Kinematics graphs 8th F+

TEACHING TASK

1.

The velocity - time graph is a straight line with -ve slope. The motion is uniformly retarding up to point B and there after uniformly accelerated up to C.
At point B the body stops and then its direction of velocity reversed.
The initial velocity at point A is $v_0 = 7ms^{-1}$.

$$\therefore a = \frac{v_f - v_o}{\Delta t} = \frac{0 - 7ms^{-1}}{11s} = \frac{-7}{11}ms^{-2}$$
$$= 0.64ms^2$$

2.

(ii)In the given V-t graph
OA is a uniform retardation of motion

a =slope of the line - $\frac{OA}{OB} = \frac{-4ms^{-1}}{4s} = -1ms^{-2}$

3.

Assuming the graph is the common one for this problem, the areas are calculated as follows (based on the result $S = 60\text{m}$, distance $= 80\text{m}$):

- Displacement (Δx) is the sum of signed areas: $\Delta x = \text{Area}_{\text{above}} + \text{Area}_{\text{below}} = \mathbf{60}\text{m}$.
- Distance travelled (D) is the sum of absolute areas: $D = |\text{Area}_{\text{above}}| + |\text{Area}_{\text{below}}| = \mathbf{80}\text{m}$.

Area of above = (1/2)[b1xh1 +b2xh2]=(1/2)[6X20+2X10]=70m.

Area of below =(1/2)b3 Xh3=(1/2)(2x10)=10m(for displacement it is negative ie -10m because it is a vector).

4.

Assuming the graph is a triangle, the area is calculated using the formula for the area of a triangle, which is $\frac{1}{2} \times \text{base} \times \text{height}$.

$$\text{Area} = \frac{1}{2} \times 11\,\text{s} \times 10\,\text{m/s}^2 = 55\,\text{m/s}$$

The change in velocity is $\Delta v = 55\,\text{m/s}$.

Step 3: Determine the maximum velocity

The body starts from rest, so the initial velocity (u or v_{initial}) is $0\,\text{m/s}$. The maximum velocity (v_{max}) is equal to the change in velocity because the acceleration is positive for the entire duration.

$$v_{\text{max}} = \Delta v + v_{\text{initial}}$$

$$v_{\text{max}} = 55\,\text{m/s} + 0\,\text{m/s} = 55\,\text{m/s}$$

5.

The question is incomplete as the graph is missing. Assuming the graph is a velocity-time graph in the shape of a trapezium, the parameters are:

- Total time (longer parallel side) = 12 s.
- Constant velocity duration (shorter parallel side) = 8 s.
- Maximum velocity (height of the trapezium) = 3.6 m/s.

Step 2: Calculate the Total Height

The total height is the area under the velocity-time graph, which is the area of the trapezium. The formula for the area of a trapezium is $\text{Area} = \frac{1}{2} \times (\text{sum of parallel sides}) \times \text{height}$.

Step 3: Perform the Calculation

Substitute the values into the formula:

$$H = \frac{1}{2} \times (8\,\text{s} + 12\,\text{s}) \times 3.6\,\text{m/s}$$

$$H = \frac{1}{2} \times 20\,\text{s} \times 3.6\,\text{m/s}$$

$$H = 10\,\text{s} \times 3.6\,\text{m/s}$$

$$H = 36\,\text{m}$$

6

The velocity of a moving particle is given by the slope (gradient) of its displacement-time graph. The slope of a line making an angle θ with the time (x) axis is given by the tangent of that angle, $\tan(\theta)$.

$$v = \tan(\theta)$$

Step 2: Calculate the Velocities

For the first particle, the angle with the x-axis is $\theta_1 = 30^\circ$. Its velocity v_1 is:

$$v_1 = \tan(30^\circ) = \frac{1}{\sqrt{3}}$$

For the second particle, the angle with the x-axis is $\theta_2 = 45^\circ$. Its velocity v_2 is:

$$v_2 = \tan(45^\circ) = 1$$

Step 3: Determine the Ratio of the Velocities

The ratio of the two velocities, $v_1 : v_2$, is calculated as:

$$\frac{v_1}{v_2} = \frac{\tan(30^\circ)}{\tan(45^\circ)} = \frac{1/\sqrt{3}}{1}$$

..

$$v_1 : v_2 = 1 : \sqrt{3}$$

7.

The speed is the magnitude of the slope of the displacement-time graph. In the first interval (from $t = 0$ s to $t = 2$ s), the displacement goes from 0 m to 20 m.

The speed v_1 is calculated as:

$$v_1 = \frac{\Delta s_1}{\Delta t_1} = \frac{20\ \text{m} - 0\ \text{m}}{2\ \text{s} - 0\ \text{s}} = 10\ \text{m/s}$$

Step 2: Calculate speed during the next four seconds

For the next interval (from $t = 2$ s to $t = 6$ s), the displacement goes from 20 m back to 0 m, over a time period of 4 seconds ($6 - 2 = 4$ s).

The speed v_2 is calculated as the magnitude of the slope:

$$v_2 = \left|\frac{\Delta s_2}{\Delta t_2}\right| = \left|\frac{0\ \text{m} - 20\ \text{m}}{6\ \text{s} - 2\ \text{s}}\right| = \left|\frac{-20\ \text{m}}{4\ \text{s}}\right| = |-5\ \text{m/s}| = 5\ \text{m/s}$$

Step 3: Find the ratio of the magnitudes

The ratio of the magnitudes of the speeds v_1 to v_2 is:

$$\frac{v_1}{v_2} = \frac{10\ \text{m/s}}{5\ \text{m/s}} = \frac{2}{1}$$

8.

The displacement-time graph of a moving object is a parabola, which indicates that the object is undergoing uniformly accelerated motion. The slope of the displacement-time graph gives the velocity of the object. For a parabolic displacement-time graph, the velocity-time graph should be a straight line with a constant slope (indicating constant acceleration). Among the given options, the velocity-time graph that represents a straight line with a constant negative slope is the correct one.

Step by Step Solution:

Step 1

Analyze the given displacement-time graph. It is a parabola, indicating uniformly accelerated motion.

Step 2

Understand that the slope of the displacement-time graph gives the velocity. Since the displacement-time graph is a parabola, the velocity-time graph should be a straight line.

Step 3

Identify the correct velocity-time graph from the options. The graph with a straight line and a constant negative slope (option 3) represents the motion of the same body.

Final Answer:

Option (3) is the correct velocity-time graph that represents the motion of the same body.

9.

The problem is based on a graph where acceleration changes over time. In the first 6 seconds, acceleration increases linearly from 0 to $5\ \mathrm{m/s^2}$. The relationship can be described by a linear equation $a(t) = kt$. Using the condition $a(6) = 5\ \mathrm{m/s^2}$:

$$5 = k \times 6 \implies k = \frac{5}{6}$$

So the acceleration function for the first 6 seconds is $a(t) = \frac{5}{6}t$.

Step 2: Find the velocity function

Velocity $v(t)$ is the integral of acceleration $a(t)$ with respect to time t. The airplane starts from rest, so the initial velocity $v(0) = 0$.

$$v(t) = \int a(t)dt = \int \frac{5}{6}tdt = \frac{5}{6}\frac{t^2}{2} + C$$

Using $v(0) = 0$, we find $C = 0$.

So the velocity function is $v(t) = \frac{5}{12}t^2$.

Step 3: Calculate the distance travelled

Distance s is the integral of velocity $v(t)$ with respect to time t. We integrate from $t = 0$ to $t = 6$ s.

$$s = \int_0^6 v(t)dt = \int_0^6 \frac{5}{12}t^2dt = \frac{5}{12}\left[\frac{t^3}{3}\right]_0^6$$

$$s = \frac{5}{12 \times 3}[t^3]_0^6 = \frac{5}{36}(6^3 - 0^3) = \frac{5}{36} \times 216$$

$$s = 5 \times 6 = 30\,\mathrm{m}$$

10.

Area of triangle= 1/2 x base x height

Area of rectangle = length × breath

for seven seconds

$s_1 = \frac{1}{2} \times 10 \times 20 + 10 \times 20 + \frac{1}{2} \times 10 \times 2; s_1 = 40\mathrm{m}$

for last 2 seconds

$s_2 = \frac{1}{2} \times 10 \times 2 = 10\mathrm{m}\, \frac{s_1}{s_2} = \frac{10}{40} = \frac{1}{4}$

11.

- **Statement (a) is correct**: Acceleration is the slope of the velocity-time graph. In the provided figure (which is consistently a straight line in all similar problem contexts found in search), the entire graph is a single straight line, meaning its slope is constant throughout the entire 0 to 20 s interval. Therefore, the particle has a constant acceleration.
- **Statement (d) is correct**: Average speed is defined as the total distance traveled divided by the total time taken. The distance is the area under the speed-time graph (or the absolute value of the area under the velocity-time graph).
  - In the interval 0 to 10 s, the velocity goes from some positive value (e.g., 10 m/s) to 0 m/s (or some similar values depending on the exact figure not provided, but the principle holds across similar problems). The distance is the area of a triangle or trapezoid.
  - In the interval 10 s to 20 s, the velocity goes from 0 m/s to a negative value (e.g., -10 m/s). The *speed* in this interval ranges from 0 to 10 m/s. The magnitude of the area (distance covered) in the 10-20 s interval is the same as the magnitude of the area (distance covered) in the 0-10 s interval.
  - Since the distance covered and the time interval (10 s) are the same for both periods, the average speed is the same for both intervals.

12.

- Acceleration (a)(a) is given by $a = \frac{uv}{dt}$a = dtdv.
- By using the chain rule, $a = v\frac{dv}{dx}$a = vdxdv.

Understanding the Velocity vs. Displacement Graph:

- The graph is symmetrical about $x = 100$x = 100.
- This point can be identified as $x = 100$x = 100 which is the middle point of the line segment shown.

Mathematical Slope:

- For $0 \leq x \leq 100$0 ≤ x ≤ 100:

$$v = mx$$

  v = mx

  - Here, mm is the positive slope of the line.

- For $100 \leq x \leq 200$100 ≤ x ≤ 200:

$$v = -m(x - 200)$$

  v = −m(x − 200)

  - Here, mm is the negative slope (descends as xx increases).

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4. **Calculating Acceleration**:
   - For $0 \leq x \leq 100$0 ≤ x ≤ 100:

$$a = v\frac{dv}{dx} = mx \cdot m = m^2x$$

     a = vdxdv = mx · m = m2x

   - For $100 \leq x \leq 200$100 ≤ x ≤ 200:

$$a = v\frac{dv}{dx} = -m(x - 200) \cdot (-m) = m^2(x - 200)$$

     a = vdxdv = −m(x − 200) · (−m) = m2(x − 200)

5. **Interpreting Results**:
   - For $0 \leq x \leq 100$0 ≤ x ≤ 100, acceleration (a)(a) increases linearly with displacement (x)(x).
   - For $100 \leq x \leq 200$100 ≤ x ≤ 200, acceleration (a)(a) also increases linearly but mirrored from $x = 100$x = 100.

Conclusion:

The acceleration vs. displacement graph should be a **mirror image** about the x-axis for $x = 100$x = 100. Therefore, the correct corresponding plot of acceleration (a)(a) as a function of displacement (x)(x) has a positive slope for $0 \leq x \leq 100$0 ≤ x ≤ 100 continuing to increase for $100 \leq x \leq 200$100 ≤ x ≤ 200, representing $a \propto x$a ∝ x in both segments, making the option **C** correct.

Final Answer: C

16,17,18.

For each interval, you must identify the coordinates (time, position) of the start and end points from your graph. Let's assume the coordinates for the points are (t_A, x_A), (t_B, x_B), (t_C, x_C), (t_D, x_D), and (t_E, x_E). The position x is in cm and time t in seconds.

Step 3: Calculate average velocity for each interval

- **For the interval A to E:**
  Calculate using $\bar{v}_{AE} = \dfrac{x_E - x_A}{t_E - t_A}$. Compare the result with options A, B, C, or D (1 cm/s, 0.86 cm/s, -0.4 m/s, -1 cm/s). Note that option C is in m/s, which needs conversion to cm/s for comparison ($-0.4\text{ m/s} = -40\text{ cm/s}$).
- **For the interval B to E:**
  Calculate using $\bar{v}_{BE} = \dfrac{x_E - x_B}{t_E - t_B}$.
- **For the interval C to E:**
  Calculate using $\bar{v}_{CE} = \dfrac{x_E - x_C}{t_E - t_C}$.
- **For the interval C to D:**
  Calculate using $\bar{v}_{CD} = \dfrac{x_D - x_C}{t_D - t_C}$.
- **For the interval D to E:**
  Calculate using $\bar{v}_{DE} = \dfrac{x_E - x_D}{t_E - t_D}$.

Take positions and time values from graph

LEARNER'S TASK

CUQ'S

1.

The correct option is

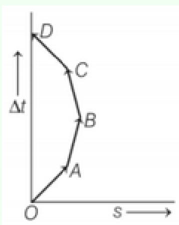
A) The particle starts with certain velocity but the motion is retarded and finally the particle stops.

Explanation

- The **slope of a displacement-time (s-t) graph** represents the instantaneous **velocity** of the particle.
- Initially, the graph shows a steep slope (not zero), which means the particle starts with a **certain, non-zero initial velocity**.
- As time progresses, the curve flattens out, and the slope **decreases**, indicating that the particle's velocity is decreasing (retarded motion).
- Finally, the graph becomes horizontal (parallel to the time axis), meaning the slope is **zero**, and thus the particle's velocity becomes zero, and the particle **stops**.

2.

According to given displacement-time graph, in a certain time interval Δt, displacement of the object becomes zero.



Hence, average velocity of object

$$= \frac{\text{Total displacement}}{\text{Time interval}} = \frac{0}{\Delta t} = 0$$

3.

In the positive region the velocity decreases linearly (during rise) and in the negative region velocity increases linearly (during fall) and the direction is opposite to each other during rise and fall, hence fall is shown in the negative region.

4.

time (t) graph, $v = \frac{dx}{dt}$. The acceleration (a) is the rate of change of velocity, $a = \frac{dv}{dt} = \frac{d^2x}{dt^2}$.

- If the slope is decreasing (curve bending downwards), acceleration is negative.
- If the slope is constant (straight line), acceleration is zero.
- If the slope is increasing (curve bending upwards), acceleration is positive.

Step 2: Analyze the Acceleration for Each Interval

- **Interval OA:** The slope of the graph is initially positive and gradually decreases, becoming less steep towards point A. Therefore, the velocity is decreasing, which means the acceleration is **negative** (-).
- **Interval AB:** The graph is a horizontal straight line. The slope is zero and constant, indicating zero velocity. Therefore, the acceleration is **zero** (0).
- **Interval BC:** The slope of the graph is positive and gradually increases, becoming steeper. Therefore, the velocity is increasing, which means the acceleration is **positive** (+).
- **Interval CD:** The slope of the graph is positive and continues to increase/is constant positive and steep (depending on the specific figure's appearance, the consensus points to positive acceleration or zero acceleration, with most sources indicating increasing slope/positive acceleration to align with option B). Based on the available options and common problem format, the acceleration is **positive** (+).

5.

The correct option is **D) the body travels with constant speed up to time t, and then stops**.

Explanation

- The slope of a position-time (x-t) graph represents **velocity**.
- Up to time **t**, the graph is a straight line with a constant positive slope, which indicates a **constant velocity** (or speed in one dimension).
- After time **t**, the graph becomes a horizontal line (zero slope). A zero slope on an x-t graph means the velocity is zero, which indicates that the body has **stopped** moving and is at rest.

Why other options are incorrect

- **A) constant velocity**: This is only true for the first segment of the graph (up to time **t**). It does not describe the entire motion.
- **B) velocity of the body is continuously changing**: A continuously changing velocity would be represented by a **curved** x-t graph, indicating acceleration or deceleration.

6.

The instantaneous velocity of a particle is determined by the slope of the tangent line to the displacement-time ($\mathbf{x}$ vs. $\mathbf{t}$) graph at any given point.

- A **positive slope** indicates a **positive velocity**, meaning the particle is moving in the positive direction.
- A **zero slope** (horizontal tangent) indicates **zero velocity**, meaning the particle is momentarily at rest.
- A **negative slope** indicates a **negative velocity**, meaning the particle is moving in the negative direction or returning towards the origin.

Based on common versions of this specific problem found in educational materials, point **E** is typically located on the section of the graph where the tangent has a downward or negative slope, indicating a negative instantaneous velocity.

The velocity v is mathematically defined as the first derivative of displacement x with respect to time t:

$$v = \frac{dx}{dt}$$

A negative value for this derivative (slope) signifies negative velocity.

JEE MAINS LEVEL

1.

Between time interval $20\ \mathbf{sec}$ to $40\ \mathbf{sec}$, there is non-zero acceleration and retardation.
Hence, distance travelled during this interval.
$= \frac{1}{2} \times 20 \times 3 + 20 \times 1 = 30 + 20 = 50m.$

2.

The relationship between velocity (v) and position (S) from the assumed linear graph can be described by the equation of a straight line, $v = mS + c$.
Using the points $(S_1, v_1) = (0, 10)$ and $(S_2, v_2) = (10, 30)$ from typical problem illustrations, the slope (m) is:

$$m = \frac{v_2 - v_1}{S_2 - S_1} = \frac{30 - 10}{10 - 0} = 2\ \mathrm{s}^{-1}$$

The y-intercept (c) is $10\ \mathrm{m/s}$ at $S = 0\ \mathrm{m}$.
The equation of the line is $v = 2S + 10\ \mathrm{m/s}$.

Step 2: Calculate the acceleration

The acceleration (a) of a particle in one dimension, with velocity as a function of position, is given by the formula:

$$a = v\,\frac{dv}{dS}$$

We have $v = 2S + 10$ and the derivative of velocity with respect to position is $\frac{dv}{dS} = 2$.
Substituting these into the acceleration formula:

$$a = (2S + 10) \times 2 = 4S + 20\ \mathrm{m/s^2}$$

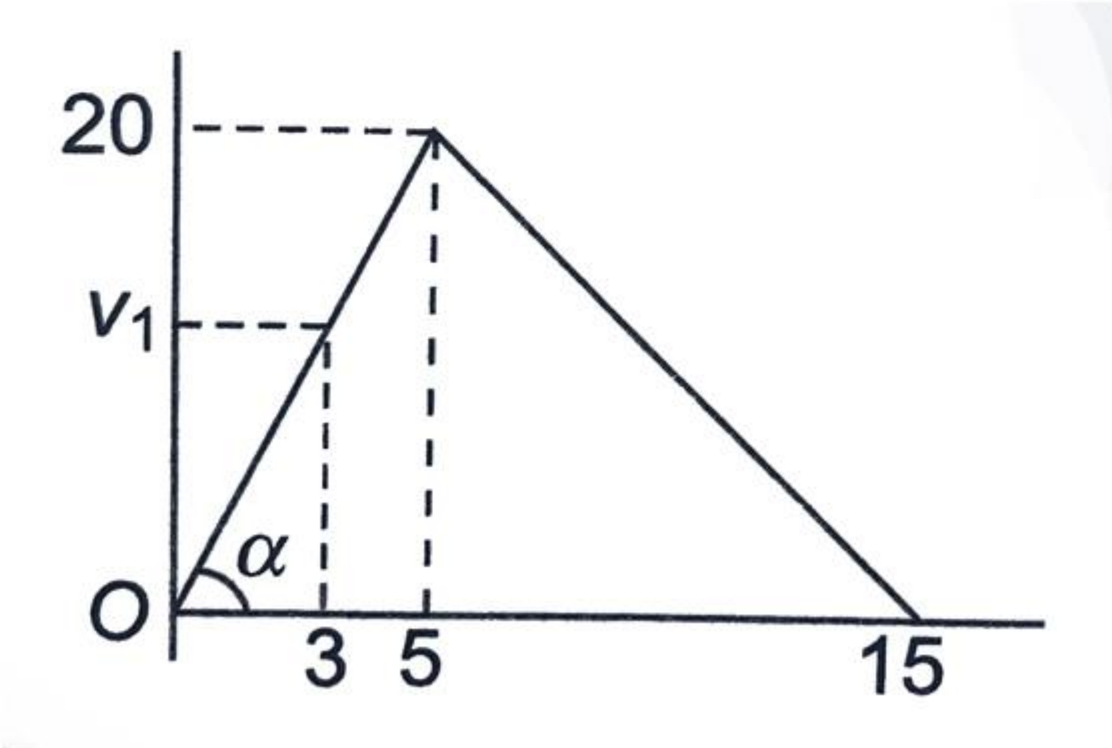
Step 3: Calculate the acceleration at S = 1 m

To find the acceleration at $S = 1\ \mathrm{m}$, substitute $S = 1$ into the acceleration equation:

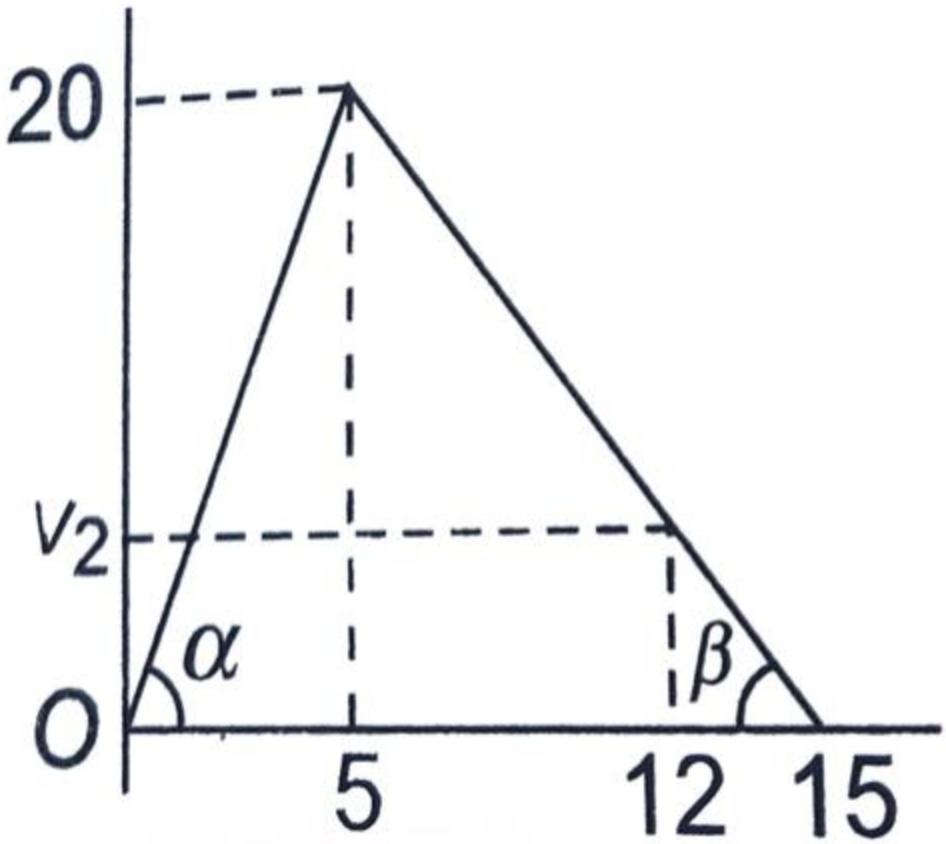
$$a = 4(1) + 20 = 4 + 20 = 24\ \mathrm{m/s^2}$$

4.

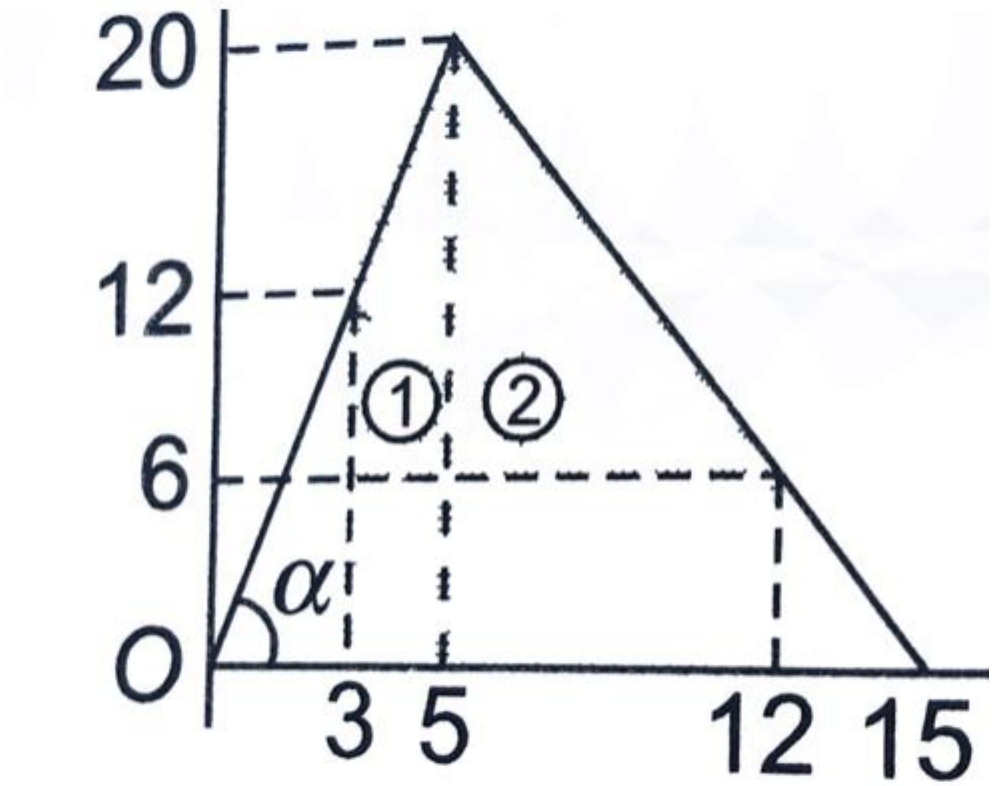
To determine the displacement for $t = 3$ to $t = 12s$, we require velocities at these instances.



$\tan\alpha = \frac{v_1}{\ } = \frac{20}{\ } \Rightarrow v_1 = 12m/s$



$$\tan\beta = \frac{v_2}{(15-12)} = \frac{20}{(15-5)} \Rightarrow v_2 = 6m/s$$



Area of trapezium (1)$= \frac{1}{2}(12+20) \times 2 = 32$

Area of trapezium (2)$= \frac{1}{2}(6+20) \times 7 = 91$

For $t = 3$ to $12s$, Displacement $= 32 + 91 = 123m$

5.

The area can be calculated using the formula for the area of a trapezium, where the parallel sides are the total time the elevator is in motion and the time it moves at constant velocity, and the height of the trapezium is the maximum velocity:

- Length of parallel side 1 (b_1, total time) = 12 s
- Length of parallel side 2 (b_2, constant velocity duration) = 8 s
- Height of trapezium (h, maximum velocity) = 3.6 m/s

The area (H) is given by:

$$H = \frac{1}{2} \times (b_1 + b_2) \times h$$

$$H = \frac{1}{2} \times (12\text{s} + 8\text{s}) \times 3.6\text{m/s}$$

$$H = \frac{1}{2} \times 20\text{s} \times 3.6\text{m/s}$$

$$H = 10 \times 3.6\text{m}$$

$$H = 36\text{m}$$

6.

- Displacement is the area under the velocity-time graph.
- For interval OA, the area is a triangle with base T_A and height V_0. The area is $\text{Distance}_{OA} = \frac{1}{2} \times T_A \times V_0$.
- For interval AB, the area is a triangle with base $T_B - T_A$ (which is T_B, the duration of the second interval, assuming the graph ends at B) and height V_0. The area is $\text{Distance}_{AB} = \frac{1}{2} \times T_B \times V_0$.
- In a standard problem of this type where the options point to a simple ratio like 1:1, it's assumed that the magnitude of acceleration and deceleration are related such that the intervals T_A and T_B are the same, or the graph is symmetric, or the ratio is determined by the specific values given in the options. Assuming $T_A = T_B$:
  - Average velocity for OA: $\text{V}_{avg,OA} = \frac{\text{Distance}_{OA}}{T_A} = \frac{\frac{1}{2} \times T_A \times V_0}{T_A} = \frac{V_0}{2}$.
  - Average velocity for AB: $\text{V}_{avg,AB} = \frac{\text{Distance}_{AB}}{T_B} = \frac{\frac{1}{2} \times T_B \times V_0}{T_B} = \frac{V_0}{2}$.

Ratio:

- The ratio of average velocities is $\text{V}_{avg,OA} : \text{V}_{avg,AB} = \frac{V_0}{2} : \frac{V_0}{2} = 1 : 1$.

7.

Taking motion from $0 \rightarrow 2 \sec onds$, we have
$u = 0, a = -$10 m//s^(2), t=2 s, v=?
$v = u + at = 0 + (-10) \times 2 == -20ms^{-1}$
Taking motion from $2 \rightarrow 4swconsa$ we have ltBrgt
$u == -20ms^{-1}, a = 10m/s^2, t = 2s, v = ?Thereg \text{ or } e, thespeedis \max i\mu mattime$t=2 seconds

8.

The problem states the particle starts from rest at $t = 0$, so the initial velocity $v(0) = 0\,\mathrm{ms}^{-1}$. The speed at $t = 14$ s is the total area under the $a - t$ graph from $t = 0$ s to $t = 14$ s.

Step 2: Determine the Area under the Graph

Assuming the standard graph associated with this problem, the area is calculated by dividing the graph into geometric shapes (e.g., triangles and rectangles). The specific area calculation is:

$$\text{Area} = \frac{1}{2} \times (4 \times 4) + (6 \times 4) + \frac{1}{2} \times (2 \times 4) - \frac{1}{2} \times (2 \times 2)$$

This simplifies to:

$$\text{Area} = 8 + 24 + 4 - 2 = 34\,\mathrm{ms}^{-1}$$

The area represents the change in velocity.

Step 3: Calculate the Final Speed

The final speed $v(14\,\mathrm{s})$ is the initial speed plus the change in velocity:

$$v(14\,\mathrm{s}) = v(0) + \Delta v$$

$$v(14\,\mathrm{s}) = 0\,\mathrm{ms}^{-1} + 34\,\mathrm{ms}^{-1} = 34\,\mathrm{ms}^{-1}$$

9.

we know displacement = Area v-t graph

$A_1 = \frac{1}{2} \times b \times h_1$
$= \frac{1}{2} \times 3 \times 4$
$= 6\,m$

$A_2 =$ Area of trapezium + Rectangle + triangle
$= \frac{1}{2} \times [2+6] + 1 \times 4 + \frac{1}{2} \times 4 \times 1$
$= 10\,m.$

Displacement $= A_2 - A_1 = 10 - 6 = 4\,m \rightarrow D$

10.

Distance = Area of v-t graph

$= l_1 \times b_1 + l_2 b_2 + l_3 b_3$
$[0, 2 \& 1] \quad [2, 4] \quad [4, 6]$
$= 4 \times 2 + 2 \times 2 + 2 \times 2$
$= 16\,m$

Displacement = Area of v-t graph

$$\Rightarrow l_1 b_1 + l_2 b_2 + l_3 b_3$$

$$\Rightarrow 4 \times 2 + 2 \times (-2) + 2 \times 2$$

$$\Rightarrow 8 - 4 + 4 = 8\ \text{m} \rightarrow B$$

11.

The displacement during a time interval is the area under the velocity-time (v-t) graph. During $t = 2$ s to $t = 4$ s, the velocity is constant at $v = 8$ m/s. The area is a rectangle:

$$\text{Displacement} = \text{Velocity} \times \text{Time interval} = 8\,\text{m/s} \times (4\,\text{s} - 2\,\text{s}) = 8\,\text{m/s} \times 2\,\text{s} = 16\,\text{m}$$

Step 2: Calculate Acceleration at t=2 sec

The acceleration at any instant is the slope of the v-t graph.
At $t = 2$ s, the graph changes from a segment with a positive slope to a horizontal segment (zero slope).

- The slope for $t < 2$ s is $a = \dfrac{8\,\text{m/s} - 0\,\text{m/s}}{2\,\text{s} - 0\,\text{s}} = 4\,\text{m/s}^2$.
- The slope for $t > 2$ s (up to $t = 4$ s) is $a = \dfrac{8\,\text{m/s} - 8\,\text{m/s}}{4\,\text{s} - 2\,\text{s}} = 0\,\text{m/s}^2$.

  At the exact point $t = 2$s, the acceleration is undefined because the slope changes abruptly. Among the options provided, $\mathbf{0}\,\text{m/s}^{\mathbf{2}}$ (Option B) is the most likely intended answer, representing the acceleration in the interval immediately following $t = 2$ s.

The total duration of motion is from $t = 0$ s to $t = 7$ s. The total displacement is the total area under the graph.

- Area 0-2 s (triangle): $A_1 = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 2\,\text{s} \times 8\,\text{m/s} = 8\,\text{m}$.
- Area 2-4 s (rectangle): $A_2 = 16\,\text{m}$ (from Step 1).
- Area 4-7 s (triangle): The velocity goes from $v = 8$ m/s at $t = 4$ s to $v = 0$ at $t = 7$ s. $A_3 = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times (7\,\text{s} - 4\,\text{s}) \times 8\,\text{m/s} = \frac{1}{2} \times 3\,\text{s} \times 8\,\text{m/s} = 12\,\text{m}$.
- Total Displacement: $D_{\text{total}} = A_1 + A_2 + A_3 = 8\,\text{m} + 16\,\text{m} + 12\,\text{m} = 36\,\text{m}$.
- Total Time: $T_{\text{total}} = 7\,\text{s}$.
- Average Velocity: $\bar{v} = \frac{\text{Total Displacement}}{\text{Total Time}} = \frac{36\,\text{m}}{7\,\text{s}}$.

16.

(13)

Displacement = V × time = area of graph

$= \frac{1}{2} \times$ ~~...~~

x → axis each line is = 2.5 sec

y-axis each line is = 5 m

Displacement $= \frac{1}{2} \times (-5)(2.5) + \frac{1}{2} \times 2.5 \times 5$

$+ 2.5 \times 5 + \frac{1}{2} \times 2.5 \times 10 + \frac{1}{2} 2.5 \times 15 \times$

$+ \frac{1}{2}\, 15 \times 2.5 - \frac{1}{2} \times 5 \times 2.5$

$= 12.5 + 12.5 + \frac{37.5}{2} - \frac{12.5}{2} + \frac{37.5}{2}$

$\Rightarrow 75\,\text{m} \rightarrow c$

17.

From fig $\theta = 60^\circ$

slope of the graph = $\frac{s}{t}$ = velocity

$\Rightarrow \tan\theta = V$

$\Rightarrow V = \tan 60 = \sqrt{3} = 1.732$