE – INTERTIAL OR NON INERTIAL FRAME, PSEUDO FORCE, ACCELERATING LIFT

61. A man is standing at a spring platform. Reading of spring balance is 60 kg-wt. If the man jumps off from the platform, then reading of spring balance:-
(1) First increases then decreases to zero (2) Decreases
(3) Increases (4) Remains same

62. A small sphere is suspended by a string from the ceiling of a car. If the car begins to move with a constant acceleration $\frac{g}{2}$, the inclination of the string with the vertical is:-
(1) $\tan^{-1}\left(\frac{1}{2}\right)$ in the direction of motion (2) $\tan^{-1}\left(\frac{1}{2}\right)$ opposite to the direction of motion
(3) $\tan^{-1}(2)$ in the direction of motion (4) $\tan^{-1}(2)$ opposite to the direction of motion

63. A pendulum is suspended from the roof of a rail road car. When the car is moving on a circular track the pendulum inclines :
(1) Forward (2) Backward
(3) Towards the centre of the path (4) Away from the centre of the path

64. A boy sitting on the upper berth in the compartment of a train, which is about to stop at a railway station, drops an apple aiming at the open hand of his brother vertically below his hands at a distance of about 2 m. The apple will fall :-
(1) In the hand of his brother
(2) Slightly away from the hands of his brother in the direction of motion of the train
(3) slightly away from the hands of his brother in the direction opposite to the direction of motion of the train
(4) none of the above

65. The force exerted by a person on the floor of an elevator is more than the weight of the person if the elevator is :-
(a) Going up and slowing down (b) Going up and speeding up
(c) Going down and slowing down (d) Going down and speeding up
(1) a, c (2) b, c (3) a, d (4) b, d

66. The ratio of weights of a man in a stationary lift and in a lift accelerating downwards with a uniform acceleration is 3 : 2. The acceleration of the lift is:-

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

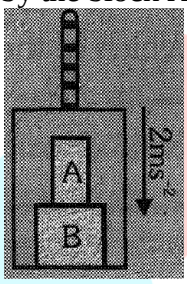
67. A lift is moving downwards with acceleration a. A man in the lift drops a ball within the lift. The acceleration of the ball as observed by the man in the lift and a man standing stationary on the ground are respectively :

(1) g, g (2) g – a, g – a (3) g – a, g (4) a, g

68. A frame will be inertial, if it moves with respect to another inertial frame with a constant :-

(1) Linear velocity (2) Angular velocity
(3) Linear acceleration (4) All of the above

69. The elevator shown in figure is descending, with an acceleration of 2 m/s^2. The mass of the block A is 0.5 kg. The force exerted by the block A on the block B is :



(1) 2 N (2) 4 N (3) 6 N (4) 8 N

70. A man weighing 100 kg carries a load of 10 kg on his head. He jumps from a tower with the load on his head. What will be the weight of the load as experienced by the man ?

(1) zero (2) 10 kg
(3) slightly more than 10 kg (4) 110 kg

71. Drums of oil are carried in a truck. If the truck accelerates at a constant rate, the surface of the oil in the drum will-

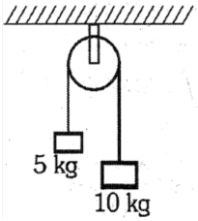
(1) Remain unaffected (2) Rise in the forward direction
(3) Rise in the backward direction (4) Nothing is certain

72. A body kept on a smooth inclined plane of inclination 1 in x will remain stationary relative to the inclined plane if the plane is given a horizontal acceleration equal to :-

(1) $\sqrt{x^2-1g}$ (2) $\frac{\sqrt{x^2-1}}{x}g$ (3) $\frac{gx}{\sqrt{x^2-1}}$ (4) $\frac{g}{\sqrt{x^2-1}}$

MOTION OF BODIES IN CONTACT OR CONNECTED BY STRINGS, PULLEY SYSTEM

73. Two blocks of masses 5 kg and 10 kg are connected to a pulley as shown. What will be their acceleration if the pulley is set free ? (g = acceleration due to gravity)



(1) g (2) g/2 (3) g/3 (4) g/4

74. Three solids of masses m_1, m_2 and m_3 are connected with weightless string in succession and are placed on a frictionless table. If the mass m_3 is dragged with a force T. The tension in the string between m_2 and m_3 is :-

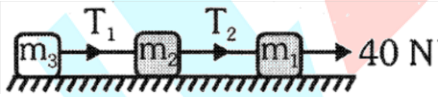
(1) $\frac{m_2}{m_1+m_2+m_3}T$ (2) $\frac{m_3}{m_1+m_2+m_3}T$ (3) $\frac{m_1+m_2}{m_1+m_2+m_3}T$ (4) $\frac{m_2+m_3}{m_1+m_2+m_3}T$

75. Two particles of masses m and M (M > m) are connected by a cord that passes over a massless and frictionless pulley. The tension T in the string and the acceleration a of the particles is :-

(1) $T = \frac{2mM}{(M-m)}g$; $a = \left(\frac{Mm}{M+m}\right)g$ (2) $T = \frac{2mM}{(M+m)}g$; $a = \left(\frac{M-m}{M+m}\right)g$

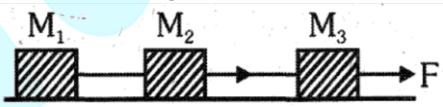
(3) $T = \left(\frac{M-m}{(M+m)}\right)g$; $a = \left(\frac{2mM}{M+m}\right)g$ (4) $T = \left(\frac{Mm}{(M+m)}\right)g$; $a = \left(\frac{2mM}{M+m}\right)g$

76. Three block of masses m_1, m_2 and m_3 are connected by massless strings as shown in the figure on a frictionless table. They are pulled with a force of 40 N. If m_1 = 10 kg, m_2 = 6 kg and m_3 = 4 kg, then tension T_2 will be :-



(1) 10 N (2) 20 N (3) 32 N (4) 40 N

77. Three masses M_1, M_2 and M_3 are lying on a frictionless table. The masses are connected by massless threads as shown. The mass M_3 is pulled by a constant force F as shown. The tension in the thread between masses M_2 and M_3 is



(1) $\left(\frac{M_1+M_2}{M_1+M_2+M_3}\right)F$ (2) $\left(\frac{M_2+M_3}{M_1+M_2+M_3}\right)F$

(3) $\left(\frac{M_1+M_3}{M_1+M_2+M_3}\right)F$ (4) $\left(\frac{M_1-M_2}{M_1+M_2+M_3}\right)F$

78. Two bodies A and B of masses 10 kg and 15 kg respectively kept on a smooth, horizontal surface are tied to the ends of a light string. If T represents the tension in the string when a horizontal force F = 500 N is applied to A (as shown in figure 1) and T' be the tension when it is applied to B (figure2), then which of the following is true?

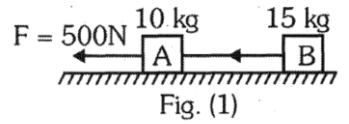


Fig. (1)

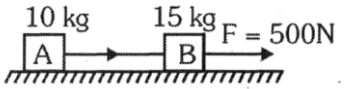


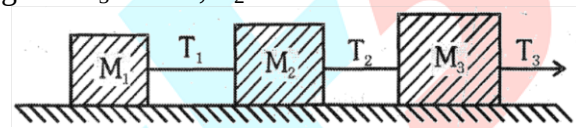
Fig. (2)

(1) T = T' = 500 N (2) T = T' = 250 N
(3) T = 200 N, T' = 300 N (4) T = 300 N, T' = 200 N

79. If a parrot starts flying upwards with an acceleration in an air tight cage, then the boy will feel the weight of the cage:
(1) Unchanged (2) Reduced (3) Increased (4) Nothing can be said

80. Two blocks of masses 2 kg and 1 kg are in contact with each other on a frictionless table. When a horizontal force of 3.0 N is applied to the block of mass 2 kg the value of the force of contact between the two blocks is -
(1) 4 N (2) 3 N (3) 5 N (4) 1 N

81. Three blocks are connected as shown in fig. on a horizontal frictionless table if m_1 = 1 kg, m_2 = 8 kg, m_3 = 27 kg and T_3 = 36N, T_2 will be:-

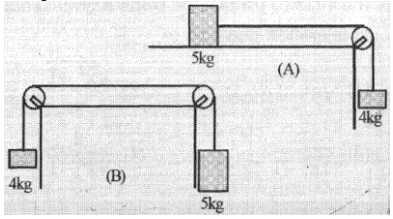


(1) 18 N (2) 9 N (3) 3.375 N (4) 1.75 N

82. In the fig. given below masses m and m' are tied with a thread passing over a pulley, m is on a frictionless horizontal surface. If acceleration due to gravity is g, the acceleration of m' in this arrangement will be :-

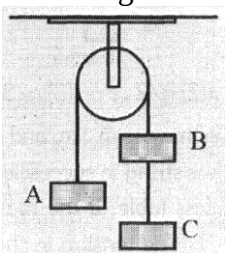
(1) g (2) m'g/(m + m') (3) mg/m' (4) mg/(m – m')

83. Two bodies of masses 5 kg and 4 kg are arranged in two different ways as shown in fig. (A) and (B). If the pulleys and the table are perfectly smooth, the acceleration of the 5 kg body in case (A) and (B) are respectively :-



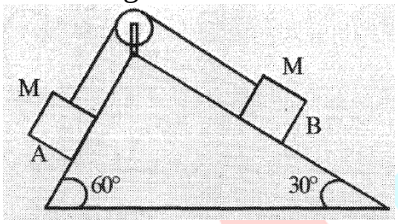
(1) g and (5/9) g (2) (4/9)g and (1/9)g
(3) g/5 and g/5 (4) (5/9)g and (1/9)g

84. Three equal weights each of mass 4 kg are hanging on a string passing over a fixed pulley as shown in fig. What is the tension in the string connecting weights B and C.



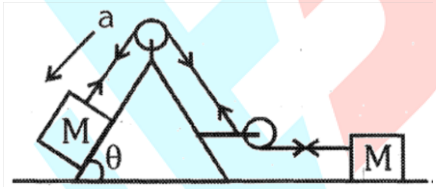
(1) Zero (2) 13.3 N (3) 26.6 N (4) 19.6 N

85. Two blocks each of mass M are resting on a frictionless inclined planes as shown in fig. then



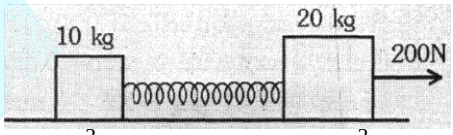
(1) The block A moves down the plane (2) The block B moves the plane
(3) Both the blocks remain at rest (4) Both the blocks move down the plane

86. Two blocks each having a mass M are placed as shown in the figure. The acceleration of the system is :-



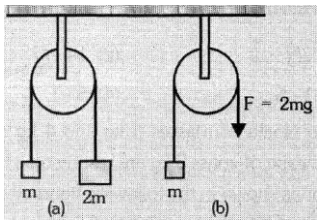
(1) 0 (2) $\frac{g\sin\theta}{2}$ (3) $g\sin\theta$ (4) $2g\sin\theta$

87. Two masses of 10 kg and 20 kg respectively are connected by a massless spring as shown in the figure. A force of 200 N acts on the 20 kg mass. At the instant shown the 10 kg mass has an acceleration 4 m/s^2 rightwards. What is the acceleration of 20 kg mass ?



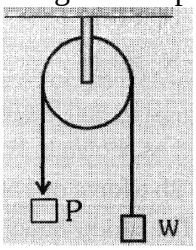
(1) Zero (2) 10 m/s^2 (3) 4 m/s^2 (4) 8 m/s^2

88. The pulley arrangements shown in the figure are identical, the mass of the rope being negligible. In case (a) mass m is lifted by attaching a mass of 2m to the other end of the rope. In case (b) the mass m is lifted by pulling the other end of the rope with a constant downward force F = 2mg, where g is the acceleration due to gravity. The acceleration of mass m in case (a) is:



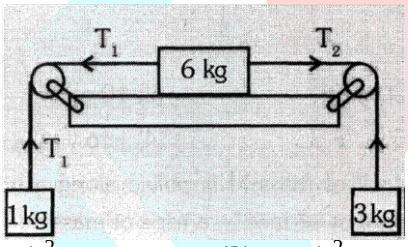
(1) Zero
(2) More than that in case (b)
(3) Less than that in case (b)
(4) Equal to that in case (b)

89. What is the mechanical advantage of single fixed pulley ?



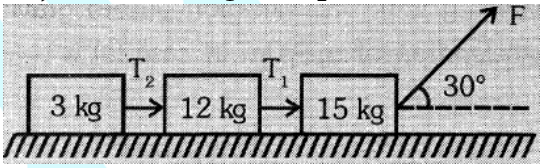
(1) 1
(2) 2
(3) 0.5
(4) 4

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



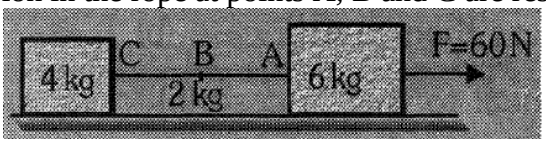
(1) Zero
(2) 2 m/s^2
(3) 4 m/s^2
(4) 3 m/s^2

91. The surface is frictionless, the ratio of T_1 and T_2 is :-



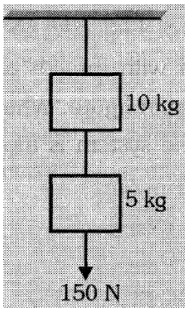
(1) $\sqrt{3}$: 1
(1) 1 : $\sqrt{3}$
(3) 1 : 5
(4) 5 : 1

92. Two blocks of masses 6 kg and 4 kg connected by a rope of mass 2 kg are resting on a frictionless floor as shown in the following figure. If a constant force of 60 N is applied to 6 kg block, then the tension in the rope at points A, B and C are respectively given by:



(1) 60 N, 60 N, 60 N
(2) 30 N, 25 N, 20 N
(3) 20 N, 25 N, 30 N
(4) 20 N, 20 N, 20 N

93. Two masses of 10 kg and 5 kg are suspended from a fixed support as shown in figure. The system is pulled down with a force of 150 N attached to the lower mass. The string attached to the support breaks and the system accelerates dowards. If the downward ·force continues to act, what is the acceleration of the system ?

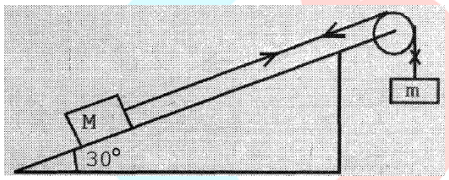


(1) 20 m/s^2 (2) 10 m/s^2 (3) 5 m/s^2 (4) zero

94. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m. If a force F is applied at one end of the rope, the force which the rope exerts on the block is :-

(1) F/(M + m) (2) F (3) FM/(m + M) (4) Zero

95. In the fig. mass M = 10 g. is placed on an inclined plane. In order to keep it at rest, the value of mass m will be :



(1) 5 g (2) 10 $\sqrt{3}$ g (3) 0.10 g (4) $\sqrt{3}$ g

96. The mechanical advantage of a wheel axle is 5. What will be the force required to lift a 200 kg wt?

(1) 10 kg wt. (2) 2 kg wt. (3) 20 kg wt. (4) 40 kg wt.

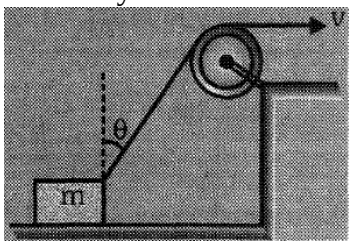
97. Two bodies A (30 kg) and B (50 kg) tied with a light string are placed on a frictionless table. A force F acting at B pulls this system with an acceleration of 2ms^{-2}. The tension in the string is:

(1) 60 N (2) 100 N (3) 35 N (4) 140 N

98. A string of length L and mass M is lying on a horizontal table. A force F is applied at one of its ends. Tension in the string at a distance x from the end at which force is applied is:

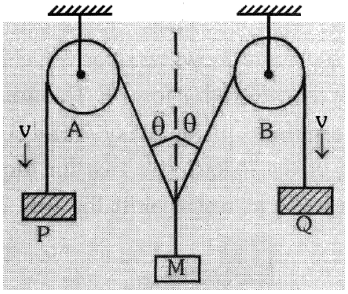
(1) Zero (2) F (3) F(L – x)/L (4) F(L – x)/M

99. A block is dragged on a smooth plane with the help of a rope which moves with a velocity v as shown in figure. The horizontal velocity of the block is :



(1) v (2) $\frac{v}{\sin\theta}$ (3) v sinθ (4) $\frac{v}{\cos\theta}$

100. In the fig. the ends P and Q of an unstrechable string move downward with uniform speed v. Mass M moves upwards with speed.



(1) v cosθ (2) v/cosθ (3) 2v cosθ (4) 2/v cosθ

FRICTION

101. The coefficient of static friction between two surfaces depend on
(1) the nature of surface (2) the shape of the surface in contact
(3) the area of contact (4) all of the above

102. A block of mass 2 kg is placed on the floor. The coefficient of static friction is 0.4. Force of 2.8 N is applied on the block. The force of friction between the block and the floor is
(1) 2.8 N (2) 8.0 N (3) 2.0 N (4) zero

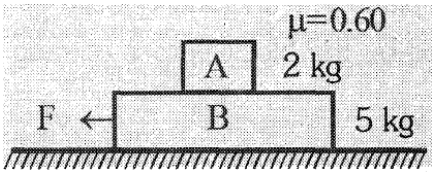
103. The frictional force of the air on a body of mass 0.25 kg, falling with an acceleration of 9.2 m/s^2, will be:
(1) 1.0 N (2) 0.55 N (3) 0.25 N (4) 0.15N

104. A block of mass 15 kg is placed on a long trolley. The coefficient of friction between the block and trolley is 0.18. The trolley accelerates from rest with 0.5 m/s^2 for 20 s. then what is the friction force?
(1) 3.5 N (2) 133.3 N (3) 7.5 N (4) N.O.T.

105. A rope lies on a table such that a part of it hangs down the table. When the length of hanging part is 1/3 of entire length the rope just begins to slide. The coefficient of friction between the rope and the table is :-
(1) 2/3 (2) 1/2 (3) l/3 (4) l/6

106. A 2 kg block (A) is placed on 8 kg block (B) which rests on a table. Coefficient of friction between (A) and (B) is 0.2 and between (B) and table is 0.5. A 25 N horizontal force is applied on the block (B), then the friction force between the blocks (A) and) (B) is :-
(1) Zero (2) 3.9 N (3) 5 N (4) 49 N

107. Two blocks (A) 2 kg and (B) 5 kg rest one over the other on a smooth horizontal plane. The coefficient of static and dynamic friction between (A) and (B) is the same and equal to 0.60. The maximum horizontal force F that can be applied to (B) in order that both (A) and (B) do not have any relative motion is:



(1) 42 N (2) 42 kgf (3) 5.4 kgf (4) 1.2 N

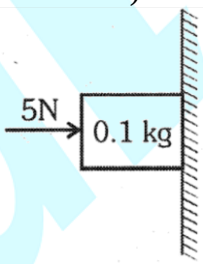
108. A body is placed on an inclined place and has to be pushed down in order to make it move. The angle made by the normal reaction with the vertical will be :-
(1) Equal to angle of repose (2) Equal to the angle of friction
(3) Less than the angle of repose (4) More than the angle of friction

109. A car is moving along a straight horizontal road with a speed v_0. If the coefficient of friction between tyres and the road is μ· The shortest distance in which the car can be stopped is :

(1) $\frac{v_0^2}{2\mu g}$ (2) $\frac{v_0^2}{\mu g}$ (3) $\left(\frac{v_0}{\mu g}\right)^2$ (4) $\frac{2v_0^2}{\mu g}$

110. The force required to just move a body up an inclined plane is double the force required to just prevent the body from sliding down the plane. The coefficient of friction is μ. The inclination θ of the plane is:-
(1) $\tan^{-1}(\mu)$ (2) $\tan^{-1}(\mu/2)$ (3) $\tan^{-1}(2\mu)$ (4) $\tan^{-1}(3\mu)$

111. A block of mass 0.1 kg. is pressed against a wall with a horizontal force of 5N as shown in the figure. If the coefficient of friction between the wall and the block is 0.5 then the frictional force acting on the block will be ($g = 9.8\ m/s^2$) :-



(1) 9.8 N (2) 2.5 N (3) 0.98 N (4) 0.49 N

112. A block slides with constant velocity on a plane inclined at an angle θ. The same block is pushed up the plane with an initial velocity v_0. The distance covered by the block before coming to rest is :-

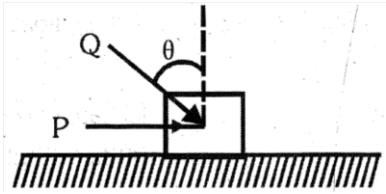
(1) $\frac{v_0^2}{2g\sin\theta}$ (2) $\frac{v_0^2}{4g\sin\theta}$ (3) $\frac{v_0^2\sin^2\theta}{2g}$ (4) $\frac{v_0^2\sin^2\theta}{4g}$

113. A block of mass m is lying on an inclined plane. The coefficient of friction between the plane and the block is μ. The force (F_1) required to move the block up the inclined plane will be:-
(1) $mg\sin\theta + \mu mg\cos\theta$ (2) $mg\cos\theta - \mu mg\sin\theta$
(3) $mg\sin\theta - \mu mg\cos\theta$ (4) $mg\cos\theta + \mu mg\sin\theta$

114. A body is sliding down an inclined plane (angle of inclination 45º). If the coefficient of friction is 0.5 and $g = 9.8\ m/s^2$, then the downward acceleration of the body in m/s^2 is :-

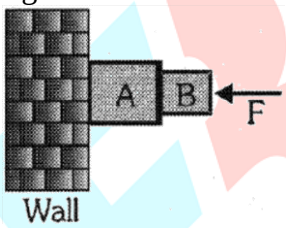
(1) $\frac{4.9}{\sqrt{2}}$ (2) $4.9\sqrt{2}$ (3) $19.6\sqrt{2}$ (4) 4.9

115. A block of mass m lying on a rough horizontal plane is acted upon by a horizontal force P and another force Q inclined at an angle θ to the vertical. The block will remain in equilibrium if the coefficient of friction between it and the surface is :-



(1) $\frac{P+Q\sin\theta}{mg+Q\cos\theta}$ (2) $\frac{P\cos\theta+Q}{mg-Q\sin\theta}$ (3) $\frac{P+Q\cos\theta}{mg+Q\sin\theta}$ (4) $\frac{P\sin\theta+Q}{mg-Q\cos\theta}$

116. Adjoining figure shows two blocks A and B pushed against the wall with a force F. The wall is smooth but the surfaces in contact of A and B are rough. Which of the following is true for the system of blocks to be at rest against the wall ? Wall

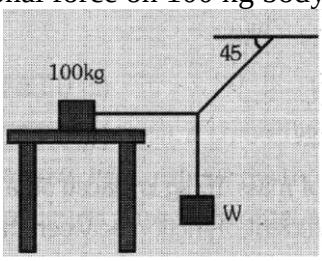


(1) F should be more than the weight of A and B
(2) F should be equal to the weight of A and B
(3) F should be less than the weight of A and B
(4) system cannot be in equilibrium

117. A body of mass 100 g is sliding on a inclined plane with an inclination of 60°. What is the frictional force experienced, if coefficient of friction is 1.7 ? (Take g = 10 m/s^2)

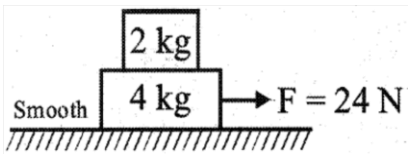
(1) 0.85 N (2) 0.95 N (3) l.05 N (4) 1.145 N

118. The system shown in the figure is in equilibrium. The maximum value of W, so that the maximum value of static frictional force on 100 kg body is 450 N, will be :-



(1) 100 N (2) 250 N (3) 450 N (4) 1000 N

119.



In the arrangement coefficient of friction between the two blocks is $\mu = \frac{1}{2}$. The force of friction acting between the two blocks is :-

(1) 8 N (2) 6 N (3) 10 N (4) 12 N

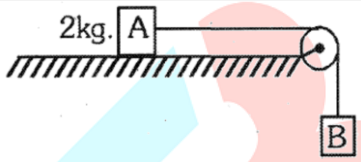
120. A block of mass 1 kg is placed ($\mu = 0.6$) on the horizontal surface of a truck which is moving with acceleration 5 m/s^2 then the frictional force on block will be :-

(1) 5 N (2) 6 N (3) 5.88 N (4) 8 N

121. A block has been placed on an inclined plane with the slope angle θ, the block slides down the plane at constant speed. The coefficient of kinetic friction is equal to :-

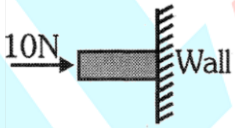
(1) $\sin\theta$ (2) $\cos\theta$ (3) g (4) $\tan\theta$

122. The coefficient of static friction, μ_s, between block A of mass 2 kg and the table as shown in the figure is 0.2. What would be the maximum mass value of block B so that the two blocks do not move? The string and the pulley are assumed to be smooth and massless. (g = 10 m/s^2)



(1) 4.0 kg (2) 0.2 kg (3) 0.4 kg (4) 2.0 kg

123. A horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of' friction between the block and wall is 0.2. The weight of the block is :-



(1) 20 N (2) 50 N (3) 100 N (4) 2 N

124. A given object takes n times as much time to slide down a 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:

(1) $\left(1-\frac{1}{n^2}\right)$ (2) $\left(\frac{1}{1-n^2}\right)$ (3) $\sqrt{\left(1-\frac{1}{n^2}\right)}$ (4) $\sqrt{\left(\frac{1}{1-n^2}\right)}$

ANSWER KEY

EXERCISE-I (Conceptual Questions)

1.	(3)	**2.**	(2)	**3.**	(1)	**4.**	(1)	**5.**	(1)	**6.**	(2)	**7.**	(2)
8.	(3)	**9.**	(3)	**10.**	(3)	**11.**	(2)	**12.**	(2)	**13.**	(4)	**14.**	(3)
15.	(2)	**16.**	(3)	**17.**	(1)	**18.**	(3)	**19.**	(2)	**20.**	(3)	**21.**	(1)
22.	(1)	**23.**	(1)	**24.**	(2)	**25.**	(1)	**26.**	(3)	**27.**	(1)	**28.**	(1)
29.	(1)	**30.**	(1)	**31.**	(2)	**32.**	(3)	**33.**	(3)	**34.**	(1)	**35.**	(3)
36.	(1)	**37.**	(2)	**38.**	(3)	**39.**	(4)	**40.**	(2)	**41.**	(2)	**42.**	(2)
43.	(2)	**44.**	(2)	**45.**	(4)	**46.**	(3)	**47.**	(4)	**48.**	(4)	**49.**	(1)
50.	(3)	**51.**	(1)	**52.**	(3)	**53.**	(3)	**54.**	(3)	**55.**	(3)	**56.**	(4)
57.	(4)	**58.**	(3)	**59.**	(4)	**60.**	(1)	**61.**	(1)	**62.**	(2)	**63.**	(4)
64.	(2)	**65.**	(2)	**66.**	(1)	**67.**	(3)	**68.**	(1)	**69.**	(2)	**70.**	(1)
71.	(3)	**72.**	(4)	**73.**	(3)	**74.**	(3)	**75.**	(2)	**76.**	(2)	**77.**	(1)
78.	(4)	**79.**	(3)	**80.**	(4)	**81.**	(2)	**82.**	(2)	**83.**	(2)	**84.**	(3)
85.	(1)	**86.**	(2)	**87.**	(4)	**88.**	(3)	**89.**	(1)	**90.**	(2)	**91.**	(4)
92.	(2)	**93.**	(1)	**94.**	(3)	**95.**	(1)	**96.**	(4)	**97.**	(1)	**98.**	(3)
99.	(2)	**100.**	(2)	**101.**	(1)	**102.**	(1)	**103.**	(4)	**104.**	(3)	**105.**	(2)
106.	(1)	**107.**	(1)	**108.**	(3)	**109.**	(1)	**110.**	(4)	**111.**	(3)	**112.**	(2)
113.	(1)	**114.**	(1)	**115.**	(1)	**116.**	(4)	**117.**	(1)	**118.**	(3)	**119.**	(1)
120.	(1)	**121.**	(4)	**122.**	(3)	**123.**	(4)	**124.**	(1)				