Q1. A particle moves along a straight line such that its position is given by $x(t) = t^3 – 6t^2 + 9t$ (in meters). Find the total distance travelled by the particle from t = 0 to t = 4 s.

A. 8 m
B. 10 m
C. 12 m
D. 16 m

Answer: C
Solution:
Position function: $x(t) = t^3 – 6t^2 + 9t$
Velocity: $v(t) = dx/dt = 3t^2 – 12t + 9$
Set $v(t) = 0 \Rightarrow 3t^2 – 12t + 9 = 0 \Rightarrow t = 1$ s and 3 s (turning points)
x(0) = 0, x(1) = 4, x(3) = 0, x(4) = 4
Distance = $|x(1) – x(0)| + |x(3) – x(1)| + |x(4) – x(3)|$
= 4 + 4 + 4 = 12 m

Q2. A particle has position $x(t) = 5t^2 – 2t$ (in meters). Find the displacement and distance travelled in the first 3 seconds.

A. Displacement = 39 m, Distance = 39 m
B. Displacement = 36 m, Distance = 36 m
C. Displacement = 33 m, Distance = 39 m
D. Displacement = 30 m, Distance = 30 m

Answer: A
Solution:
$x(0) = 0, x(3) = 5\times9 – 2\times3 = 45 – 6 = 39$ m
$v(t) = 10t – 2 \Rightarrow v = 0$ when t = 0.2 s
But for t = 0 to 3 s, particle moves in one direction (v > 0)
So, Distance = Displacement = 39 m

Q3. A car travels 3 km at 30 km/h and then 3 km at 60 km/h. What is the average speed during the entire journey?

A. 45 km/h
B. 40 km/h
C. 48 km/h
D. 36 km/h

Answer: B
Solution:
$Time_1 = 3 / 30 = 0.1$ h, $Time_2 = 3 / 60 = 0.05$ h
Total distance = 6 km, Total time = 0.15 h
Average speed = 6 / 0.15 = 40 km/h

Q4. A body moves with uniform acceleration. Its initial velocity is 5 m/s, and its final velocity after 4 seconds is 17 m/s. Find its acceleration and displacement.

A. $a = 3$ m/s², $s = 44$ m
B. $a = 3$ m/s², $s = 45$ m
C. $a = 2$ m/s², $s = 44$ m
D. $a = 2$ m/s², $s = 45$ m

Answer: A
Solution:
Acceleration: $a = (v – u)/t = (17 – 5)/4 = 3$ m/s²
Displacement: $s = ut + ½at^2 = 5×4 + ½×3×16 = 20 + 24 = 44$ m

Q5. The velocity-time graph of a body is a straight line inclined to the time axis. What physical quantity does the slope of the graph represent?

A. Velocity
B. Displacement
C. Acceleration
D. Jerk

Answer: C
Solution:
Slope of a v–t graph = $\Delta v / \Delta t$ = Acceleration

Q6. A particle starts from rest and moves with uniform acceleration of 2 m/s² for 5 seconds. What is the total distance travelled by the particle?

A. 10 m
B. 20 m
C. 25 m

D. 50 m

Answer: C
Solution:
Initial velocity, u = 0
Acceleration, a = 2 m/s²
Time, t = 5 s

Use: $s = ut + (1/2)at^2$
$s = 0 \times 5 + (1/2) \times 2 \times (5)^2$
$= 0 + 1 \times 25 = 25$ m

Q7. A particle has a velocity–time graph that is a straight line from (0 s, 0 m/s) to (4 s, 8 m/s). What is the total displacement?

A. 8 m
B. 12 m
C. 16 m
D. 32 m

Answer: C
Solution:
Displacement = Area under v–t graph
Here, graph is a triangle with base = 4 s, height = 8 m/s
Area = (1/2) × base × height
$= (1/2) \times 4 \times 8 = 16$ m

Q8. A particle moves with constant velocity of 6 m/s for 10 seconds. What is the displacement of the particle?

A. 60 m
B. 600 m
C. 120 m
D. 30 m

Answer: A
Solution:
Displacement = velocity × time = 6 × 10 = 60 m

Q9. A particle's velocity–time graph is a straight line from point (0 s, 4 m/s) to point (4 s, 0 m/s). What is the acceleration?

A. $-1\ m/s^2$
B. $-2\ m/s^2$
C. $-4\ m/s^2$
D. $+1\ m/s^2$

Answer: A
Solution:
Initial velocity = 4 m/s
Final velocity = 0 m/s
Time = 4 s
Acceleration = $(v - u) / t = (0 - 4) / 4 = -1\ m/s^2$

Q10. A displacement–time graph is a curve starting from the origin with increasing slope. Which of the following is correct?

A. Velocity is constant
B. Acceleration is zero
C. Velocity is increasing
D. Acceleration is decreasing

Answer: C
Solution:
Increasing slope of displacement–time graph means velocity is increasing.
Hence, velocity is increasing, and acceleration is positive.

Q11. A particle has the following data:

At t = 0 s, x = 0 m
At t = 1 s, x = 5 m
At t = 2 s, x = 20 m
Assuming uniformly accelerated motion, what is the initial velocity?

A. 0 m/s
B. 5 m/s
C. 10 m/s
D. 15 m/s

Answer: A
Solution:
Use: $x = ut + (1/2)at^2$
From t = 1:
$5 = u \times 1 + (1/2)a \times (1)^2 \rightarrow$ (i): $5 = u + 0.5a$
From t = 2:
$20 = u \times 2 + (1/2)a \times (4) \rightarrow$ (ii): $20 = 2u + 2a$

Multiply (i) by 2:
$10 = 2u + a \rightarrow$ (iii)
Now (ii) – (iii):
$(2u + 2a) – (2u + a) = 20 – 10$
$\Rightarrow a = 10$
Now from (i): $5 = u + 5 \Rightarrow u = 0$ m/s

Q12. A particle starts from rest and covers a distance of 40 m in 4 seconds under uniform acceleration. Find the acceleration.

A. 2 m/s^2
B. 5 m/s^2
C. 10 m/s^2
D. 20 m/s^2

Answer: B
Solution:
Given: u = 0, s = 40 m, t = 4 s
Use: $s = ut + (1/2)at^2$
$\Rightarrow 40 = 0 + (1/2)a(4^2)$
$\Rightarrow 40 = 8a \Rightarrow a = 5$ m/s^2

Q13. A car is moving at 20 m/s. The driver applies brakes and brings the car to rest in 5 seconds. What is the distance travelled during this time?

A. 25 m
B. 50 m
C. 100 m
D. 200 m

Answer: B
Solution:
Given: u = 20 m/s, v = 0, t = 5 s
Use: s = (u + v)/2 × t = (20 + 0)/2 × 5 = 10 × 5 = 50 m

Q14. A body moving with initial velocity 5 m/s has acceleration 2 m/s². What is its velocity after covering 20 meters?

A. 10 m/s
B. 12 m/s
C. 15 m/s
D. 25 m/s

Answer: C
Solution:
Given: u = 5 m/s, a = 2 m/s², s = 20 m
Use: $v^2 = u^2 + 2as$
⇒ $v^2 = 25 + 2×2×20 = 25 + 80 = 105$
⇒ $v = \sqrt{105} \approx 10.25$ m/s (≈ not matching any option?)
But none of the options match this. So let's recheck.

Let’s change the values for clarity:

Revised Question:

Q14 (Corrected). A body moving with initial velocity 5 m/s has acceleration 2 m/s². What is its velocity after 20 seconds?

A. 25 m/s
B. 30 m/s
C. 35 m/s
D. 45 m/s

Answer: B
Solution:
u = 5 m/s, a = 2 m/s², t = 20 s
Use: v = u + at = 5 + 2×20 = 45 m/s

✅ So correct option is D

Q15. A stone is thrown vertically upward with speed 20 m/s. How long will it take to return to the thrower's hand? (g = 10 m/s²)

A. 2 s
B. 3 s
C. 4 s
D. 5 s

Answer: C
Solution:
Time to reach max height = t = u/g = 20 / 10 = 2 s
Time to return = 2 × 2 = 4 s

Q16. A body is projected vertically upwards with a velocity of 50 m/s. Find the distance travelled in the 6th second. (Take g = 10 m/s²)

A. 5 m
B. 10 m
C. 15 m
D. 20 m

Answer: A
Solution:
Time to reach max height = u / g = 50 / 10 = 5 s

So in the 6th second, the particle is coming down.

Use:
$s_n = u - (g/2)(2n - 1)$
$s_6 = 50 - 5\times11 = 50 - 55 = -5$ m

Distance = $|-5| = 5$ m

Q17. A body starts from rest and moves with an acceleration of 10 m/s². Find the displacement in the 5th second of motion.

A. 40 m
B. 45 m
C. 50 m
D. 55 m

Answer: B
Solution:
Given:
$u = 0$, $a = 10\ m/s^2$, $n = 5$

Displacement in the nth second:
$s_n = u + (a/2)(2n - 1)$

$s_5 = 0 + (10/2)(2\times5 - 1)$
$= 5 \times 9$
$= 45\ m$

Q18. A stone is thrown vertically upward with a velocity of 40 m/s. How high will it rise before coming to momentary rest?

A. 60 m
B. 80 m
C. 100 m
D. 120 m

Answer: B
Solution:
Given:
Initial velocity, $u = 40\ m/s$
At highest point, final velocity $v = 0$
Acceleration due to gravity, $a = -10\ m/s^2$ (upward motion)

Use:
$v^2 = u^2 + 2a\,s$
$0 = (40)^2 + 2\times(-10)\times s$
$0 = 1600 - 20s$
$\Rightarrow 20s = 1600$
$\Rightarrow s = 80\ m$

Q19. A ball is thrown vertically upward with a speed of 30 m/s. How long will it take to return to the thrower's hand?

A. 3 s
B. 6 s

C. 9 s
D. 12 s

Answer: B
Solution:
Time to rise = t = u/g = 30/10 = 3 s
Total time of flight = 2t = 2×3 = 6 s

Q20. A body is thrown vertically upward and it reaches the maximum height in 4 seconds. What was its initial velocity?

A. 20 m/s
B. 30 m/s
C. 40 m/s
D. 50 m/s

Answer: C
Solution:
Time to reach max height: t = 4 s
At max height, v = 0
Use:
$v = u - g\,t$
$0 = u - 10\times4$
$u = 40$ m/s

Q21. A ball is dropped from a height of 80 m. How long will it take to reach the ground?

A. 2 s
B. 3 s
C. 4 s
D. 5 s

Answer: C
Solution:
Given: u = 0, s = 80 m, a = g = 10 m/s²
Use:
$s = ut + (1/2)\,a\,t^2$
$80 = 0 + (1/2)(10)t^2$
$80 = 5t^2$

$t^2 = 16 \Rightarrow t = 4$ s

Q22. A ball is thrown upward with a speed of 20 m/s from the top of a tower 80 m high. How long will it take to hit the ground?

A. 5 s
B. 6 s
C. 7 s
D. 8 s

Answer: C
Solution:
Given:
$u = +20$ m/s, $s = -80$ m (downward), $a = -10$ m/s²

Use:
$s = ut + (1/2)\, a t^2$
$-80 = 20t - 5t^2$
$\Rightarrow 5t^2 - 20t - 80 = 0$
$\Rightarrow t^2 - 4t - 16 = 0$
Use quadratic formula:
$t = [4 \pm \sqrt{(16 + 64)}] / 2 = [4 \pm \sqrt{80}] / 2$
$\approx [4 \pm 8.94]/2$
Take positive root:
$t \approx (4 + 8.94)/2 \approx 12.94/2 \approx 6.47$ s

Closest option: 7 s

Q23. A body is projected upwards with a velocity 50 m/s. Find the total time it remains in the air.

A. 5 s
B. 8 s
C. 10 s
D. 12 s

Answer: C
Solution:
Time to rise: $t = u/g = 50/10 = 5$ s
Total time of flight $= 2t = 10$ s

Q24. A ball thrown vertically upward returns to the thrower after 6 seconds. What was its initial speed?

A. 20 m/s
B. 25 m/s
C. 30 m/s
D. 35 m/s

Answer: C
Solution:
Total time = 6 s
Time to rise = 6/2 = 3 s
$u = g\,t = 10 \times 3 = 30$ m/s

Q25. A stone is thrown downwards from a tower with a velocity of 10 m/s. It takes 4 seconds to reach the ground. Find the height of the tower.

A. 80 m
B. 100 m
C. 120 m
D. 140 m

Answer: C
Solution:
Given: $u = 10$ m/s, $t = 4$ s, $a = 10$ m/s²
Use:
$s = ut + (1/2)\,a\,t^2$
$s = 10 \times 4 + (1/2)(10)(4^2)$
$= 40 + 80 = 120$ m

Q26. A ball is thrown vertically upward with a speed of 25 m/s. What is the maximum height attained by it?

A. 25.5 m
B. 31.25 m
C. 35.5 m
D. 40.5 m

Answer: B

Solution:
v = 0 at highest point
Use:
$v^2 = u^2 – 2g\,h$
$0 = (25)^2 – 2\times10\times h$
$625 = 20h \Rightarrow h = 31.25$ m

Q27. A body is projected vertically upward with a velocity of 49 m/s. Find the distance travelled by it during the 6th second.

A. 4.9 m
B. 9.8 m
C. 14.7 m
D. 19.6 m

Answer: A
Solution:
Given: u = 49 m/s, n = 6, g = 9.8 m/s²
Use:
$s_n = u – (1/2)g(2n – 1)$
$s_6 = 49 – (1/2)(9.8)(2\times6 – 1)$
$= 49 – 4.9\times11$
$= 49 – 53.9 = –4.9$ m
Distance = $|–4.9| = 4.9$ m

Q28. A ball is thrown upwards and reaches a maximum height of 45 m. Find the velocity with which it was thrown.

A. 20 m/s
B. 25 m/s
C. 30 m/s
D. 15 m/s

Answer: C
Solution:
At maximum height, v = 0, s = 45 m, g = 10 m/s²
Use:
$v^2 = u^2 – 2gs$
$0 = u^2 – 2\times10\times45$
$u^2 = 900 \Rightarrow u = \sqrt{900} = 30$ m/s

Q29. A body is dropped from a height of 80 m. Find the time taken to reach the ground.

A. 2 s
B. 3 s
C. 4 s
D. 5 s

Answer: C
Solution:
Given: $u = 0$, $s = 80$ m, $g = 10$ m/s²
Use:
$s = ut + (1/2)gt^2$
$80 = 0 + (1/2)(10)t^2 \Rightarrow 80 = 5t^2$
$t^2 = 16 \Rightarrow t = \sqrt{16} = 4$ s

Q30. A body is projected vertically upward with a velocity of 20 m/s. How high will it rise before coming to rest?

A. 10 m
B. 15 m
C. 20 m
D. 25 m

Answer: C
Solution:
Given: $u = 20$ m/s, $v = 0$ at maximum height, $g = 10$ m/s²
Use:
$v^2 = u^2 – 2gh$
$0 = (20)^2 – 2\times10\times h$
$0 = 400 – 20h \Rightarrow 20h = 400$
$h = 400 / 20 = 20$ m

Q31. Two trains A and B are moving on parallel tracks in the same direction with speeds 54 km/h and 36 km/h respectively. If the length of train A is 180 m, how long will it take to completely pass train B?

A. 36 s
B. 18 s
C. 12 s
D. 9 s

Answer: A
Solution:
Relative speed = (54 – 36) km/h = 18 km/h = 5 m/s
Length of train A = 180 m
Time = distance / relative speed = 180 / 5 = 36 s

Q32. A man runs at 10 m/s and observes rain falling vertically at 10 m/s. What is the actual direction of rain?

A. 45° with vertical
B. 60° with vertical
C. Horizontal
D. Vertical

Answer: A
Solution:
Let actual velocity of rain = v (has horizontal and vertical components)
Let man's velocity = 10 m/s horizontally
Given rain appears vertical to man ⇒ horizontal component of rain = man's velocity
So, $v_{rain\_horizontal} = 10$ m/s, $v_{rain\_vertical} = 10$ m/s
So, $\tan\theta = 10 / 10 = 1 \Rightarrow \theta = 45°$ with vertical

Q33. A car is moving east at 40 m/s and a scooter is moving north at 30 m/s. What is the velocity of the scooter relative to the car?

A. 10 m/s
B. 50 m/s
C. 70 m/s
D. 80 m/s

Answer: B
Solution:
Use vector relative velocity:
$v_{rel} = \sqrt{[(40)^2 + (30)^2]} = \sqrt{(1600 + 900)} = \sqrt{2500} = 50$ m/s

Q34. Two trains each 200 m long are moving toward each other on parallel tracks, one at 36 km/h and the other at 54 km/h. In how much time will they cross each other completely?

A. 10 s
B. 12 s
C. 16 s

D. 20 s

Answer: C
Solution:
Relative speed = 36 + 54 = 90 km/h = 25 m/s
Total distance = 200 + 200 = 400 m
Time = 400 / 25 = 16 s

Q35. A man is running horizontally at 4 m/s. Rain appears to fall at 60° to the vertical. If the rain is actually falling vertically, find its speed.

A. 2.31 m/s
B. 4 m/s
C. 4.62 m/s
D. 6 m/s

Answer: C
Solution:
tan(60°) = horizontal velocity / vertical velocity
$\sqrt{3} = 4 / v \Rightarrow v = 4 / \sqrt{3} \approx 2.31$ m/s

Now total rain speed = $\sqrt{[(2.31)^2 + 4^2]} \approx \sqrt{(5.33 + 16)} = \sqrt{21.33} \approx 4.62$ m/s

Q36. A train starts from rest and accelerates uniformly at 2 m/s² for 10 seconds. It then moves with constant speed for the next 20 seconds and finally decelerates at 1 m/s² to come to rest. Find the total distance covered by the train.

A. 600 m
B. 700 m
C. 800 m
D. 900 m

Answer: B
Solution:
Step 1: First phase (acceleration)
Initial velocity, u = 0 m/s
Acceleration, a = 2 m/s²
Time, t_1 = 10 s
Use: $s_1 = ut_1 + (1/2)\, a\, t_1^2 = 0 + (1/2)(2)(10^2) = 100$ m
Final velocity after 10 s: v = u + at = 0 + 2×10 = 20 m/s

Step 2: Second phase (constant speed)
Speed = 20 m/s
Time = 20 s
$s_2 = v \times t = 20 \times 20 = 400$ m

Step 3: Third phase (deceleration)
Initial velocity = 20 m/s
Final velocity = 0
Deceleration, $a = -1$ m/s²
Use: $v^2 = u^2 + 2a\,s \Rightarrow 0 = (20)^2 - 2\times1\times s_3$
$400 = 2s_3 \Rightarrow s_3 = 200$ m

Total distance = $s_1 + s_2 + s_3 = 100 + 400 + 200 = 700$ m

Q37. A particle starts from rest and accelerates at 2 m/s². Find the time to cover 100 m.

A. 5 s
B. 10 s
C. 15 s
D. 20 s

Answer: B
Solution:
$u = 0$, $a = 2$, $s = 100$
$s = (1/2)\,a\,t^2 \Rightarrow 100 = (1/2)(2)t^2 \Rightarrow t^2 = 100 \Rightarrow t = 10$ s

Q38. A train is moving with a uniform velocity of 72 km/h. How long will it take to cross a bridge of length 500 m?

A. 20 s
B. 25 s
C. 30 s
D. 35 s

Answer: B
Solution:
Speed = 72 km/h = 72 × (1000/3600) = 20 m/s
Distance = 500 m
Time = Distance / Speed = 500 / 20 = 25 s

Q39. A body dropped from the top of a tower travels 7/16 of the total height in the last second before hitting the ground. Find the height of the tower.

A. 80 m
B. 100 m
C. 120 m
D. 140 m

Answer: A
Solution:
Let height = h, and time to fall = t seconds
Distance in last second = $h - h(t-1)^2 / t^2 = 7h/16$
Using standard result:
Distance in last second = $h - h(t-1)^2 / t^2 = h[1 - (t-1)^2 / t^2] = 7h/16$
Solve: $1 - (t-1)^2 / t^2 = 7/16$
$\Rightarrow (t-1)^2 / t^2 = 9/16$
$\Rightarrow (t-1)/t = 3/4 \Rightarrow 4(t-1) = 3t \Rightarrow t = 4$ s
Now use: $h = (1/2)gt^2 = (1/2)(10)(16) = 80$ m

Q40. A man running at 5 m/s sees a bus 40 m ahead of him moving in the same direction at 3 m/s. In how much time will he catch the bus?

A. 10 s
B. 15 s
C. 20 s
D. 25 s

Answer: C
Solution:
Relative speed = 5 – 3 = 2 m/s
Distance = 40 m
Time = Distance / Relative speed = 40 / 2 = 20 s

Q41. A body starts from rest and travels 20 m in the 4th second. Find its acceleration.

A. 4 m/s^2
B. 5 m/s^2
C. 5.71 m/s^2
D. 6 m/s^2

Answer: C
Solution:
$s_4 = u + (1/2)a(2n - 1)$
$= 0 + (1/2)\times a \times 7 = 3.5a$
$3.5a = 20 \Rightarrow a = 5.71\ m/s^2$

Q42. A ball is dropped from a height of 45 m. After bouncing, it rises to a height of 20 m. How much total time does it remain in the air? (Take g = 10 m/s^2)

A. 4.5 s
B. 5 s
C. 5.5 s
D. 6 s

Answer: B
Solution:
Time to fall from 45 m:
$t_1 = \sqrt{}(2h/g) = \sqrt{}(2\times45 / 10) = \sqrt{}9 = 3$ s

Time to rise to 20 m = time to fall from 20 m:
$t_2 = \sqrt{}(2h/g) = \sqrt{}(2\times20 / 10) = \sqrt{}4 = 2$ s

Total time = 3 + 2 = 5 s

Q43. A particle moves with a constant acceleration and covers distances 5 m and 9 m in the 3rd and 4th seconds respectively. What is the acceleration?

A. 2 m/s^2
B. 3 m/s^2
C. 4 m/s^2
D. 5 m/s^2

Answer: A
Solution:
Distance in nth second:
$s_n = u + (1/2)a(2n - 1)$

For 3rd second:
$s_3 = u + (1/2)a(5) = 5$

For 4th second:

$s_4 = u + (1/2)a(7) = 9$

Now, subtract:
$s_4 - s_3 = (1/2)a(7 - 5) = 9 - 5 = 4$
$\Rightarrow (1/2)a(2) = 4 \Rightarrow a = 2\ m/s^2$

Q44. A particle is projected vertically upward with a velocity of 30 m/s. Find the time interval during which the particle is at a height greater than 40 m. (Take $g = 10\ m/s^2$)

A. 1 s
B. 2 s
C. 3 s
D. 4 s

Answer: C
Solution:
Use equation:
$h = ut - (1/2)gt^2$
$\Rightarrow 40 = 30t - 5t^2$
$\Rightarrow 5t^2 - 30t + 40 = 0$
$\Rightarrow t^2 - 6t + 8 = 0$
$\Rightarrow (t - 4)(t - 2) = 0 \Rightarrow t = 2\ s, 4\ s$

So, the particle is above 40 m between t = 2 s and t = 4 s
Duration = 4 – 2 = 2 s

Q45. A balloon is ascending vertically with a velocity of 10 m/s. When it is at a height of 80 m from the ground, a packet is dropped from it. How long will it take for the packet to reach the ground? (Take $g = 10\ m/s^2$)

A. 4 s
B. 5 s
C. 6 s
D. 8 s

Answer: B
Solution:
Initial velocity of packet, u = 10 m/s upward
Height from ground, s = 80 m
Acceleration due to gravity, $a = -10\ m/s^2$ (since it's downward)

Use:

$s = ut + (1/2)\, a\, t^2$

$\rightarrow 80 = 10t - 5t^2$

$\rightarrow 5t^2 - 10t + 80 = 0$

$\rightarrow t^2 - 2t - 16 = 0$

Solve using quadratic formula:

$t = [2 \pm \sqrt{(4 + 64)}] / 2$

$t = [2 \pm \sqrt{68}] / 2$

$t \approx [2 \pm 8.25] / 2$

Taking positive root:

$t \approx (2 + 8.25)/2 \approx 10.25/2 \approx 5.12$ s