PHYSICS

Crash Course for
JEE Main 2020

KINEMATICS

RECTILINEAR MOTION

Average Velocity (in an interval) :

$$v_{av} = \bar{v} = \langle v \rangle = \frac{\text{Total displacement}}{\text{Total time taken}} = \frac{\vec{r}_f - \vec{r}_i}{\Delta t}$$

Average Speed (in an interval)

$$\text{Average Speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

Instantaneous Velocity (at an instant) :

$$\vec{v}_{inst} = \lim_{\Delta t \to 0} \left(\frac{\Delta \vec{r}}{\Delta t} \right)$$

Average acceleration (in an interval):

$$\vec{a}_{av} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$$

Instantaneous Acceleration (at an instant):

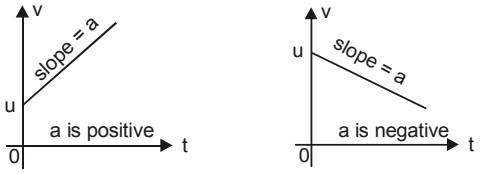
$$\vec{a} = \frac{d\vec{v}}{dt} = \lim_{\Delta t \to 0} \left(\frac{\overrightarrow{\Delta v}}{\Delta t} \right)$$

Graphs in Uniformly Accelerated Motion along a straight line ($a \neq 0$)

- x is a quadratic polynomial in terms of t. Hence x – t graph is a parabola.

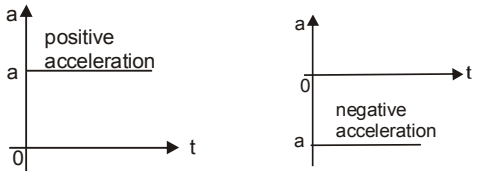
x-t graph

- v is a linear polynomial in terms of t. Hence v–t graph is a straight line of slope a.



v-t graph

- a–t graph is a horizontal line because a is constant.



a-t graph

Maxima & Minima

$\frac{dy}{dx} = 0$ & $\frac{d}{dx}\left(\frac{dy}{dx}\right) < 0$ at maximum

and $\frac{dy}{dx} = 0$ & $\frac{d}{dx}\left(\frac{dy}{dx}\right) > 0$ at minima.

Equations of Motion (for constant acceleration)

(a) $v = u + at$

(b) $s = ut + \frac{1}{2} at^2$ $s = vt - \frac{1}{2} at^2$ $x_f = x_i + ut + \frac{1}{2} at^2$

(c) $v^2 = u^2 + 2as$

(d) $s = \frac{(u+v)}{2} t$ (e) $s_n = u + \frac{a}{2}(2n - 1)$

For freely falling bodies : (u = 0)
(taking upward direction as positive)

(a) $v = -gt$

(b) $s = -\frac{1}{2} gt^2$ $s = vt + \frac{1}{2} gt^2$ $h_f = h_i - \frac{1}{2} gt^2$

(c) $v^2 = -2gs$

(d) $s_n = -\frac{g}{2}(2n - 1)$

PROJECTILE MOTION & VECTORS

Time of flight : $T = \dfrac{2u\sin\theta}{g}$

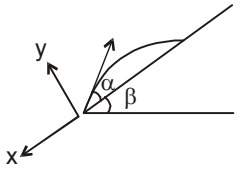
Horizontal range : $R = \dfrac{u^2 \sin 2\theta}{g}$

Maximum height : $H = \dfrac{u^2 \sin^2\theta}{2g}$

Trajectory equation (equation of path) :

$$y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta} = x\tan\theta\left(1 - \frac{x}{R}\right)$$

Projection on an inclined plane



Range	Up the Incline	Down the Incline
	$\dfrac{2u^2\sin\alpha\cos(\alpha+\beta)}{g\cos^2\beta}$	$\dfrac{2u^2\sin\alpha\cos(\alpha-\beta)}{g\cos^2\beta}$
Time of flight	$\dfrac{2u\sin\alpha}{g\cos\beta}$	$\dfrac{2u\sin\alpha}{g\cos\beta}$
Angle of projection with incline plane for maximum range	$\dfrac{\pi}{4}-\dfrac{\beta}{2}$	$\dfrac{\pi}{4}+\dfrac{\beta}{2}$
Maximum Range	$\dfrac{u^2}{g(1+\sin\beta)}$	$\dfrac{u^2}{g(1-\sin\beta)}$

RELATIVE MOTION

$\vec{v}_{AB}$ (velocity of A with respect to B) $= \vec{v}_A - \vec{v}_B$

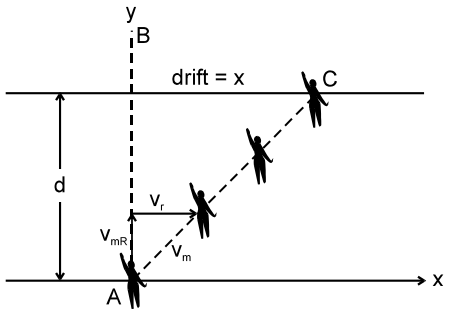
$\vec{a}_{AB}$ (acceleration of A with respect to B) $= \vec{a}_A - \vec{a}_B$

Relative motion along straight line - $\vec{x}_{BA} = \vec{x}_B - \vec{x}_A$

CROSSING RIVER

A boat or man in a river always moves in the direction of resultant velocity of velocity of boat (or man) and velocity of river flow.

1. Shortest Time :



Velocity along the river, $v_x = v_R$.
Velocity perpendicular to the river, $v_f = v_{mR}$

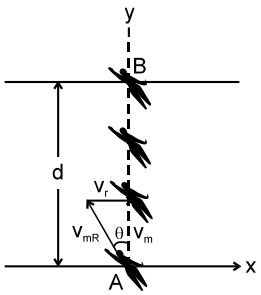
The net speed is given by $v_m = \sqrt{v_{mR}^2 + v_R^2}$

2. Shortest Path :

velocity along the river, $v_x = 0$

and velocity perpendicular to river $v_y = \sqrt{v_{mR}^2 - v_R^2}$

The net speed is given by $v_m = \sqrt{v_{mR}^2 - v_R^2}$



at an angle of 90° with the river direction.
velocity v_y is used only to cross the river,

therefore time to cross the river, $t = \frac{d}{v_y} = \frac{d}{\sqrt{v_{mR}^2 - v_R^2}}$

and velocity v_x is zero, therefore, in this case the drift should be zero.

$\Rightarrow \quad v_R - v_{mR} \sin\theta = 0 \quad$ or $\quad v_R = v_{mR} \sin\theta$

or $\quad \theta = \sin^{-1}\left(\frac{v_R}{v_{mR}}\right)$

RAIN PROBLEMS

$\vec{v}_{Rm} = \vec{v}_R - \vec{v}_m \quad$ or $\quad v_{Rm} = \sqrt{v_R^2 + v_m^2}$

SECTION-1 SCQ

Q.1 A particle is projected vertically upwards from a point A on the ground. It takes t_1 time to reach a point B but it still continues to move up. If it takes further t_2 time to reach the ground from point B then height of point B from the ground is

(A) $\frac{1}{2}g(t_1+t_2)^2$ (B) $g\,t_1\,t_2$ (C) $\frac{1}{8}g(t_1+t_2)^2$ (D) $\frac{1}{2}\,g\,t_1\,t_2$

Q.2 An object is moving along the x axis with position as a function of time given by x = x(t). Point O is at x = 0. The object is definitely moving toward O when

(A) $dx/dt < 0$ (B) $dx/dt > 0$ (C) $d(x^2)/dt < 0$ (D) $d(x^2)/dt > 0$

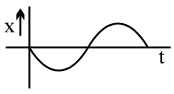
Q.3 A particle starts moving rectilinearly at time t = 0 such that its velocity 'v' changes with time 't' according to the equation $v = t^2 - t$ where t is in seconds and v is in m/s. The time interval for which the particle retards is

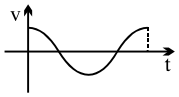
(A) $t < 1/2$ (B) $1/2 < t < 1$ (C) $t > 1$ (D) $t < 1/2$ and $t > 1$

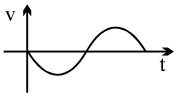
Q.4 An object is tossed vertically into the air with an initial velocity of 8 m/s. Using the sign convention upwards as positive, how does the vertical component of the acceleration a_y of the object (after leaving the hand) vary during the flight of the object?

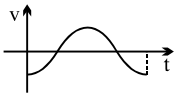
(A) On the way up $a_y > 0$, on the way down $a_y > 0$
(B) On the way up $a_y < 0$, on the way down $a_y > 0$
(C) On the way up $a_y > 0$, on the way down $a_y < 0$
(D) On the way up $a_y < 0$, on the way down $a_y < 0$

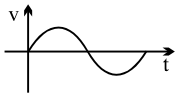
Q.5 If position time graph of a particle is sine curve as shown, what will be its velocity-time graph.



(A) 

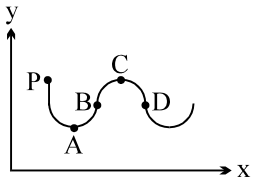
(B) 

(C) 

(D) 

Q.6 A man moves in x-y plane along the path shown. At what point is his average velocity vector in the same direction as his instantaneous velocity vector. The man starts from point P.

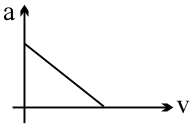
(A) A (B) B (C) C (D) D

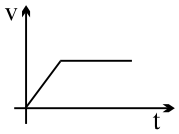


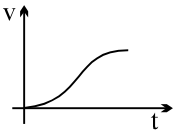
Q.7 The greatest acceleration or deceleration that a train may have is a. The minimum time in which the train may reach from one station to the other separated by a distance d is

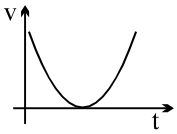
(A) $\sqrt{\frac{d}{a}}$ (B) $\sqrt{\frac{2d}{a}}$ (C) $\frac{1}{2}\sqrt{\frac{d}{a}}$ (D) $2\sqrt{\frac{d}{a}}$

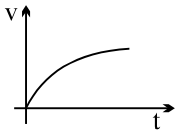
Q.8 Acceleration versus velocity graph of a particle moving in a straight line starting from rest is as shown in figure. The corresponding velocity-time graph would be



(A) 

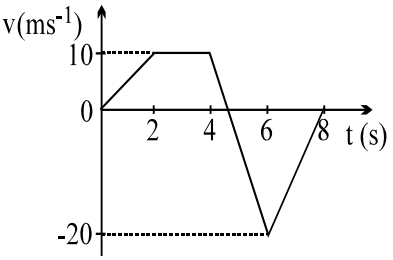
(B) 

(C) 

(D) 

Question No. 9 to 13 (5 questions)

The figure shows a velocity-time graph of a particle moving along a straight line



Q.9 Choose the incorrect statement. The particle comes to rest at

(A) t = 0 s (B) t = 5 s

(C) t = 8 s (D) none of these

Q.10 Identify the region in which the rate of change of velocity $\left|\frac{\Delta\vec{v}}{\Delta t}\right|$ of the particle is maximum

(A) 0 to 2s (B) 2 to 4s (C) 4 to 6 s (D) 6 to 8 s

Q.11 If the particle starts from the position $x_0 = -15$ m, then its position at t = 2s will be

(A) –5 m (B) 5 m (C) 10 m (D) 15 m

Q.12 The maximum displacement of the particle is

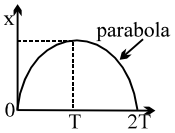
(A) 33.3 m (B) 23.3 m (C) 18.3 m (D) zero

Q.13 The total distance travelled by the particle is

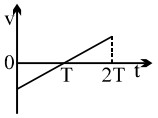
(A) 66.7 m (B) 51.6 m (C) zero (D) 36.6 m

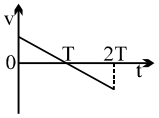
Question No. 14 to 16 (3 questions)

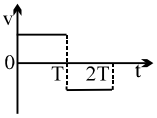
The x-t graph of a particle moving along a straight line is shown in figure

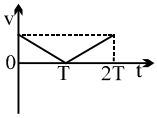


Q.14 The v-t graph of the particle is correctly shown by

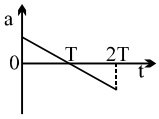
(A) 

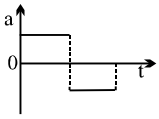
(B) 

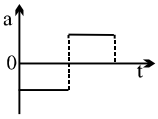
(C) 

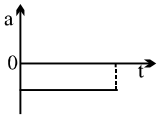
(D) 

Q.15 The a-t graph of the particle is correctly shown by

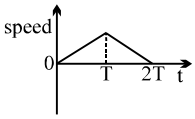
(A) 

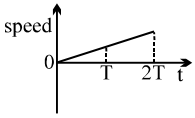
(B) 

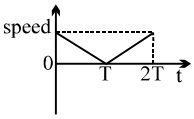
(C) 

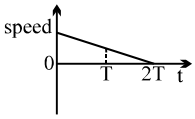
(D) 

Q.16 The speed-time graph of the particle is correctly shown by

(A) 

(B) 

(C) 

(D) 

Q.17 Two projectiles A and B are thrown with the same speed such that A makes angle θ with the horizontal and B makes angle θ with the vertical, then

(A) Both must have same time of flight (B) Both must achieve same maximum height

(C) A must have more horizontal range than B (D) Both may have same time of flight

Q.18 Suppose a player hits several baseballs. Which baseball will be in the air for the longest time?

(A) The one with the farthest range.

(B) The one which reaches maximum height.

(C) The one with the greatest initial velocity.

(D) The one leaving the bat at 45° with respect to the ground.

Question No. 19 to 21 (3 questions)

A projectile is thrown with a velocity of 50 ms^{-1} at an angle of 53° with the horizontal

Q.19 Choose the incorrect statement

(A) It travels vertically with a velocity of 40 ms^{-1}

(B) It travels horizontally with a velocity of 30 ms^{-1}

(C) The minimum velocity of the projectile is 30 ms^{-1}

(D) None of these

Q.20 Determine the instants at which the projectile is at the same height

(A) t = 1s and t = 7s (B) t = 3s and t = 5s (C) t = 2s and t = 6 s (D) all the above

Q.21 The equation of the trajectory is given by

(A) $180y = 240x - x^2$ (B) $180y = x^2 - 240x$

(C) $180y = 135x - x^2$ (D) $180y = x^2 - 135x$

Q.22 A ball is thrown from a point on ground at some angle of projection. At the same time a bird starts from a point directly above this point of projection at a height h horizontally with speed u. Given that in its flight ball just touches the bird at one point. Find the distance on ground where ball strikes

(A) $2u\sqrt{\frac{h}{g}}$ (B) $u\sqrt{\frac{2h}{g}}$ (C) $2u\sqrt{\frac{2h}{g}}$ (D) $u\sqrt{\frac{h}{g}}$

Q.23 A projectile is fired with a speed u at an angle θ with the horizontal. Its speed when its direction of motion makes an angle 'α' with the horizontal is

(A) $u\sec\theta\cos\alpha$ (B) $u\sec\theta\sin\alpha$ (C) $u\cos\theta\sec\alpha$ (D) $u\sin\theta\sec\alpha$

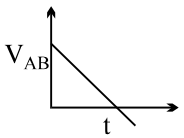
Q.24 A projectile is fired with a velocity at right angle to the slope which is inclined at an angle θ with the horizontal. The expression for the range R along the incline is

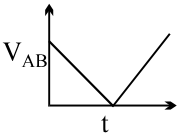
(A) $\frac{2v^2}{g}\sec\theta$ (B) $\frac{2v^2}{g}\tan\theta$ (C) $\frac{2v^2}{g}\tan\theta\sec\theta$ (D) $\frac{v^2}{g}\tan^2\theta$

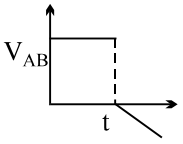
Q.25 It takes one minute for a passenger standing on an escalator to reach the top. If the escalator does not move it takes him 3 minute to walk up . How long will it take for the passenger to arrive at the top if he walks up the moving escalator ?

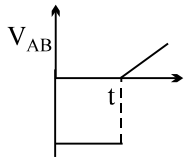
(A) 30 sec (B) 45 sec (C) 40 sec (D) 35 sec

Q.26 A body A is thrown vertically upwards with such a velocity that it reaches a maximum height of h. Simultaneously another body B is dropped from height h. It strikes the ground and does not rebound. The velocity of A relative to B v/s time graph is best represented by : (upward direction is positive)

(A) 

(B) 

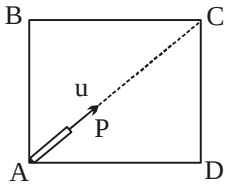
(C) 

(D) 

Q.27 A hunter tries to hunt a monkey with a small, very poisonous arrow, blown from a pipe with initial speed v_0. The monkey is hanging on a branch of a tree at height H above the ground. The hunter is at a distance L from the bottom of the tree. The monkey sees the arrow leaving the blow pipe and immediately loses the grip on the tree, falling freely down with zero initial velocity. The minimum initial speed v_0 of the arrow for hunter to succeed while monkey is in air :

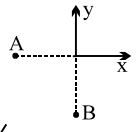
(A) $\sqrt{\frac{g(H^2+L^2)}{2H}}$ (B) $\sqrt{\frac{gH^2}{\sqrt{H^2+L^2}}}$ (C) $\sqrt{\frac{g(H^2+L^2)}{H}}$ (D) $\sqrt{\frac{2gH^2}{\sqrt{H^2+L^2}}}$

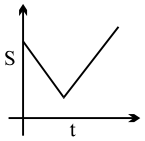
Q.28 A large rectangular box moves vertically downward with an acceleration a. A toy gun fixed at A and aimed towards C fires a particle P.

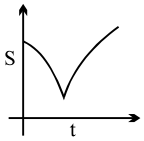


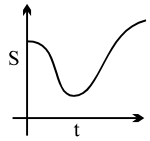
(A) P will hit C if a = g
(B) P will hit the roof BC, if a > g
(C) P will hit the wall CD if a < g
(D) May be either (A), (B) or (C), depending on the speed of projection of P

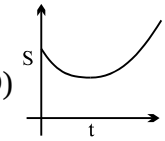
Q.29 Particles A and B are moving with constant velocities along x and y axis respectively, the graph of separation between them with time is



(A) 

(B) 

(C) 

(D) 

Question No. 30 to 32 (3 questions)

Two projectiles are thrown simultaneously in the same plane from the same point. If their velocities are v_1 and v_2 at angles θ_1 and θ_2 respectively from the horizontal, then answer the following questions

Q.30 The trajectory of particle 1 with respect to particle 2 will be
(A) a parabola (B) a straight line
(C) a vertical straight line (D) a horizontal straight line

Q.31 If $v_1\cos\theta_1 = v_2\cos\theta_2$, then choose the incorrect statement
(A) one particle will remain exactly below or above the other particle
(B) the trajectory of one with respect to other will be a vertical straight line
(C) both will have the same range
(D) none of these

Q.32 If $v_1\sin\theta_1 = v_2\sin\theta_2$, then choose the incorrect statement
(A) the time of flight of both the particles will be same
(B) the maximum height attained by the particles will be same
(C) the trajectory of one with respect to another will be a horizontal straight line
(D) none of these

Q.33 A motor boat is to reach at a point 30° upstream (w.r.t. normal) on other side of a river flowing with velocity 5m/s. Velocity of motorboat w.r.t. water is $5\sqrt{3}$ m/s. The driver should steer the boat at an angle
(A) 120° w.r.t. stream direction (B) 30° w.r.t. normal to the bank
(C) 30° w.r.t. the line of destination from starting point. (D) none of these

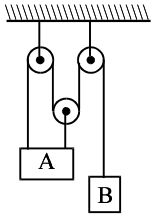
Q.34 A flag is mounted on a car moving due North with velocity of 20 km/hr. Strong winds are blowing due East with velocity of 20 km/hr. The flag will point in direction
(A) East (B) North - East (C) South - East (D) South - West

Q.35 Three ships A, B & C are in motion. The motion of A as seen by B is with speed v towards north – east. The motion of B as seen by C is with speed v towards the north – west. Then as seen by A, C will be moving towards
(A) north (B) south (C) east (D) west

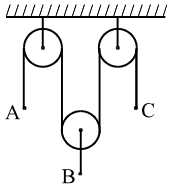
Q.36 Wind is blowing in the north direction at speed of 2 m/s which causes the rain to fall at some angle with the vertical. With what velocity should a cyclist drive so that the rain appears vertical to him :
(A) 2 m/s south (B) 2 m/s north (C) 4 m/s west (D) 4 m/s south

Q.37 When the driver of a car A sees a car B moving towards his car and at a distance 30 m, takes a left turn of 30°. At the same instant the driver of the car B takes a turn to his right at an angle 60°. The two cars collides after two seconds, then the velocity (in m/s) of the car A and B respectively will be : [assume both cars to be moving along same line with constant speed]
(A) 7.5, $7.5\sqrt{3}$ (B) 7.5, 7.5 (C) $7.5\sqrt{3}$, 7.5 (D) None

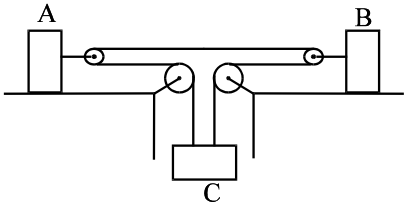
Q.38 At a given instant, A is moving with velocity of 5m/s upwards.What is velocity of B at that time
(A) 15 m/s ↓ (B) 15 m/s ↑
(C) 5 m/s ↓ (D) 5 m/s ↑



Q.39 The pulleys in the diagram are all smooth and light. The acceleration of A is a upwards and the acceleration of C is f downwards. The acceleration of B is
(A) ½(f - a) up (B) ½(a + f) down
(C) ½(a + f) up (D) ½(a - f) up



Q.40 If acceleration of A is 2 m/s^2 to left and acceleration of B is 1m/s^2 to left, then acceleration of C is
(A) 1 m/s^2 upwards (B) 1 m/s^2 downwards
(C) 2 m/s^2 downwards (D) 2 m/s^2 upwards



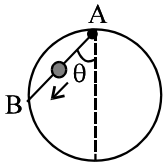
SECTION-2 MCQ

Q.41 A particle moves with constant speed v along a regular hexagon ABCDEF in the same order. Then the magnitude of the average velocity for its motion from A to
(A) F is v/5 (B) D is v/3 (C) C is $v\sqrt{3}/2$ (D) B is v

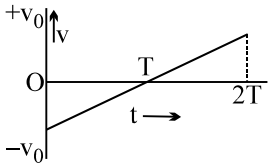
Q.42 A particle moving with a speed v changes direction by an angle θ, without change in speed.
(A) The change in the magnitude of its velocity is zero.
(B) The change in the magnitude of its velocity is $2v\sin(\theta/2)$.
(C) The magnitude of the change in velocity is $2v\sin(\theta/2)$
(D) The magnitude of the change in its velocity is $v(1 - \cos\theta)$.

Q.43 A particle has initial velocity 10 m/s. It moves due to constant retarding force along the line of velocity which produces a retardation of 5 m/s^2. Then
(A) the maximum displacement in the direction of initial velocity is 10 m
(B) the distance travelled in first 3 seconds is 7.5 m
(C) the distance travelled in first 3 seconds is 12.5 m
(D) the distance travelled in first 3 seconds is 17.5 m.

Q.44 A bead is free to slide down a smooth wire tightly stretched between points A and B on a vertical circle. If the bead starts from rest at A, the highest point on the circle
(A) its velocity v on arriving at B is proportional to $\cos\theta$
(B) its velocity v on arriving at B is proportional to $\tan\theta$
(C) time to arrive at B is proportional to $\cos\theta$
(D) time to arrive at B is independent of θ



Q.45 The figure shows the velocity (v) of a particle plotted against time (t)
(A) The particle changes its direction of motion at some point
(B) The acceleration of the particle remains constant
(C) The displacement of the particle is zero
(D) The initial and final speeds of the particle are the same



Q.46 A projectile of mass 1 kg is projected with a velocity of $\sqrt{20}$ m/s such that it strikes on the same level as the point of projection at a distance of $\sqrt{3}$ m. Which of the following options are incorrect:
(A) the maximum height reached by the projectile can be 0.25 m.
(B) the minimum velocity during its motion can be $\sqrt{15}$ m/s
(C) the time taken for the flight can be $\sqrt{\frac{3}{5}}$ sec.
(D) minimum kinetic energy during its motion can be 6J.

Q.47 Choose the correct alternative (s)
(A) If the greatest height to which a man can throw a stone is h, then the greatest horizontal distance upto which he can throw the stone is 2h.
(B) The angle of projection for a projectile motion whose range R is n times the maximum height is $\tan^{-1}(4/n)$
(C) The time of flight T and the horizontal range R of a projectile are connected by the equation $gT^2 = 2R\tan\theta$ where θ is the angle of projection.
(D) A ball is thrown vertically up. Another ball is thrown at an angle θ with the vertical. Both of them remain in air for the same period of time. Then the ratio of heights attained by the two balls 1 : 1.

Q.48 If T is the total time of flight, h is the maximum height & R is the range for horizontal motion, the x & y co-ordinates of projectile motion and time t are related as :

(A) $y = 4h\left(\frac{t}{T}\right)\left(1-\frac{t}{T}\right)$ (B) $y = 4h\left(\frac{X}{R}\right)\left(1-\frac{X}{R}\right)$

(C) $y = 4h\left(\frac{T}{t}\right)\left(1-\frac{T}{t}\right)$ (D) $y = 4h\left(\frac{R}{X}\right)\left(1-\frac{R}{X}\right)$

Q.49 A particle moves in the xy plane with a constant acceleration 'g' in the negative y-direction. Its equation of motion is $y = ax - bx^2$, where a and b are constants. Which of the following are correct?
(A) The x-component of its velocity is constant.
(B) At the origin, the y-component of its velocity is $a\sqrt{\frac{g}{2b}}$.
(C) At the origin, its velocity makes an angle $\tan^{-1}(a)$ with the x-axis.
(D) The particle moves exactly like a projectile.

Q.50 A particle is projected from the ground with velocity u at angle θ with horizontal. The horizontal range, maximum height and time of flight are R, H and T respectively. They are given by,

$$R = \frac{u^2 \sin 2\theta}{g},\ H = \frac{u^2 \sin^2 \theta}{2g} \text{ and } T = \frac{2u \sin \theta}{g}$$

Now keeping u as fixed, θ is varied from 30° to 60°. Then,
(A) R will first increase then decrease, H will increase and T will decrease
(B) R will first increase then decrease while H and T both will increase
(C) R will decrease while H and T will increase
(D) R will increase while H and T will increase

Q.51 A ball is rolled off along the edge of a horizontal table with velocity 4 m/s. It hits the ground after time 0.4 s. Which of the following are correct?
(A) The height of the table is 0.8 m
(B) It hits the ground at an angle of 60° with the vertical
(C) It covers a horizontal distance 1.6 m from the table
(D) It hits the ground with vertical velocity 4 m/s

Q.52 An observer moves with a constant speed along the line joining two stationary objects. He will observe that the two objects
(A) have the same speed
(B) have the same velocity
(C) move in the same direction
(D) move in opposite directions

Q.53 A man on a rectilinearly moving cart, facing the direction of motion, throws a ball straight up with respect to himself
(A) The ball will always return to him
(B) The ball will never return to him
(C) The ball will return to him if the cart moves with constant velocity
(D) The ball will fall behind him if the cart moves with some positive acceleration

SECTION-3 INTEGER TYPE

Q.54 A ball is projected from top of a tower with a velocity of 5 m/s at an angle of 53^0 to horizontal. Its speed when it is at a height of 0.45 m from the point of projection is

Q.55 Particle is dropped from the height of 20m from horizontal ground. A constant force acts on the particle in horizontal direction due to which horizontal acceleration of the particle becomes 6 ms^{-2}. Find the horizontal displacement of the particle till it reaches ground.

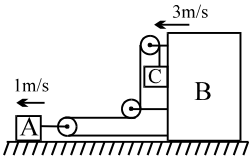
Q.56 Find time of flight of projectile thrown horizontally with speed 10 ms^{-1} from a long inclined plane which makes an angle of θ = 45° from horizontal.

Q.57 A swimmer swims in still water at a speed = 5 km/hr. He enters a 200 m wide river, having river flow speed = 4 km/hr at point A and proceeds to swim at an angle of 127° with the river flow direction. Another point B is located directly across A on the other side. The swimmer lands on the other bank at a point C, from which he walks the distance CB with a speed = 3 km/hr. The total time in which he reaches from A to B is

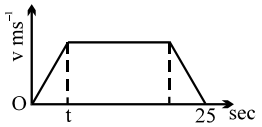
Q.58 A boat having a speed of 5 km/hr. in still water, crosses a river of width 1 km along the shortest possible path in 15 minutes. The speed of the river in Km/hr.

Q.59 A, B & C are three objects each moving with constant velocity. A's speed is 10 m/sec in a direction $\overrightarrow{PQ}$. The velocity of B relative to A is 6 m/sec at an angle of, $\cos^{-1}(15/24)$ to PQ . The velocity of C relative to B is 12 m/sec in a direction $\overrightarrow{QP}$, then find the magnitude of the velocity of C.

Q.60 The velocities of A and B are marked in the figure. Find the velocity of block C (assume that the pulleys are ideal and string inextensible).

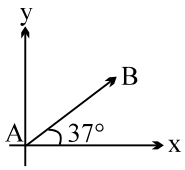


Q.61 The velocity-time graph of the particle moving along a straight line is shown. The rate of acceleration and deceleration is constant and it is equal to 5 ms^{-2}. If the average velocity during the motion is 20 ms^{-1}, then find the value of t.



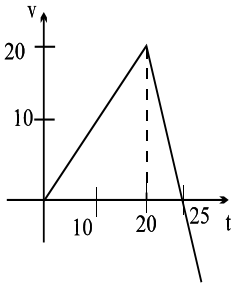
Q.62 A rifle with a muzzle velocity of 100m/s shoots a bullet at small target 30m away in the same horizontal line. How high above the target must the gun be aimed so that the bullet will hit the target.
(Hint: use small angle approximation)

Q.63 A butterfly is flying with velocity $10\hat{i}+12\hat{j}$ m/s and wind is blowing along x axis with velocity u. If butterfly starts motion from A and after some time reaches point B, find the value of u.



Q.64 An object moving with uniform acceleration has a velocity of 12.0 cm/s in the positive x direction when its x coordinate is 3.00 cm. If its x coordinate 2.00 s later is – 5.00 cm, what is its acceleration?

Q.65 The figure shows the v–t graph of a particle moving in straight line. Find the time when particle returns to the starting point.



ANSWER KEY

SECTION-1 SCQ

Q.1	D	Q.2	C	Q.3	B	Q.4	D	Q.5	C	Q.6	C	Q.7	D
Q.8	D	Q.9	B	Q.10	C	Q.11	A	Q.12	A	Q.13	A	Q.14	B
Q.15	D	Q.16	C	Q.17	D	Q.18	B	Q.19	A	Q.20	D	Q.21	A
Q.22	C	Q.23	C	Q.24	C	Q.25	B	Q.26	C	Q.27	A	Q.28	A, B,
Q.29	D	Q.30	B	Q.31	C	Q.32	D	Q.33	C	Q.34	C	Q.35	B
Q.36	B	Q.37	C	Q.38	A	Q.39	A	Q.40	A				

SECTION-2 SCQ

Q.41	A, C, D	Q.42	A, C	Q.43	A, C	Q.44	A, D		
Q.45	A, B, C, D	Q.46	D	Q.47	A, B, C, D	Q.48	A, B		
Q.49	A, B, C, D	Q.50	B	Q.51	A, C, D	Q.52	A, B, C	Q.53	C, D

SECTION-3 INTEGER TYPE

Q.54	4	Q.55	12	Q.56	2	Q.57	4	Q.58	3
Q.59	5 m/sec	Q.60	5 m/s	Q.61	5 s	Q.62	h = 0.45mc	Q.63	6 m/s
Q.64	$-16\ cm/s^2$	Q.65	36.2 sec.						