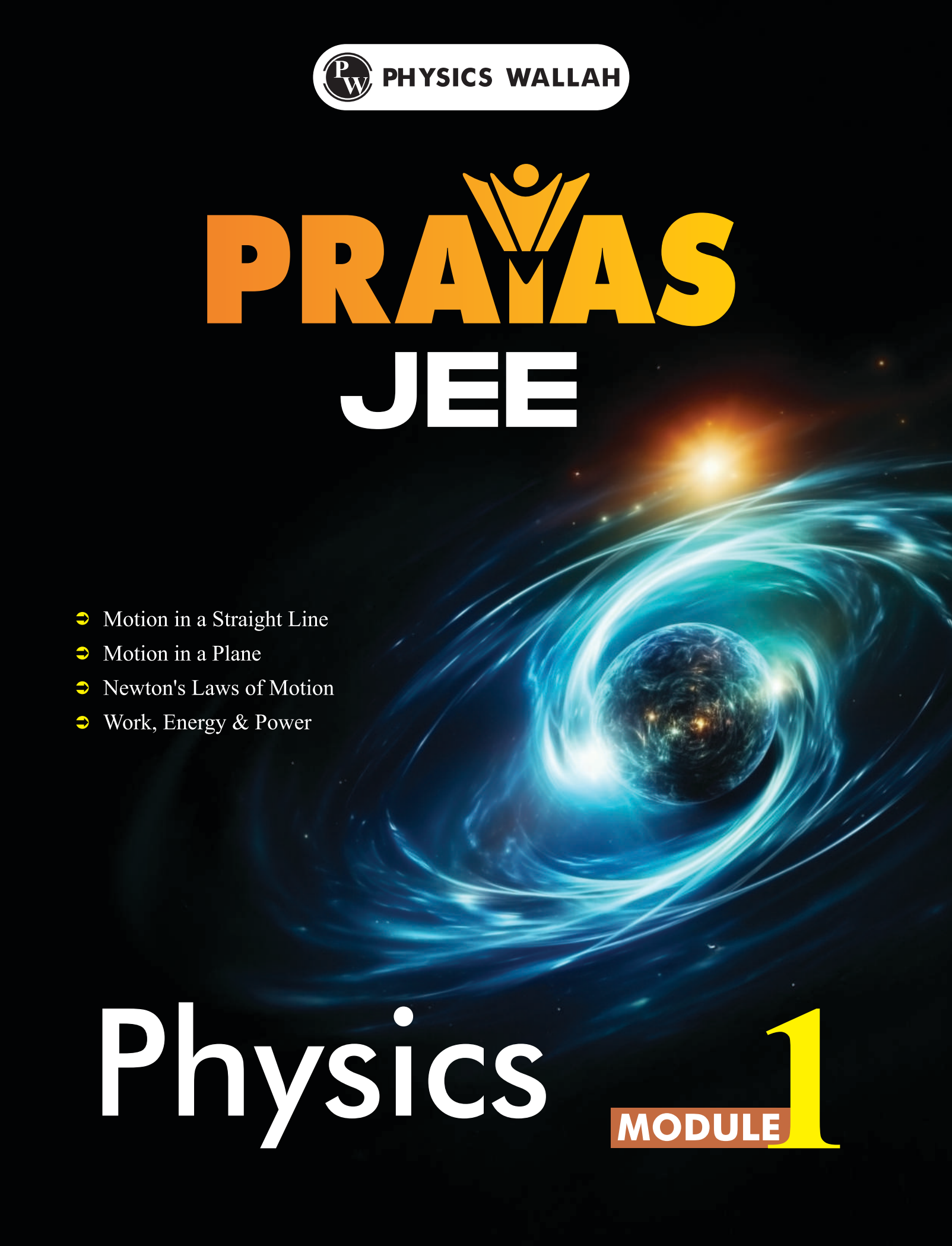
PHYSICS WALLAH

PRAYAS

JEE



- Motion in a Straight Line
- Motion in a Plane
- Newton's Laws of Motion
- Work, Energy & Power

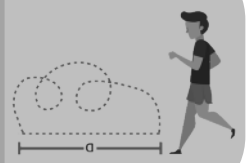
Physics

MODULE 1

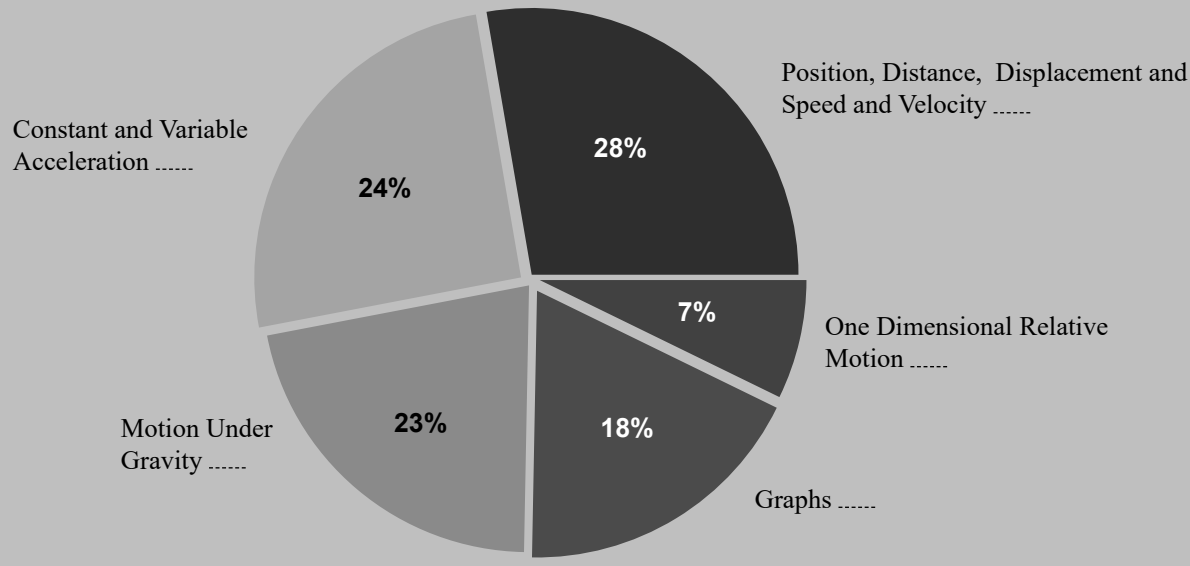
CHAPTER

1

Motion in a Straight Line



Topicwise Weightage of JEE Main 6 Years Paper (124 Sets)



"How's the Josh?" for these Topics: *Mark your confidence level in the blank space around the topic (Low-L, Medium-M, High-H)*

INTRODUCTION

A body is at rest when it does not change its position with time and is in motion if it changes its position with time in the frame of reference of the observer.

All motion is relative. There is no meaning of rest or motion without reference to the observer.

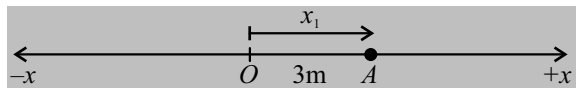
A passenger in a moving train is at rest with respect to another passenger in the same train while both are in motion with respect to observer on the ground. Therefore nothing is at absolute rest or in absolute motion.

To describe the motion of a particle, we introduce four important quantities namely position, displacement, velocity and acceleration. In general motion of a particle in three dimensions these quantities are vectors which have direction as well as magnitude. But for a particle moving in a straight line, there are only two directions, distinguished by designating one as positive and other as negative.

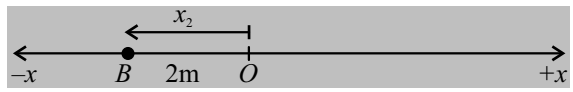
DISTANCE AND DISPLACEMENT

Position

The position of a particle is the location of particle measured with respect to some reference point. It is a vector quantity.



Position of A wrt O, $x_1 = 3$ m



Position of B wrt O, $x_2 = -2$ m

If particle lies towards +ve side of the chosen reference, then its position is also +ve and vice-versa.

Train Your Brain

Example 21: The acceleration a of a particle moving in one dimension is given by $a = 6 - 2t$. If the particle is initially at $x = 0$ and its velocity is 2 m/s, find its position and velocity at time t.

Sol. $\frac{dv}{dt} = 6 - 2t$

$\int_2^v dv = \int_0^t (6-2t)dt$

$\Rightarrow v - 2 = (6t - t^2)|_0^t = 6t - t^2 \Rightarrow v(t) = 2 + 6t - t^2$

To find position, we integrate velocity.

$v = \frac{dx}{dt} = 2 + 6t - t^2 \Rightarrow dx = (2 + 6t - t^2)dt$

$\int_0^x dx = \int_0^t (2 + 6t - t^2)dt = 2t + 3t^2 - \frac{t^3}{3}$

or $x(t) = 2t + 3t^2 - \frac{t^3}{3}$

Example 22: The retardation of a car when its engine is shut off depends on its velocity as $a = -\alpha v$ where α is positive constant. Find the total distance travelled by the car if its initial velocity is 20 m/s and $\alpha = 0.5$/s.

Sol. $\frac{dv}{dt} = -\alpha v$

$\frac{dv}{dx}\left(\frac{dx}{dt}\right) = -\alpha v \Rightarrow \frac{vdv}{dx} = -\alpha v$

or $dv = -\alpha dx$

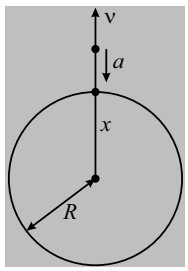
$\int_{20}^0 dv = -\alpha \int_0^d dx \Rightarrow v|_{20}^0 = -\alpha x|_0^d$

$-20 = -\alpha d$

$d = \frac{20}{\alpha} = \frac{20}{0.5} = 40$ m

Example 23: With what velocity in vertical upward direction should a body be projected from the surface of earth so that it reaches a height equal to radius of earth? The acceleration of body is given by $a = -\frac{GM}{x^2}$ where x is the distance from centre of earth and M is the mass of earth.

Sol. Note that acceleration due to gravity is nearly constant near the surface of earth. But if the height become too large its dependence on distance can not be ignored.



$a = \frac{dv}{dt} = -\frac{GM}{x^2}$

or $\frac{dv}{dx}.\frac{dx}{dt} = -\frac{GM}{x^2} \Rightarrow vdv = = -\frac{GM}{x^2}dx$

At the highest point, velocity is zero. Also note $x_i = R$ and $x_f = 2R$.

$\int_u^0 vdv = -GM\int_R^{2R}\frac{dx}{x^2}$

$\frac{v^2}{2}\Big|_u^0 = -GM\int_R^{2R} x^{-2}dx = \frac{GM}{x}\Big|_R^{2R}$

$\Rightarrow -\frac{u^2}{2} = GM\left[\frac{1}{2R} - \frac{1}{R}\right]$

$\Rightarrow u^2 = \frac{GM}{R} \Rightarrow u = \sqrt{\frac{GM}{R}} = \sqrt{\frac{GM}{R^2}R}$

$\because g = \left(\frac{GM}{R^2}\right)$

$= \sqrt{gR} = 8$ km/s $[\because R = 6400$ km, g = 10 m/s$^2]$

Concept Application

10. Starting from rest at $t = 0$, a particle moves in a straight line with an acceleration a given by $a = t^3$ m/s^2 where t is in seconds. Then the velocity of particle after 4 seconds is

(a) 32 m/s (b) 64 m/s

(c) 128 m/s (d) 16 m/s

11. A particle moves in a straight line with acceleration $a = -\frac{1}{3v^2}$ where v is its velocity at time t. If initial velocity is 5 m/s then time t at which its velocity becomes zero is

(a) 5 sec (b) 25 sec (c) 125 sec (d) 50 sec

12. The acceleration of a particle as a function of its position x is given $a = -2x$. If velocity at $x = 0$ is 20 m/s, find the position x where its velocity becomes zero.

(a) $10\sqrt{2}$ m (b) $5\sqrt{2}$ m

(c) $20\sqrt{2}$ m (d) 20 m

RELATIVE MOTION

Every motion is actually only relative motion. There is nothing like absolute motion. Whether a body is moving or is at rest is not a quality of body itself rather it is always with respect to an observer. If the observer finds that the position of an object is not changing when observed by him then the object is 'actually' at rest (and vice-versa). Therefore, when a passenger (A) in a train observes another passenger (B) then he finds that passenger (and

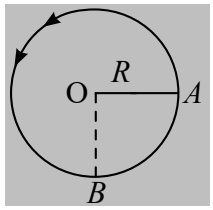
POSITION, DISTANCE AND DISPLACEMENT

1. A body moves 6 m north. 8 m east and 10 m vertically upwards, what is its resultant displacement from initial position?

(*a*) $10\sqrt{2}$ m (*b*) 10 m

(*c*) $\frac{10}{\sqrt{2}}$ m (*d*) 20 m

2. A body moves in circular path of radius R from A to B as shown. Its displacement and distance covered are



(*a*) $R, \frac{3\pi R}{2}$ (*b*) $\sqrt{2}R, \frac{\pi R}{2}$

(*c*) $\sqrt{2}R, \frac{3\pi R}{2}$ (*d*) None of these

3. A particle covers half of the circle of radius r. Then the displacement and distance of the particle are respectively

(*a*) $2\pi r, 0$ (*b*) $2r, \pi r$ (*c*) $\frac{\pi r}{2}, 2r$ (*d*) $\pi r, r$

SPEED AND VELOCITY

4. A person travels along a straight road for half the distance with velocity v_1 and the remaining half distance with velocity v_2. The average velocity is given by

(*a*) $v_1 v_2$ (*b*) $\frac{v_2^2}{v_1^2}$

(*c*) $\frac{v_1 + v_2}{2}$ (*d*) $\frac{2v_1 v_2}{v_1 + v_2}$

5. A car travels the first half of a distance between two places at a speed of 30 km/hr and the second half of the distance at 50 km/hr. The average speed of the car for the whole journey is

(*a*) 42.5 km/hr (*b*) 40.0 km/hr

(*c*) 37.5 km/hr (*d*) 35.0 km/hr

6. A person travels along a straight road for the first half time with a velocity v_1 and the next half time with a velocity v_2. The mean velocity V of the man is

(*a*) $\frac{2}{V} = \frac{1}{v_1} + \frac{1}{v_2}$ (*b*) $V = \frac{v_1 + v_2}{2}$

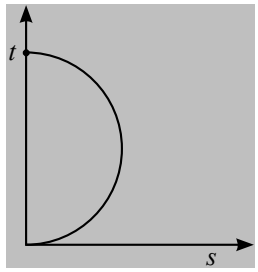
(*c*) $V = \sqrt{v_1 v_2}$ (*d*) $V = \sqrt{\frac{v_1}{v_2}}$

7. If a car covers 2/5th of the total distance with v_1 speed and 3/5th distance with v_2 then average speed is

(*a*) $\frac{1}{2}\sqrt{v_1 v_2}$ (*b*) $\frac{v_1 + v_2}{2}$

(*c*) $\frac{2v_1 v_2}{v_1 + v_2}$ (*d*) $\frac{5v_1 v_2}{3v_1 + 2v_2}$

8. Which of the following options is correct for the object having a straight line motion represented by the following graph?



(*a*) The object moves with constantly increasing velocity from O to A and then it moves with constant velocity

(*b*) Velocity of the object increases uniformly

(*c*) Average velocity is zero

(*d*) The graph shown is impossible

CONSTANT ACCELERATION

9. A particle experiences a constant acceleration for 20 sec after starting from rest. If it travels a distance S_1 in the first 10 sec and a distance S_2 in the next 10 sec, then

(*a*) $S_1 = S_2$ (*b*) $S_1 = S_2/3$

(*c*) $S_1 = S_2/2$ (*d*) $S_1 = S_2/4$

10. A body is moving from rest under constant acceleration and let S_1 be the displacement in the first $(p - 1)$ sec and S_2 be the displacement in the first p sec. The displacement in $(p^2 - p + 1)^{th}$ sec. will be

(*a*) $S_1 + S_2$ (*b*) $S_1 S_2$

(*c*) $S_1 - S_2$ (*d*) S_1 / S_2

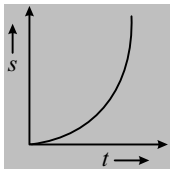
11. The displacement of body moving with constant acceleration, in 3rd seconds is 2m and in 5th second is 9m. Find the acceleration of body.

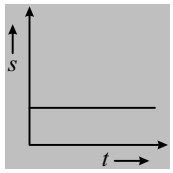
(*a*) $\frac{5}{2}\text{ms}^{-2}$ (*b*) $\frac{7}{2}\text{ms}^{-2}$

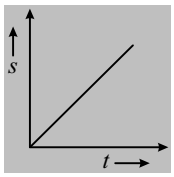
(*c*) $\frac{9}{2}\text{ms}^{-2}$ (*d*) $\frac{11}{2}\text{ms}^{-2}$

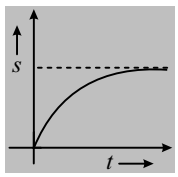
12. A point moves with uniform acceleration and v_1, v_2 and v_3 denote the average velocities in the three successive intervals of time t_1, t_2 and t_3. Which of the following relations is correct?

32. Which graph must represent non-uniform acceleration (s is displacement)?

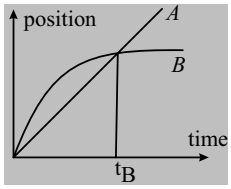
(*a*) 

(*b*) 

(*c*) 

(*d*) 

33. The graph shows position as a function of time for two trains running on parallel tracks. Which one of the following statements is true?



(*a*) At time t_B, both trains have the same velocity
(*b*) Both trains have the same velocity at some time after t_B
(*c*) Both trains have the same velocity at some time before t_B
(*d*) Somewhere on the graph, both trains have the same acceleration

ONE DIMENSIONAL RELATIVE MOTION

34. Two trains, each 50 m long are travelling in opposite direction with velocity 10 m/s and 15 m/s. The time of crossing is

(*a*) 2 *s* (*b*) 4 *s* (*c*) $2\sqrt{3}$ *s* (*d*) $4\sqrt{3}$ *s*

35. A 210 meter long train is moving due North at a of 25m/s. A small bird is flying due South a little above the train with speed 5m/s. The time taken by the bird to cross the train is

(*a*) 6 *s* (*b*) 7 *s*
(*c*) 9 *s* (*d*) 10 *s*

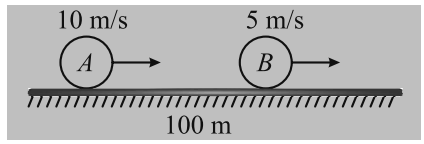
36. A stone is dropped from a building, and 2 seconds later another stone is dropped. (Both a are dropped from rest.) How far apart are the two stones by the time the first one has reached a speed of 30 m/s ?

(*a*) 80 m (*b*) 100 m
(*c*) 60 m (*d*) 40 m

37. Two trains each of length 50 m are approaching each other on parallel rails. Their velocities are 10 m/sec and 15 m/sec. They will cross each other in

(*a*) 2 sec (*b*) 4 sec
(*c*) 10 sec (*d*) 6 sec

38. An object *A* is moving with 10 m/s and *B* is moving with 5 m/s in the same direction of positive *x*-axis. *A* is 100 m behind *B* as shown. Find time taken by *A* to Meet *B*



(*a*) 18 sec (*b*) 16 sec (*c*) 20 sec (*d*) 17 sec

39. A thief is running away on a straight road with a speed of 9 ms^{-1}. A police man chases him on a jeep moving at a speed of 10 ms^{-1}. If the instantaneous separation of the jeep from the motorcycle is 100m, how long will it take for the police man to catch the thief?

(*a*) 1s (*b*) 19s (*c*) 90s (*d*) 100s

DISTANCE OF NEAREST APPROACH

40. A body is projected vertically up at $t = 0$ with a velocity of 98 m/s. Another body is projected from the same point with same velocity after 4 seconds. Both bodies will meet after:

(*a*) 6 *s* (*b*) 8 *s*
(*c*) 10 *s* (*d*) 12 *s*

Prabal (JEE Main Level)

1. A car runs at constant speed on a circular track of radius 100 m taking 62.8 s on each lap. What is the average speed and average velocity on each complete lap?

(*a*) Average velocity 10 m/s, average speed 10 m/s

(*b*) Average velocity zero, average speed 10 m/s

(*c*) Average velocity zero, average speed zero

(*d*) Average velocity 10 m/s, average speed zero

2. A body starts from rest and is uniformly accelerated for 30 s. The distance travelled in the first 10s is x_1, in next 10 s is x_2 and in last 10 s is x_3. Then $x_1 : x_2 : x_3$ is

(*a*) 1 : 2 : 4 (*b*) 1 : 2 : 5
(*c*) 1 : 3 : 5 (*d*) 1 : 3 : 9

3. A body is thrown upward and reaches its maximum height. At that position

(*a*) Its velocity is zero and its acceleration is also zero

(*b*) Its velocity is zero but its acceleration is maximum

(*c*) Its acceleration is minimum

(*d*) Its velocity is zero and its acceleration is the acceleration due to gravity

4. The motion of a body is given by the equation $\frac{dv(t)}{dt} = 6.0 - 3v(t)$, where $v(t)$ is speed in m/s and t in sec.

If body was at rest at $t = 0$ choose the wrong option.

(*a*) The terminal speed is 2.0 m/s

(*b*) The speed varies with the time as $v(t) = 2(1 - e^{-3t})$ m/s

(*c*) The speed is 0.1 m/s when the acceleration is half the initial value

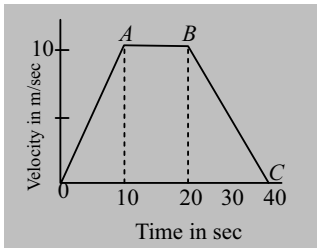
(*d*) The magnitude of the initial acceleration is 6.0 m/s^2

5. The displacement time graphs of motion of two particles A and B are straight lines making angles of 30º and 60º respectively with the time axis. If the velocity of A is v_A and that of B is v_B then the value of $\frac{v_A}{v_B}$ is

(*a*) 1/2 (*b*) $1/\sqrt{3}$

(*c*) $\sqrt{3}$ (*d*) 1/3

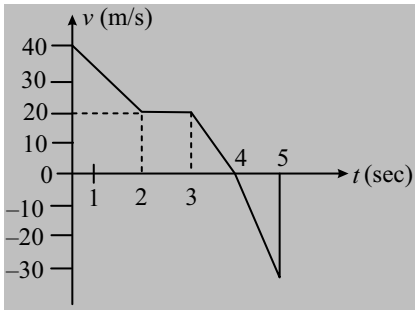
6. The curve shown represents the velocity-time graph of a particle, its acceleration values along OA, AB and BC in metre/sec^2 are respectively



(*a*) 1, 0, –0.5 (*b*) 1, 0, 0.5

(*c*) 1, 1, 0.5 (*d*) 1, 0.5, 0

7. In the following velocity-time graph of a body, the distance and displacement travelled by the body in 5 second in meters will be

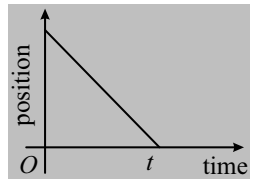


(*a*) 75, 115 (*b*) 105, 75

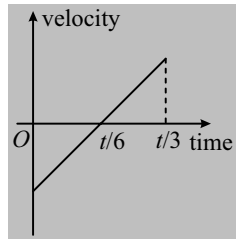
(*c*) 45, 75 (*d*) 95, 55

8. For which of the following graphs the average velocity of a particle moving along a straight line for time interval $(0, t)$ must be negative?

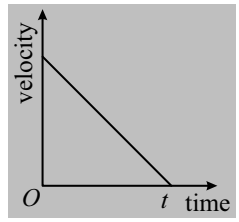
(*a*)



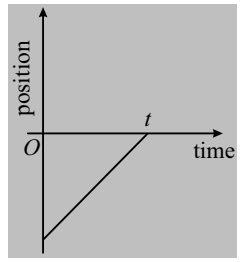
(*b*)



(*c*)



(*d*)



9. Four particles move along x-axis. Their coordinates (in meters) as functions of time (in seconds) are given by

Particle 1 : $x(t) = 3.5 - 2.7t^3$

Particle 2 : $x(t) = 3.5 + 2.7t^3$

Particle 3 : $x(t) = 3.5 + 2.7t^2$

Particle 4 : $x(t) = 3.5 - 3.4t - 2.7t^2$

Which of these particles have constant acceleration?

(*a*) All four

(*b*) Only 1 and 2

(*c*) Only 2 and 3

(*d*) Only 3 and 4

10. A particle is projected up from ground with initial speed v_0. Starting from time $t = 0$ to $t = t_1$,

(*a*) Distance travelled and magnitude of displacement are not equal if $t_1 < \frac{v_0}{g}$

(*b*) Distance travelled and magnitude of displacement are equal if $\frac{v_0}{g} < t_1 < \frac{2v_0}{g}$

(*c*) Distance travelled and magnitude of displacement may not be equal if $0 < t_1 < \frac{2v_0}{g}$

(*d*) The magnitude of displacement is greater than the distance travelled if $\frac{v_0}{g} < t_1 < \frac{2v_0}{g}$

11. Two bodies P and Q have to move equal distances starting from rest. P is accelerated with $2a$ for first half distance, then its acceleration becomes a for last half, whereas Q has acceleration a for first half and acceleration $2a$ for last half, then for whole journey.

(*a*) Average speed of P is more than that of Q

(*b*) Average speed of both will be same

(*c*) Maximum speed during the journey is more for P

(*d*) Maximum speed during the journey is more for Q

MULTIPLE CORRECT TYPE QUESTIONS

1. Mark the correct statements for a particle going on a straight line

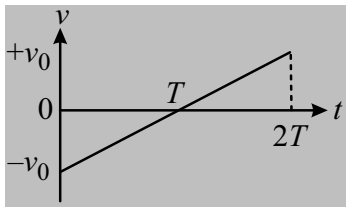
(*a*) If the velocity is zero at any instant, the acceleration should also be zero at that instant.

(*b*) If the velocity is zero for a time interval, the acceleration is zero at any instant within the time interval.

(*c*) If the velocity and acceleration have opposite sign, the object is slowing down.

(*d*) If the position and velocity have opposite sign, the particle is moving towards the origin.

2. 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.

3. 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 $\frac{v\sqrt{3}}{2}$ (*d*) B is v

4. Path of a particle moving in x-y plane is $y = 3x + 4$. At some instant suppose x-component of velocity is 1 m/s and it is increasing at a rate of 1 m/s^2. Then

(*a*) At this instant the speed of particle is $\sqrt{10}$ m/s.

(*b*) At this instant the acceleration of particle is $\sqrt{10}$ m/s^2.

(*c*) Velocity time graph is a straight line.

(*d*) Acceleration-time graph is a straight line.

5. A particle having a velocity $v = v_0$ at $t = 0$ is brought to rest by decelerating at the rate $|a| = \alpha\sqrt{v}$, where α is a positive constant.

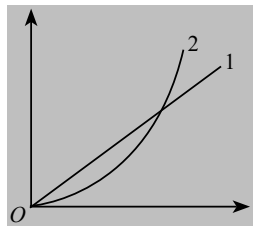
(*a*) The particle comes to rest at $t = \frac{2\sqrt{v_0}}{\alpha}$

(*b*) The particle will come to rest at infinity.

(*c*) The distance travelled by the particle is $\frac{2v_0^{3/2}}{\alpha}$.

(*d*) The distance travelled by the particle is $\frac{2}{3}\frac{v_0^{3/2}}{\alpha}$.

6. A particle is resting over a smooth horizontal floor. At $t = 0$, a horizontal force starts acting on it. Magnitude of the force increases with time as $F = kt$, where k is a constant. Two curves are drawn for this particle as shown.



(*a*) Curve-1 shows acceleration versus time.

(*b*) Curve-2 shows velocity versus time.

(*c*) Curve-2 shows velocity versus acceleration.

(*d*) Curve-1 shows velocity versus acceleration.

7. The minimum speed with respect to air that a particular jet aircraft must have in order to keep aloft is 300 km/hr. Suppose that as its pilot prepares to take off, the wind blows eastward at a ground speed that can vary between 0 and 30 km/hr. Ignoring any other fact, a safe procedure to follow, consistent with using up as little fuel as possible, is to:

(*a*) Take off eastward at a ground speed of 320 km/hr

(*b*) Take off westward at a ground speed of 320 km/hr

(*c*) Take off westward at a ground speed of 300 km/hr

(*d*) Take off westward at a ground speed of 280 km/hr

8. A block is thrown with a velocity of 2 ms^{-1} (relative to ground) on a belt, which is moving with velocity 4 ms^{-1} in opposite direction of the initial velocity of block. If the block stops slipping on the belt after 4 sec of the throwing then choose the correct statements

(*a*) Displacement with respect to ground is zero after 2.66s and magnitude of displacement with respect to ground is 12 m after 4 sec.

(*b*) Magnitude of displacement with respect to ground in 4 sec is 4 m.

(*c*) Magnitude of displacement with respect to belt in 4 sec is 12 m.

(*d*) Displacement with respect to ground is zero in 8/3 sec

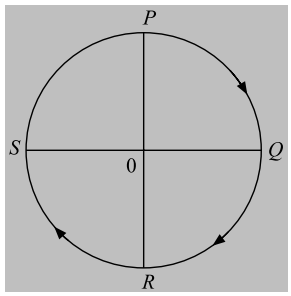
9. A particle has initial velocity 10 m/s. It moves under constant retarding force along the line of velocity which produces a retardation of 5 m/s^2. Then

(*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.

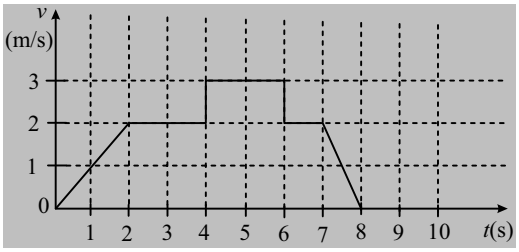
POSITION, DISTANCE AND DISPLACEMENT

1. A cyclist starts from the point P of a circular ground of radius 2 km and travels along its circumference to the point S. The displacement of cyclist is: **[04 April, 2024 (Shift-II)]**



(*a*) 6 km (*b*) $\sqrt{8}$ km (*c*) 4 km (*d*) 8 km

2. A particle starts from the origin at time $t = 0$ and moves along the positive x-axis. The graph of velocity with respect to time is shown in figure. What is the position of the particle at time $t = 5s$? **[10 Jan, 2019 (Shift-II)]**



(*a*) 10 m (*b*) 6 m (*c*) 3 m (*d*) 9 m

SPEED AND VELOCITY

3. A particle is moving in a straight line. The variation of position 'x' as a function of time 't' is given as $x = (t^3 - 6t^2 + 20t + 15)$ m. The velocity of the body when its acceleration becomes zero is:

(*a*) 4 m/s (*b*) 8 m/s (*c*) 10 m/s (*d*) 6 m/s

[29 Jan, 2024 (Shift-II)]

4. A particle is moving in one dimension (along x axis) under the action of a variable force. It's initial position was 16 m right of origin. The variation of its position (x) with time (t) is given as $x = -3t^3 + 18t^2 + 16t$, where x is in m and t is in s. The velocity of the particle when its acceleration becomes zero is _____ m/s.

[1 Feb, 2024 (Shift-I)]

5. A train starting from rest first accelerates uniformly up to a speed of 80 km/h for time t, then it moves with a constant speed for time $3t$. The average speed of the train for this duration of journey will be (in km/h): **[6 April, 2024 (Shift-I)]**

(*a*) 80 (*b*) 70 (*c*) 30 (*d*) 40

6. A particle moves in a straight line so that its displacement x at any time t is given by $x^2 = 1 + t^2$. Its acceleration at any time t is x^{-n} where $n =$ _____. **[6 April, 2024 (Shift-II)]**

7. A particle moving in a straight line covers half the distance with speed 6 m/s. The other half is covered in two equal time intervals with speeds 9 m/s and 15 m/s respectively. The average speed of the particle during the motion is: **[09 April, 2024 (Shift-I)]**

(*a*) 8.8 m/s (*b*) 10 m/s (*c*) 9.2 m/s (*d*) 8 m/s

8. A horse rider covers half the distance with 5 *m/s* speed. The remaining part of the distance was travelled with speed 10 *m/s* for half the time and with speed 15 *m/s* for other half of the time. The mean speed of the rider averaged over the whole time of motion is $x/7$ *m/s*. The value of x is _____ .

[30 Jan, 2023 (Shift-I)]

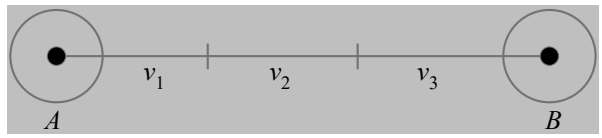
9. A car travels a distance of 'x' with speed v_1 and then same distance 'x' with speed v_2 in the same direction. The average speed of the car is: **[25 Jan, 2023 (Shift-I)]**

(*a*) $\frac{v_1 v_2}{2(v_1 + v_2)}$ (*b*) $\frac{v_1 + v_2}{2}$

(*c*) $\frac{2x}{v_1 + v_2}$ (*d*) $\frac{2v_1 v_2}{v_1 + v_2}$

10. A car covers AB distance with first one-third at velocity v_1 ms^{-1}, second one-third at v_2 ms^{-1} and last one-third at v_3 ms^{-1}. If $v_3 = 3v_1$, $v_2 = 2v_1$ and $v_1 = 11$ ms^{-1} then the average velocity of the car is _____ms^{-1}.

[28 June, 2022 (Shift-II)]



11. A car is moving with speed of 150 km/h and after applying the break it will move 27m before it stops. If the same car is moving with a speed of one third the reported speed then it will stop after travelling _____ m distance.

[25 July, 2022 (Shift-I)]

12. The velocity of a particle is $v = v_0 + gt + Ft^2$. Its position is $x = 0$ at $t = 0$; then its displacement after time ($t = 1$) is: **[17 March, 2021 (Shift-II)]**

(*a*) $v_0 + g + f$ (*b*) $v_0 + \frac{g}{2} + \frac{F}{3}$

(*c*) $v_0 + 2g + 3F$ (*d*) $v_0 + \frac{g}{2} + F$

13. The position of a particle as a function of time t, is given by $x(t) = at + bt^2 - ct^3$ where a, b and c are constants. When the particle attains zero acceleration, then its velocity will be: **[9 April, 2019 (Shift-II)]**

(*a*) $a + \frac{b^2}{4c}$ (*b*) $a + \frac{b^2}{c}$

(*c*) $a + \frac{b^2}{2c}$ (*d*) $a + \frac{b^2}{3c}$

44. The distance x covered by a particle in one dimensional motion varies with time t as $x^2 = at^2 + bt + c$. If the acceleration of the particle depends on x as x^{-n}, where n is an integer, the value of n is _____.

[9 Jan, 2020 (Shift-I)]

ONE DIMENSIONAL RELATIVE MOTION

45. Train A is moving along two parallel rail tracks towards north with speed 72 km/h and train B is moving towards south with speed 108 km/h. Velocity of train B with respect to A and velocity of ground with respect to B are (in ms^{-1}): **[1 Feb, 2024 (Shift-II)]**

(a) –30 and 50 (b) –50 and –30

(c) –50 and 30 (d) 50 and –30

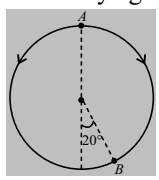
PW Challengers

SINGLE CORRECT TYPE QUESTIONS

1. A man left his dog sitting on a large slippery ground and walks away with a velocity of 2m/s. When he is 207 m away from the dog, the dog decides to catch him and thereafter they move together. The dog can not develop acceleration more that $2m/s^2$ in any direction due to slippery ground. If the maximum velocity with which dog can move is 18 m/s then the minimum time in which dog will meet the man is

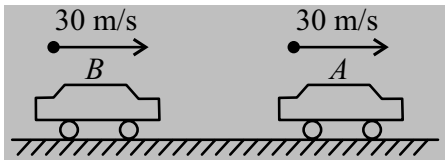
(a) 20 sec (b) 21 sec (c) 22 sec (d) 24 sec

2. Two motorcyclists simultaneously start a race with constant speeds from point A to traverse on a circular track, one clockwise and other in anticlockwise sense. They simultaneously cross point B first time after a time interval of 10 minutes. If they continue to move, how long after they cross at B first time will they again cross at point B.



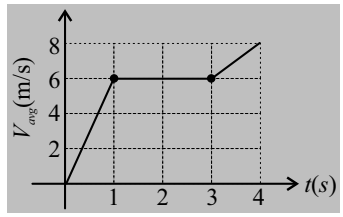
(a) 10 min (b) 95 min (c) 90 min (d) 85 min

3. Two cars A and B are running on a highway with same velocity of 30 m/s. On application of brakes car A retards at a rate of $3 m/s^2$ while car B retards at a rate of $4 m/s^2$. Car A is running ahead of car B. In an emergency when driver of front car A applies brakes, in response the driver of near car B has to apply brakes to avoid accident. The response time of driver of car B is 1 sec. The minimum distance between them to avoid accident is

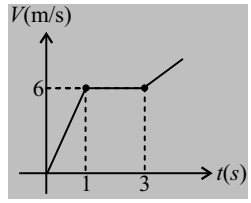


(a) 7.5 m (b) 6 m (c) 8.5 m (d) 10 m

4. The relation between average velocity v_{av} of a particle and time t is shown in the graph. If during the time interval considered, the particle did not change its direction of motion, then plot instantaneous velocity as a function of time?



(a)



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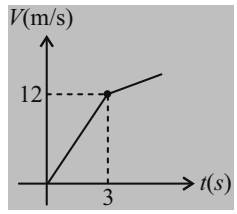
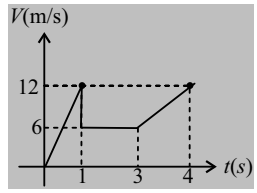
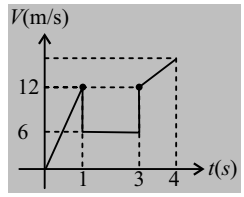


(c)



(d)



5. When a deer was 48 m from a leopard, the leopard starts chasing the deer and the deer immediately starts running away from the leopard with constant velocity. A leopard cannot run at high speeds for a long time and has to slow down due to fatigue. If we assume that the leopard starts with an initial speed of 30 m/s and reduces its speed in equal steps of 5 m/s after every 2 s interval, at what minimum speed must the deer run to escape from the leopard?

(a) 15 ms^{-1} (b) 16 ms^{-1} (c) 17 ms^{-1} (d) 18 ms^{-1}

6. At the initial instant, two particles are observed at different locations moving towards each other with velocities u_1 and u_2. If they are subjected to constant accelerations a_1, and a_2 in directions opposite to their initial velocities, they will meet twice. If time interval between these two meetings is Δt, find suitable expression for their initial separation.

(a) $\dfrac{(u_1+u_2)^2}{a_1+a_2}+\dfrac{a_1+a_2}{8}(\Delta t)^2$

(b) $\dfrac{(u_1+u_2)^2}{2(a_1+a_2)}+\dfrac{a_1+a_2}{8}(\Delta t)^2$

ANSWER KEY

CONCEPT APPLICATION

1. (24 km/hr, 24 km/hr) **2.** 10 km/h, $\frac{10}{3}\left(\sqrt{2}+1\right)$km/hr **3.** **(***a***)** 2 m/sec^2, **(***b***)** 75 m **4.** (*a*) 1, (*b*) 125 m

5. (*b*) **6.** (*a*) **7.** (*c*) **8.** (*d*) **9.** (*a*) **10.** (*b*) **11.** (*c*) **12.** (*a*) **13.** (*b*)

PRARAMBH (TOPICWISE)

1. (*a*)	**2.** (*c*)	**3.** (*b*)	**4.** (*d*)	**5.** (*c*)	**6.** (*b*)	**7.** (*d*)	**8.** (*c*)	**9.** (*b*)	**10.** (*a*)
11. (*b*)	**12.** (*b*)	**13.** (*b*)	**14.** (*a*)	**15.** (*c*)	**16.** (*c*)	**17.** (*c*)	**18.** (*c*)	**19.** (*b*)	**20.** (*d*)
21. (*c*)	**22.** (*a*)	**23.** (*b*)	**24.** (*c*)	**25.** (*d*)	**26.** (*b*)	**27.** (*d*)	**28.** (*c*)	**29.** (*d*)	**30.** (*a*)
31. (*c*)	**32.** (*d*)	**33.** (*c*)	**34.** (*b*)	**35.** (*b*)	**36.** (*d*)	**37.** (*b*)	**38.** (*c*)	**39.** (*d*)	**40.** (*d*)

PRABAL (JEE MAIN LEVEL)

1. (*b*)	**2.** (*c*)	**3.** (*d*)	**4.** (*c*)	**5.** (*d*)	**6.** (*a*)	**7.** (*b*)	**8.** (*a*)	**9.** (*d*)	**10.** (*c*)
11. (*a*)	**12.** (*c*)	**13.** (*c*)	**14.** (*a*)	**15.** (*d*)	**16.** (*b*)	**17.** (*d*)	**18.** (*b*)	**19.** [1125]	**20.** [225]
21. [72]	**22.** [24]	**23.** [80]	**24.** [7]	**25.** [750]					

PARIKSHIT (JEE ADVANCED LEVEL)

1. (*b*,*c*,*d*)	**2.** (*a*,*b*,*c*,*d*)	**3.** (*a*,*c*,*d*)	**4.** (*a*,*b*,*c*,*d*)	**5.** (*a*,*d*)	**6.** (*a*,*b*,*c*)	**7.** (*c*)	**8.** (*b*,*c*,*d*)	**9.** (*a*,*c*)	**10.** (*a*,*b*,*c*,*d*)
11. (*c*,*d*)	**12.** (*a*,*b*,*d*)	**13.** (*b*)	**14.** (*c*)	**15.** (*d*)	**16.** (*c*)	**17.** (*b*)	**18.** (*c*)	**19.** (*b*)	**20.** (*b*)
21. (*a*)	**22.** (*a*)	**23.** (*b*)	**24.** (*d*)	**25.** (*a*)	**26.** (*b*)	**27.** [0.82]	**28.** [1.25]	**29.** [160.00]	**30.** [30.00]
31. [55]	**32.** [15]	**33.** [25]	**34.** [45]	**35.** [2]	**36.** (*b*)	**37.** (*d*)	**38.** (*d*)	**39.** (*c*)	**40.** (*a*)
41. (*c*)	**42.** (*b*)	**43.** (*c*)	**44.** (*b*)						

PYQ's (PAST YEAR QUESTIONS)

1. (*b*)	**2.** (*d*)	**3.** (*b*)	**4.** [52]	**5.** (*b*)	**6.** [3]	**7.** (*d*)	**8.** [50]	**9.** (*d*)	**10.** [18]
11. [3]	**12.** (*b*)	**13.** (*d*)	**14.** (Bonus)	**15.** [45]	**16.** [8]	**17.** (*b*)	**18.** [40]	**19.** [19]	**20.** (*a*)
21. (*c*)	**22.** [200]	**23.** (*d*)	**24.** [100]	**25.** (*b*)	**26.** (*c*)	**27.** (*b*)	**28.** [120]	**29.** (*d*)	**30.** [392]
31. [50]	**32.** (*a*)	**33.** (*a*)	**34.** (*b*)	**35.** [8]	**36.** (*d*)	**37.** (*a*)	**38.** (*d*)	**39.** (*b*)	**40.** [1]
41. [20]	**42.** (*c*)	**43.** (*c*)	**44.** [3]	**45.** (*c*)					

PW CHALLENGERS

1. (*c*)	**2.** (*c*)	**3.** (*b*)	**4.** (*d*)	**5.** (*c*)	**6.** (*c*)	**7.** (*c*)	**8.** (*d*)	**9.** (*d*)	**10.** (*b*)
11. (*c*)	**12.** (*c*)	**13.** (*d*)	**14.** (*c*)	**15.** [2]					

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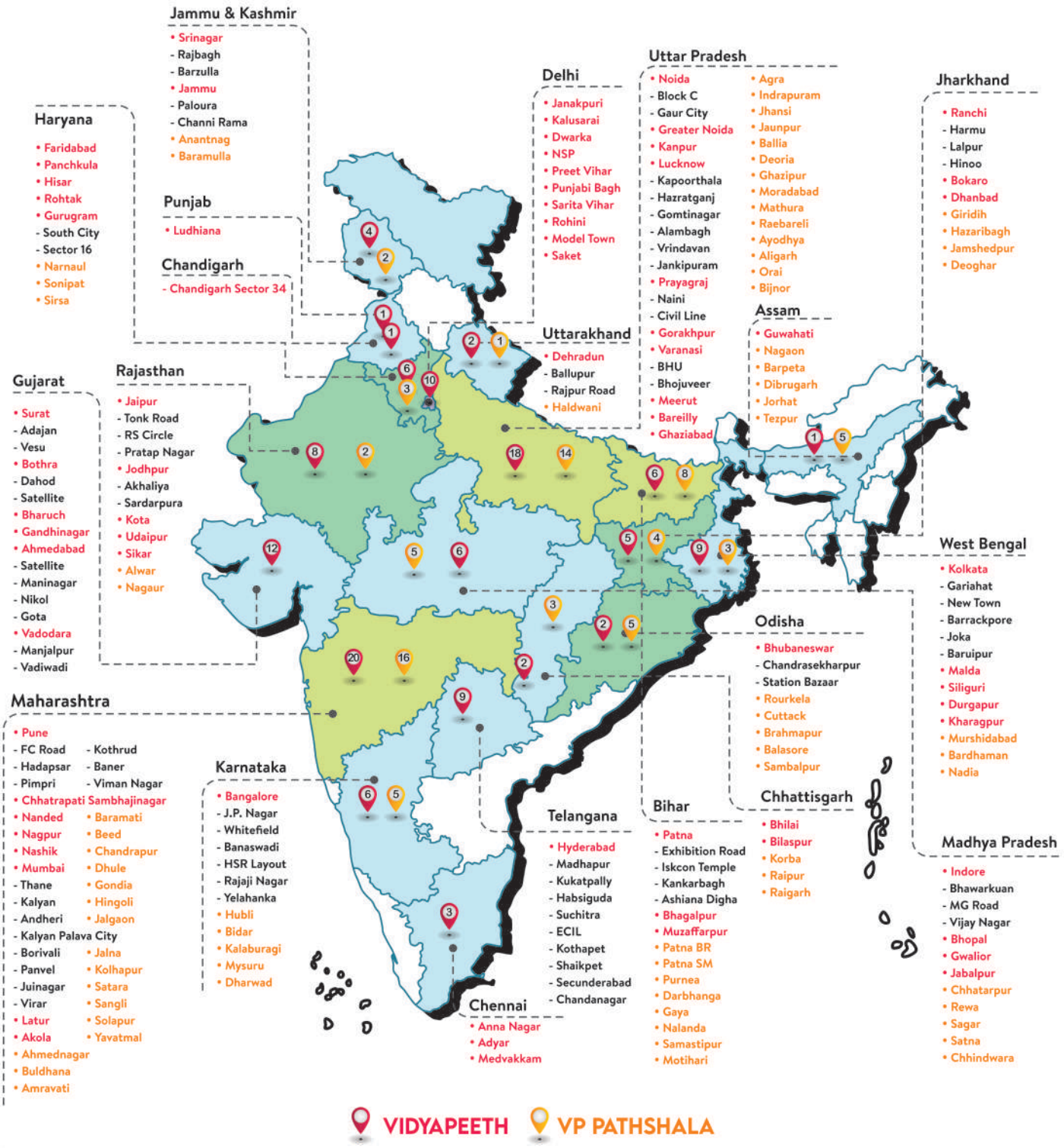

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