Chapter 6
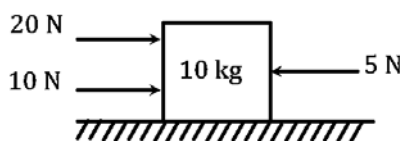
Newton's Laws of Motion   Exercise
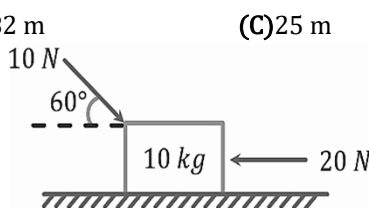
Second Law of Motion

Q.1   In the figure shown, the forces are acting simultaneously on the body of mass 10 kg which is initially at rest. Find its velocity after 10 s.


(A)10 m/s   (B)20 m/s   (C)25 m/s   (D)30 m/s

Q.2   In the given figure, the distance (in m) travelled by the 10kg mass after 10 s if the forces were applied simultaneously at t = 0 is. (All the surfaces are smooth).
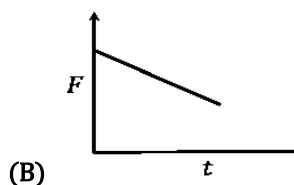
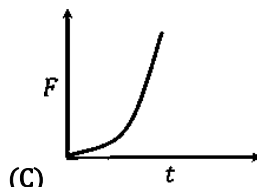(A)75 m   (B)82 m   (C)25 m   (D)30 m

Q.3   An impulse acts on a body of constant mass (m) initially at rest. If it travels with constant velocity afterwards, which of graph represents the variation of force (F) with time during the time impulse was acting.
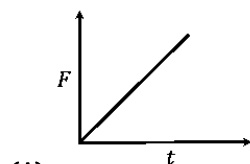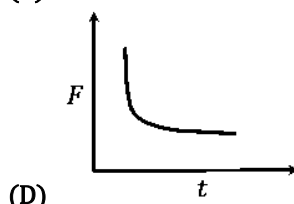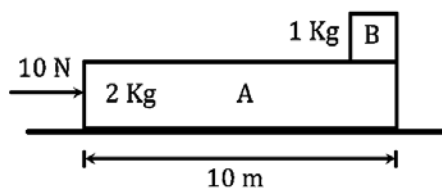

(A)

(B)

(C)

(D)

Equation of Motion

Q.4   In the figure shown, a force of 10 N is applied to the 2 Kg mass at t = 0s. All surfaces are smooth and ignore the size of body B. Find the time after which the body B will loose contact with the plank A of length 10 m.

(A)1s   (B)2s   (C)3s   (D)4s
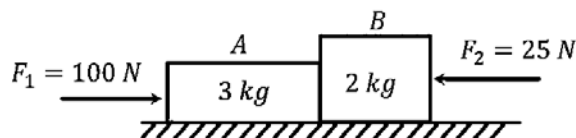
Free Body Diagram
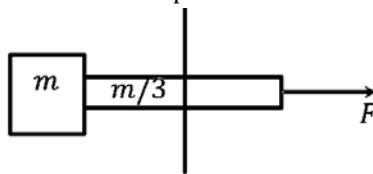**Q.5** Find the contact force between the 3 Kg and 2 Kg block as shown in figure.

(A)75 N   (B)25 N   (C)55 N   (D)45 N

Rope
Q.6 A block of mass m is resting on a smooth horizontal surface. One end of a uniform rope of mass (m/3) is fixed to the block, which is pulled in the horizontal direction by applying a force F at the other end. The tension in the middle of the rope is.

(A)$\frac{8}{7}F$ (B)$\frac{1}{7}F$ (C)$\frac{1}{8}F$ (D)$\frac{7}{8}F$

Net Force
Q.7 In the figure shown, the ratio of the force exerted by 1 Kg body on 2 Kg body in the two cases is
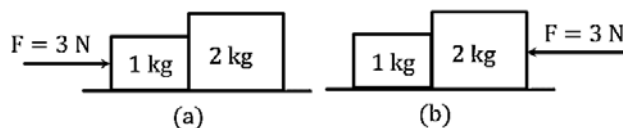
(A)1   (B)2   (C)3   (D)4

Q.8 Find the force of interaction between the 2 kg and 1 kg bodies.
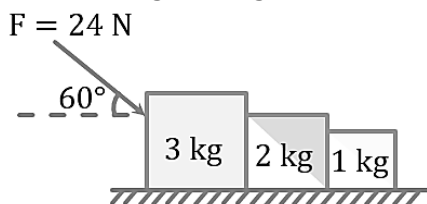
(A)2 N   (B)3 N   (C)4 N   (D)5 N

Tension in a String
Q.9 Three blocks A, B and C weighing 1 kg, 8 kg and 27 kg respectively are connected as shown in the figure, with an inextensible string and are moving on a smooth surface. If tension T_3 is equal to 36 N, then tension T_2 is.
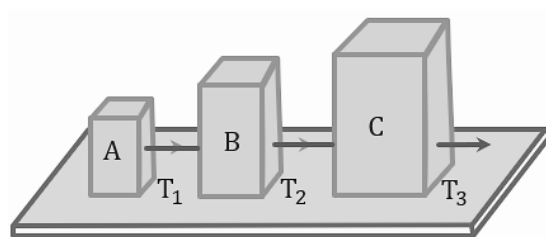
(A)18 N   (B)9 N   (C)3.375 N   (D)1.25 N

Tension in a String

Q.10   If the surface shown in figure is frictionless and the strings are inextensible, then the ratio of tensions T_1 and T_2 in the string is.

(A)3   (B)5   (C)12   (D)15

WORK SHEET

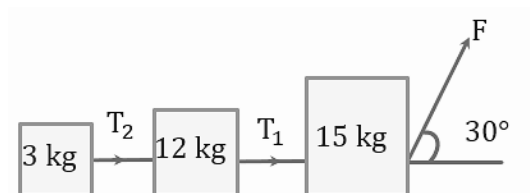### Instantaneous Velocity

Q.1 The motion of a particle along a straight line is described by the function $x = (2t - 3)^2$ where x is in meters and t is in seconds. Find the velocity of the particle at origin.

(A) 0 m/s   (B) 1 m/s   (C) 2 m/s   (D) 3 m/s

Q.2 A car and a truck move in the same straight line at the same instant of time from the same place. The car moves with a constant velocity of 40 m/s and the truck starts with a constant acceleration of 4 m/s^2. Find the time t that elapses before the truck catches up with the car.

(A) 10s   (B) 20s   (C) 30s   (D) 40s

Vectors

Q.3 A force $(3\hat{\imath} + 4\hat{\jmath})$ N acts on a body and displaces it by $(3\hat{\imath} + 4\hat{\jmath})$ meters. The work done by the force is (Given that formula for work done is $W = \vec{F}.\vec{s}$)

(A) 5J   (B) 25J   (C) 10J   (D) 30J

1D Motion Under Gravity

Q.4 A body falls from rest under gravity and travels half of its total path in the last second. Find the time of fall. (Take g $= 10 \text{ ms}^{-2}$)

(A) 2.8s   (B) 3.4s   (C) 3.8s   (D) 4.2s

$a - t$ Graph

Q.5 Acceleration-time graph for a particle moving in a straight line is as shown in figure. Change in velocity of the particle from $t = 0$ to $t = 6$ s is.
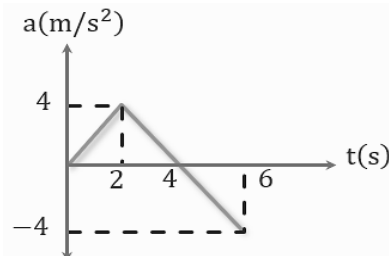
(A) 10 m/s   (B) 4 m/s   (C) 12 m/s   (D) 8m/s

Projectile Motion

Q.6 A ball is projected from the ground with a speed u making an angle θ with the horizontal. Which of the following graphs correctly represents the variation of angle between the velocity and acceleration vectors with time.

[If T is the time of flight]
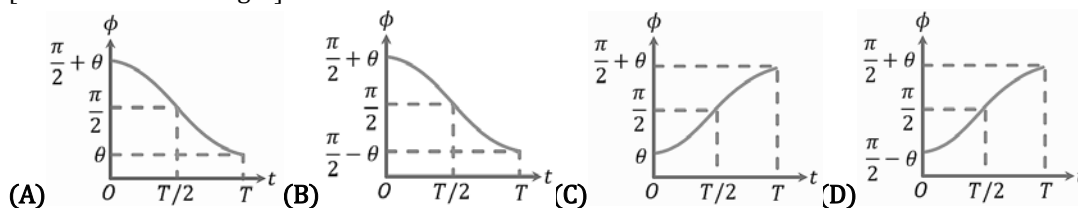
Projectile Motion

Q.7 Two stones A and B are projected from the same point. B is thrown 1 second after A is thrown. A is projected with a velocity of 60 m/s at an angle 30° with the horizontal and B is projected with velocity u at an angle of 45° with the horizontal. Find u if both stones hit the ground at the same time. (Take g = 10 m/s)

(A)25 m/s   (B)$25\sqrt{2}\ m/s$ (C)$25\sqrt{3}\ m/s$ (D)$\frac{25}{3}\ m/s$

Relative Acceleration

Q.8 Two bodies A and B are thrown simultaneously. A is projected vertically upwards with 80 m/s speed from the ground and B is projected vertically downwards from a height of 160 m with 40 m/s and along the same line of motion. The time taken for the two bodies to collide is

(A)1 sec   (B)1.33 sec   (C)1.66 sec   (D)2 sec

1D Motion

Q.9 A man can row a boat at 4 km/h in still water. What is the minimum possible time in which he can cross the river if the speed of current is 4 km/h and width of the river is 8 km?

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

Vectors

Q.10 A particle undergoes three successive displacements given by $S_1 = \sqrt{2}$ m north-east, $S_2 = 2$ m due south and $S_3 = 4$ m, 30° north of west, then magnitude of net displacement is

(A)$\sqrt{14 + 4\sqrt{3}}\ m$ (B)$\sqrt{14 - 4\sqrt{3}}\ m$ (C)$\sqrt{4}\ m$ (D)$1 - 2\sqrt{3}\ m$

Net Force

Q.11 In the figure, all surfaces are smooth. Find the acceleration of the body and the force exerted by the floor on the body. (Take g = 10 m/s^2)
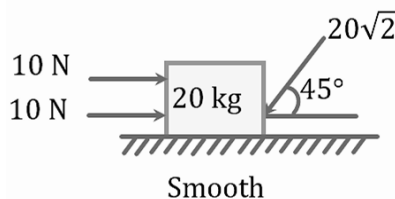
(A)0, 100 N   (B)4 m/s^2, 200 N   (C)2 m/s^2, 210 N   (D)0, 220 N

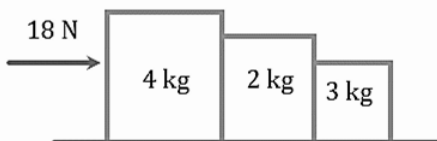### Second Law of Motion

Q.12 Blocks A and B of masses 2 kg and 3 kg respectively are placed on a smooth ground. If an external force P of magnitude 10 N acts on A as shown, find the force exerted by B on A is.
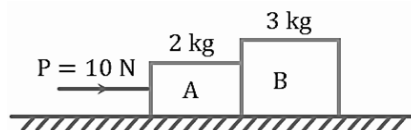
(A)6N   (B)3N   (C)9N   (D)1N

Q.13 Find the ratio of force of interaction between the 4 kg and 2 kg blocks and 2 kg and 3 kg blocks. (Assume all surfaces to be smooth)

18 N → 4 kg | 2 kg | 3 kg

(A) $\frac{1}{3}$ N   (B) $\frac{5}{3}$ N   (C) 2 N   (D) $\frac{7}{3}$ N

Second Law of Motion

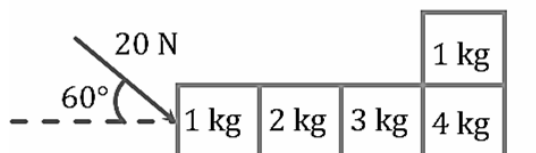**Q.14** Find the force of interaction between 2 kg and 3 kg. (Assume all surface are smooth)
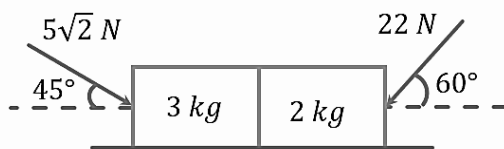
(A) 2 N   (B) 7N   (C) 8 N   (D) 10 N

20 N at 60°, 1 kg | 2 kg | 3 kg | 4 kg with 1 kg on top

Second Law of Motion

Q.15 Find the force of interaction between 3 kg and 2 kg (Assume surfaces are frictionless)

$5\sqrt{2}$ N at 45°, 3 kg | 2 kg, 22 N at 60°

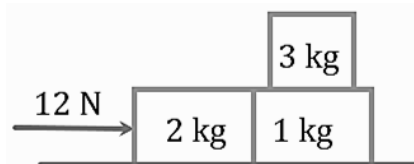(A) 2 N   (B) 3 N   (C) 8.6 N   (D) 5 N

Normal Force

Q.16 Find the force exerted by 3 kg body on 1 kg assuming all surfaces are smooth ($g = 10$ m/s^2)

12 N → 2 kg | 1 kg with 3 kg on top

(A) 30 N   (B) 20 N   (C) 8 N   (D) 2 N
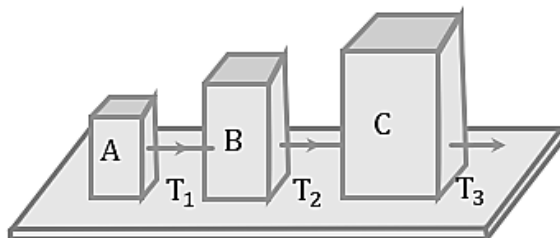
Tension In a String

Q.17 Three blocks A, B and C weighing 1, 8 and 27 kg respectively are connected as shown in the figure with an inextensible string and are moving on a smooth surface. T_1 is equal to 2 N. Then T_3 is
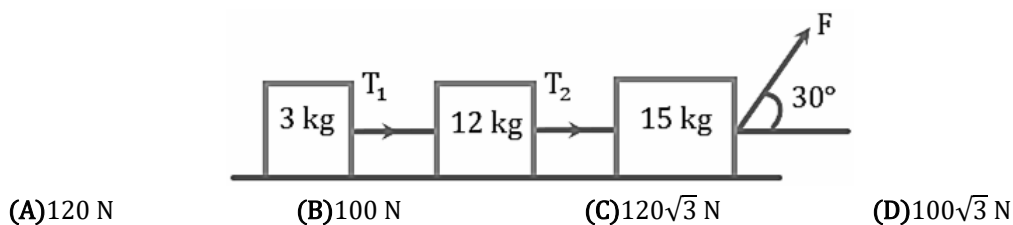
(A) 18 N   (B) 36 N   (C) 72 N   (D) 144 N

A T_1→ B T_2→ C T_3→

Tension In a String

Q.18 If the surface shown in figure is frictionless, and $T_1 = 6\sqrt{3}$ N, find F.

(A)120 N   (B)100 N   (C)$120\sqrt{3}$ N   (D)$100\sqrt{3}$ N

Net Force

Q.19 In the figure below, if all surface is assumed to be smooth and the force $F = 100$ N. If acceleration of block B of mass 20 kg is a and tension in string connecting block A of mass 20 kg is T then, just after force F is applied find the values of T and a.
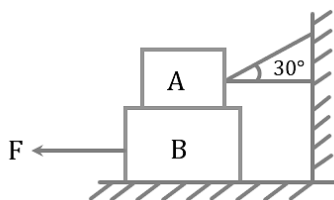

(A)$T = 0$ and a $= 5$ m/s^2 (B)$T = 100$ N and a $= 0$

(C)$T = 200$ N and a $= 5$ m/s^2 (D)$T = 100$ N and a $= 5$ m/s^2

Tension In a String

Q.20 Find the ratio of tensions T_1 and T_2 for the figure shown

(A)$13:15$ (B)$15:13$ (C)$4:3$ (D)$3:4$
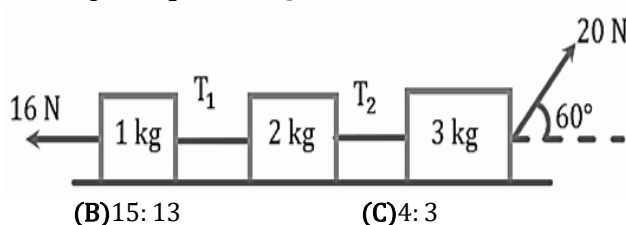
Inclined Plane

Q.21 In the figure shown, find the velocity acquired by the block on reaching the ground and the force exerted by the inclined plane on the block if takes 5 seconds for the block to reach the ground. Assume all surfaces to be smooth. (Take $g = 10$ m/s^2)
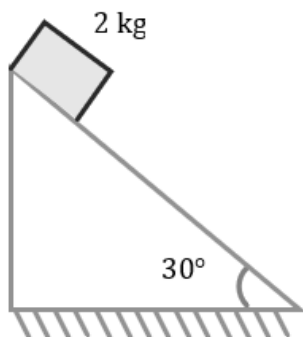

(A)10 m/s, $10\sqrt{3}$ N   (B)20 m/s, 10 N   (C)25 m/s, 20 N   (D)25 m/s, $10\sqrt{3}$ N

Inclined Plane

Q.22   Three bodies each of masses 1 kg, 2 kg and 3 kg slide down a smooth inclined plane starting from rest. Then choose which of the following statements is correct.

(A)1 kg body will have least velocity on reaching bottom of the inclined plane.

(B)3 kg body will have least velocity on reaching bottom of the inclined plane.

(C)1 kg body will take least time on reaching bottom of the inclined plane.

(D)All bodies will have the same velocity and take the sametime on reaching bottom of the inclined plane.

Tension In a String

Q.23   A steel ball is suspended from the ceiling of an accelerating carriage by means of two cords A and B. Determine the acceleration a (in m/s^2) of the carriage which will cause the tension in A to be twice that in B
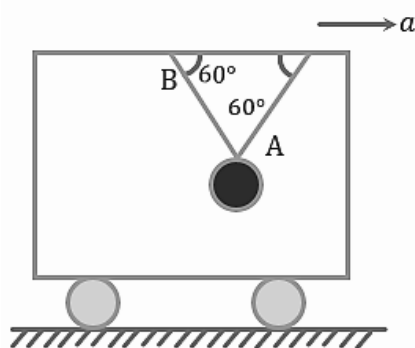
(A)$g\sqrt{3}$ (B)$\frac{g}{\sqrt{3}}$ (C)$3\sqrt{3}\,g$ (D)$\frac{g}{3\sqrt{3}}$

ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(C)	(A)	(D)	(B)	(C)	(D)	(B)	(A)	(B)	(B)
WORK SHEET										
Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(A)	(B)	(B)	(B)	(B)	(B)	(A)	(B)	(B)	(B)
Q.	11	12	13	14	15	16	17	18	19	20
Sol.	(D)	(A)	(B)	(B)	(C)	(A)	(C)	(A)	(A)	(B)
Q.	21	22	23	24	25	26	27	28	29	30
Sol.	(D)	(D)	(D)							