Chapter 6

Newton's Laws of Motion

Exercise

First Law of Motion

Q.1 A man getting down a running bus falls forward because

(**A**)Due to inertia of rest, road is left behind, and man reaches forward

(**B**)Due to inertia of motion upper part of body continues to be in motion in forward direction while feet come to rest as soon as they touch the road

(C) He leans forward as a matter of habit

(D) Of the combined effect of all the three factors stated in (a), (b) and (c).

Four Fundamental Forces

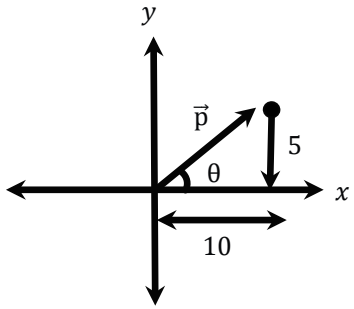
Q.2 Which of the following is not an Electromagnetic force?

(**A**)Reacton a body (**B**)Tension in a string

(C) Weight of a body **(D)**Elastic force in a spring

Momentum

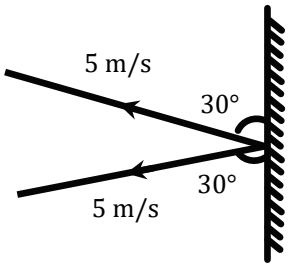
Q.3 A body of mass 1 kg is moving with a velocity $v = (10\hat{i} + 5\hat{j})$ m/s. What is the angle made by the momentum vector with x −axis?



(**A**) $\tan^{-1}\left(\frac{1}{2}\right)$ (**B**) $\tan^{-1}\left(\frac{1}{4}\right)$ **(C)**$\tan^{-1} 2$ **(D)**$\cot^{-1}(\frac{1}{2})$

Second law of motion

Q.4 A body of mass 0.05 kg travelling with a velocity of 5 m/smake angle of 30° with the wall as shown. The body rebounds with the same speed making an angle of 30° with the wall. Find the contact force on the body in kN if the duration of contact is 1 ms.



(**A**)0.20 (**B**)0.25 **(C)**0.35 **(D)**0.50

Q.5 A 2 kg object is subjected to three forces that give it an acceleration $\vec{a} = -8\ \text{m/s}^2\ \hat{i}$. If two of the three forces are $F_1 = (30.0\ \text{N})\hat{i} + 16.0\ \text{N})\hat{j}$ and $F_2 = -(12\ \text{N})\hat{i} + (8\text{N})\hat{j}$. Find the third force.

(**A**)$(34\ \text{N})\hat{i} + (24\ \text{N})\hat{j}$ (**B**)$(-34\ \text{N})\hat{i} - (24\ \text{N})\hat{j}$ (**C**)$(18\ \text{N})\ \hat{i} + (24\ \text{N})\hat{j}$ (**D**)$-(18\ \text{N})\hat{i} - (24\ \text{N})\hat{j}$

Q.6 A force acts for 10 s on a body of mass 100 kg which was at rest, after which it ceases to act. If the body travels 160 m in the next 8 s. Find the magnitude of the force

(**A**)100 N (**B**)200 N (**C**)300 N (**D**)400 N

Equations of Motion

Q.7 A force of 5 kg − wt is acting on a body of mass 5 kg kept on a smooth horizontal surface at rest. If it acts for 10 seconds at an angle of 60°with the horizontal, find the distance travelled by the body. (Take $g = 10\ \text{m/s}^2$)

(**A**)100 m (**B**)150 m (**C**)200 m (**D**)250 m

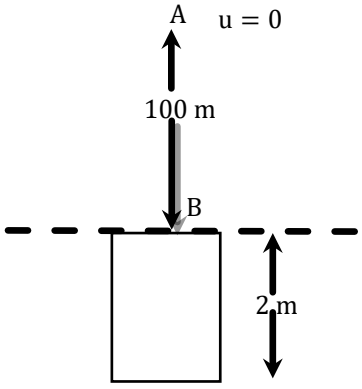
Second Law of Motion

Q.8 A metal plate of mass 200 gm is balanced in mid–air by throwing 40 balls/sec, each of mass 2 gm vertically upwards from below. The balls rebound with the same speed with which they strike the plate. Find the velocity with which the balls strike the plate.

(**A**)20 m/s (**B**)12.25 m/s (**C**)10 m/s (**D**)5 m/s

Equations of Motion

Q.9 A stone weighing 3 kg falls from the top of a tower 100 m high and buries itself 2 m deep in sand. Find the time (in seconds) of penetration ($g = 10\ \text{m/s}^2$)



(**A**)$\sqrt{5}$ (**B**)$2\sqrt{5}$ (**C**)$25\sqrt{5}$ (**D**)$\sqrt{\frac{5}{25}}$

Second Law of Motion

Q.10 The acceleration of a body starting from rest is given by $a = 13 - 0.1\ s$, where a is the acceleration (in m/s^2) and s is the displacement (in meters). If its mass is 2 kg, find its momentum when the displacement is 100 m.

(**A**)40 Ns (**B**)80 Ns (**C**)120 Ns (**D**)130 Ns

WS_NLM_S1

WORK SHEET

Differentiation

Q.1 Find the differentiation of y w.r.t x, if $y = \frac{\sin x}{x}$

(A) $\frac{x \sin x - \cos x}{x^2}$ **(B)** $\frac{x \cos x - \sin x}{x}$ **(C)** $\frac{x \cos x - \sin x}{x^2}$ **(D)** $\frac{x^2 \cos x - \sin x}{x^2}$

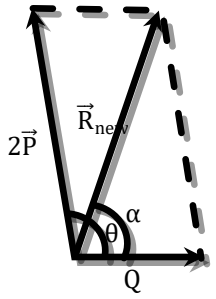
Integration

Q.2 The value of $\int_1^5 x^2 \, dx$ is

(A) $\frac{125}{3}$ **(B)** $\frac{124}{3}$ **(C)** $\frac{1}{3}$ **(D)** 45

Vector Addition

Q.3 Two forces P and Q act such that the resultant R is equal to P. If P is doubled, what is the angle made by the new resultant with the force Q?



(A) 0° **(B)** 30° **(C)** 60° **(D)** 90°

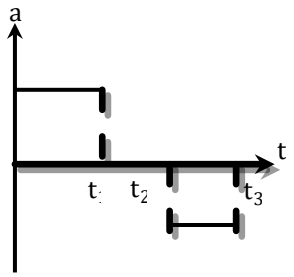
Velocity

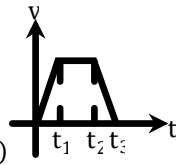
Q.4 A body covers first 1/3 of the distance with a velocity of 2 m/s, next 1/3 with 3 m/s and the rest of the distance with 6 m/s. The average velocity in m/s for covering the whole distance is (assume that the body travels with constant velocity in all the parts in a straight line)

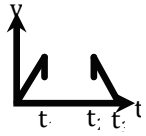
(A) 3 **(B)** $\frac{11}{3}$ **(C)** $\frac{8}{3}$ **(D)** $\frac{4}{3}$

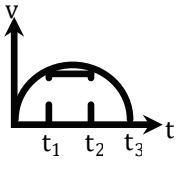
Graphs in Kinematics

Q.5 Acceleration-time graph of a body is shown in the figure. Its velocity-time graph can be given as



(A)


(B)


(C)


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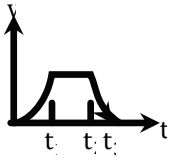
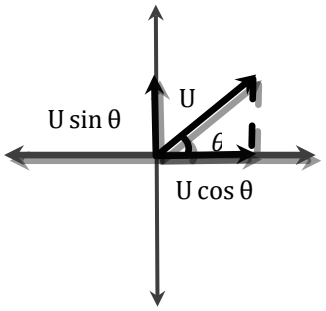


Projectile motion

Q.6 A projectile is thrown from the ground with an initial velocity of $(4\hat{i} + 3\hat{j})$ m/s. It reaches its greatest height above the ground after (Take $g = 10\ m/s^2$)

(**A**)0.20 s (**B**)0.30 s **(C)**0.45 s **(D)**4.5 s



Projectile motion

Q.7 An airplane flying 490 m above ground level at 100 m/s, releases a bomb. The horizontal distance it has to travel before it hits the ground is (Take $g = 9.8\ m/s^2$)

(**A**)0.1 km (**B**)1 km **(C)**2 km **(D)**2.5 km

Relative motion

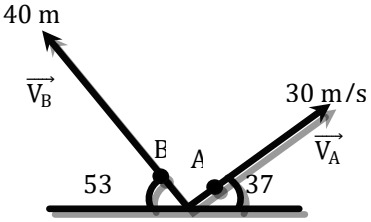
Q.8 What are the speeds of two objects if, when they move uniformly towards each other, they get 4 m closer in each second and when they move uniformly in the same direction with the original speeds, they get 4.0 m closer in each 10 s?

(**A**)2.8 m/s and 1.2 m/s (**B**)5.2 m/s and 4.6 m/s

(C)3.2 m/s and 2.1 m/s **(D)**2.2 m/s and 1.8 m/s

Relative motion

Q.9 Two particles A and B projected in air. A is thrown with a speed of 30 m/sec and B with a speed of 40 m/sec as shown in the figure. What is the separation between them after 1 sec.



(**A**)30 m (**B**)40 m **(C)** 50 m **(D)**60 m

Q.10 Rain is falling downwards with a velocity of 3 km/h. A man walks in the rain with a velocity of 4 km/h. Raindrops will appear to be falling on the man with a velocity of;

(**A**)1 km/h (**B**)3 km/h **(C)**4 km/h **(D)**5 km/h

Four Fundamental Forces

Q.11 When John Cena shook hand with Randy Orton, what kind of force they exerted?

(**A**)Gravitational (**B**)Electromagnetic **(C)**Strong Nuclear **(D)**Weak Nuclear

Four Fundamental Forces

Q.12 Let E, G and N represent the magnitudes of electromagnetic, gravitational and nuclear forces between two electrons at a given separation. Then

(**A**)N $> E > G$ (**B**)E $> N > G$ **(C)**G $> N > E$ **(D)**E $> G > N$

Equations of Motion

Q.13 A body of mass 100 g is allowed to fall freely under gravity. Find its momentum after 10 seconds (in Ns)

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

Second law of motion

Q.14 A 1 kg body falls vertically with a speed of 25 m/s and rebounds with a speed of 10 m/s. If the time for which the ball is in contact with the ground is 1 ms, what is the contact force on the body by the ground?

(**A**)15 kN (**B**)25 kN **(C)**35 kN **(D)**45 kN

Momentum

Q.15 A glass marble whose mass is 200 gm, falls from a height of 2.5 m and rebounds to a height of 1.6 m. Find the change in momentum due to its rebound.

(**A**)5. 65 Ns (**B**)25.4 Ns **(C)**56.5 Ns **(D)**2.54 Ns

Equations of Motion

Q.16 A body of mass 1 kg is traveling with a velocity of 3 m/s accelerates uniformly with 8 m/s^2 to travel for 2 s. Find the force acting on the body.

(**A**)2 N (**B**)2.5 N **(C)**4 N **(D)**5 N

Net Force

Q.17 A projectile of mass 0.5 kg is thrown with a velocity of 30 m/s at an angle of 60° with the horizontal. Find the net force acting on the body.

(**A**)9.8 N (**B**)6.5 N **(C)**4.9 N **(D)**20 N

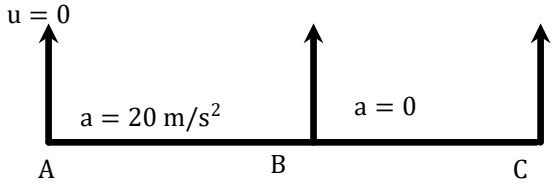
Second Law of Motion

Q.18 A gun fires 10 bullets/sec each of mass 10 gm, with a muzzle velocity of 50 m/s. Find the force required to hold the gun in position.

(**A**)5 N (**B**)50 N **(C)**500 N **(D)**5000 N

Second Law of Motion

Q.19 A body of mass 1 kg is subjected to a force of 20 N for 10 seconds after which the force ceases to act. What distance would it travel in the next 10 seconds? Assume that the body starts from rest.

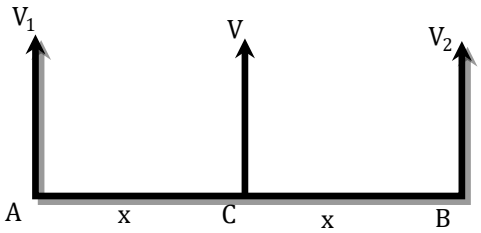


(**A**)20 m (**B**)200 m **(C)**2 km **(D)**20 km

Equations of Motion

Q.20 A train has each compartment of mass '$\boldsymbol{m}$' is accelerating uniformly. At the instant they cross a certain mile marker, the velocity of the engine is $\boldsymbol{v_1}$ and that of the last compartment is $\boldsymbol{v_2}$. Find the

momentum of the compartment in the middle when it passes the same mile marker assuming that the compartments are of point sizes.



(**A**)$m\sqrt{\frac{v_1^2-v_2^2}{2}}$ (**B**)$m\sqrt{\frac{v_1^2+v_2^2}{2}}$ **(C)**$m\times\left(\frac{v_1^2-v_2^2}{2}\right)$ **(D)**$m\times\left(\frac{v_1^2+v_2^2}{2}\right)$

Second Law of Motion

Q.21 A disc of mass 100 g is kept floating horizontally in air by firing bullets each of mass 5 g with the same velocity at the same rate of 10 bullets per second. The bullets rebound with the same speed in opposite direction. Then, the velocity of each bullet at the time of impact is: Take ($g = 10\ m/s^2$)

(**A**)1000 m/s (**B**)100 m/s **(C)**50 m/s **(D)**10 m/s

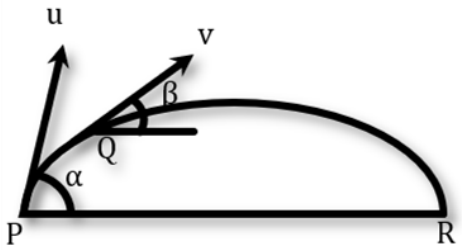
Equations of Motion

Q.22 A ship of mass 3×10^7 kg initially at rest is pulled by a force of $5\times10^4\ N$ through a distance of $3\ m$.Assume that the resistance due to water is negligible. The speed of the ship is

(**A**)1.5 m/s (**B**)60 m/s **(C)**0.1m/s **(D)**5 m/s

Projectile motion

Q.23 A projectile of mass m is fired with a velocity u from a point P as shown. Neglecting air resistance, find the magnitude of the change in momentum of the projectile between the points P and Q.



(**A**)$mu\cos\alpha(\tan\beta-1)$ (**B**)$mu\sin\alpha(\tan\beta-1)$

(C)$mu(\tan\beta-1)$ **(D)**$mu\cos\alpha$

Equations of Motion

Q.24 An object of mass 10 kg moves at a constant speed of 10 ms^{-1}. A constant force that acts for 4 s on the object gives it a speed of 2 ms^{-1} in the opposite direction. The force acting on the object is (Take the direction of initial velocity as positive)

(**A**)3 N (**B**)30 N **(C)**300 N **(D)**0.3 N

Q.25 A truck and a car are moving with equal velocity. If equal retarding force is applied on each of them on applying the brakes, both will stop after a certain distance. Then

(**A**)Truck will cover less distance before rest (**B**)Car will cover less distance before rest

(C) Both will cover equal distance **(D)**Cannot be determined

ANSWER KEY

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