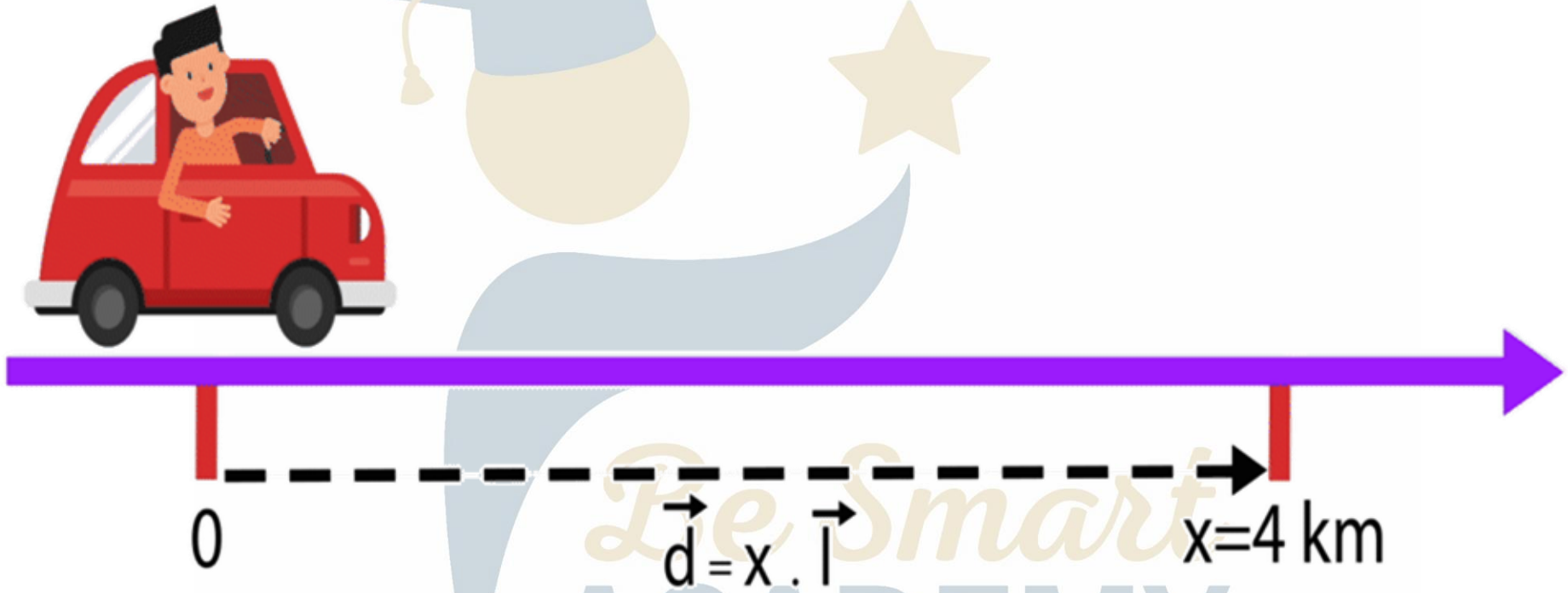
Physics – Grade 10

Unit Four – Mechanics



Chapter 15 – Rectilinear motion

Prepared & Presented by: Mr. Mohamad Seif

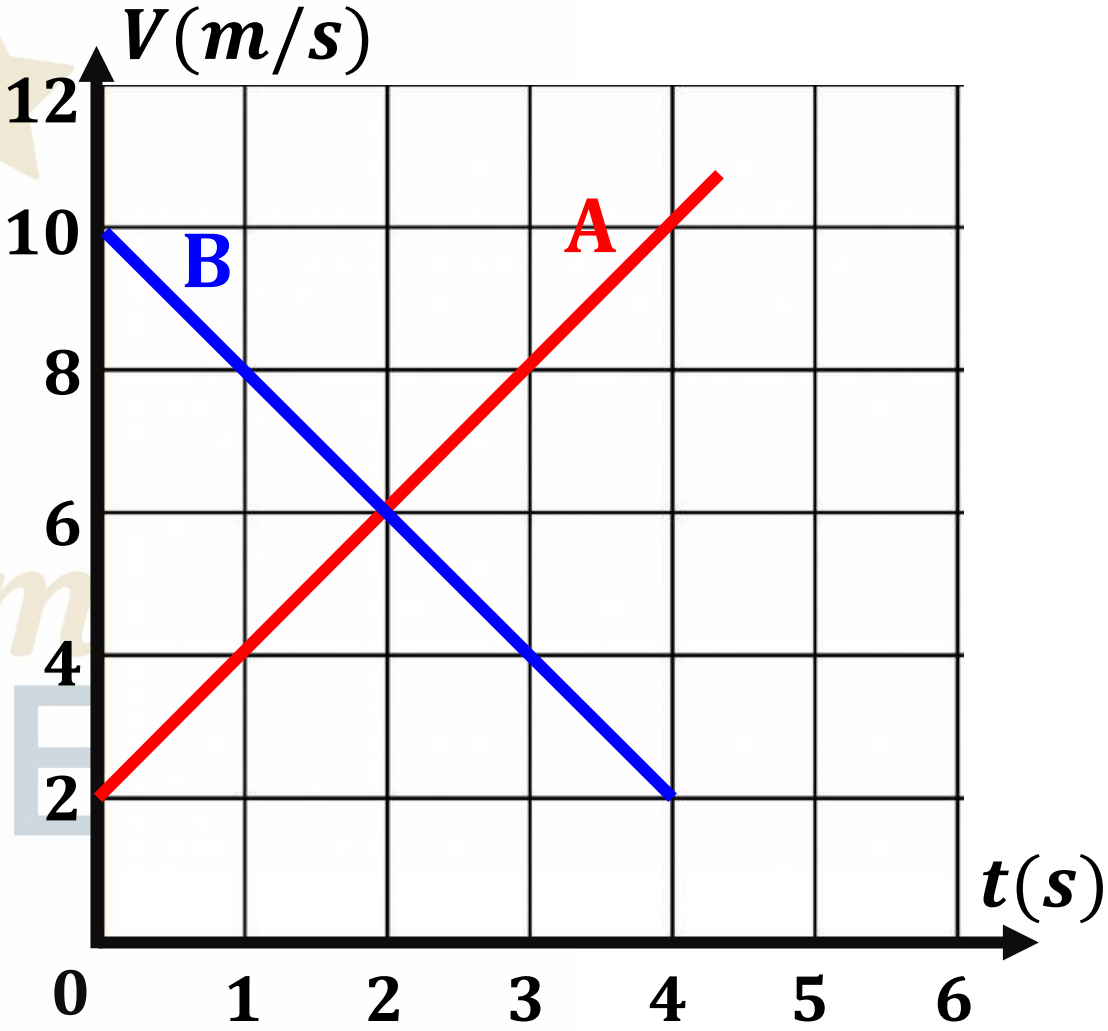
Think then Solve

Exercise 1

Two cars (A) and (B) move in rectilinear paths parallel to each other.

The variation of speed V of each car with respect to time is represented in the adjacent figure.

Initially, at $t_0 = 0$, the two cars start from origin O.



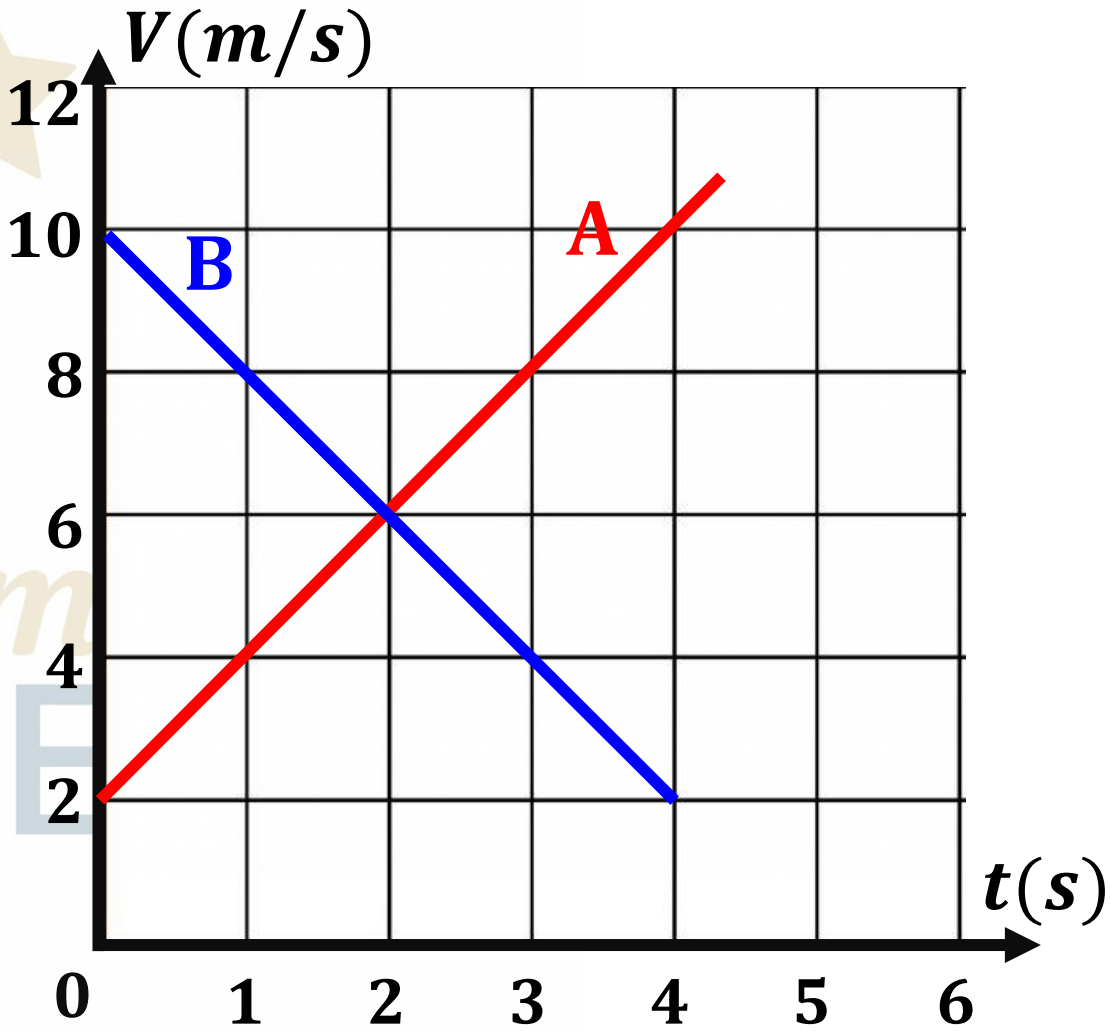
Exercise 1

1. Indicate, with justification, the nature of motion of each car.
2. Indicate the initial speed V_0 of each car.
3. Determine the acceleration a_A and a_B of car (A) and car (B) respectively.
4. Write as a function of time the equation of speed of each car.
5. Show that the time equation of motion of each car is:

$$X_A = t^2 + 2t \text{ and } X_B = -t^2 + 10t$$

Exercise 1

1. Indicate, with justification, the nature of motion of each car.



For car (A): The motion is U.A.R.M, because the curve of its speed increases with time.

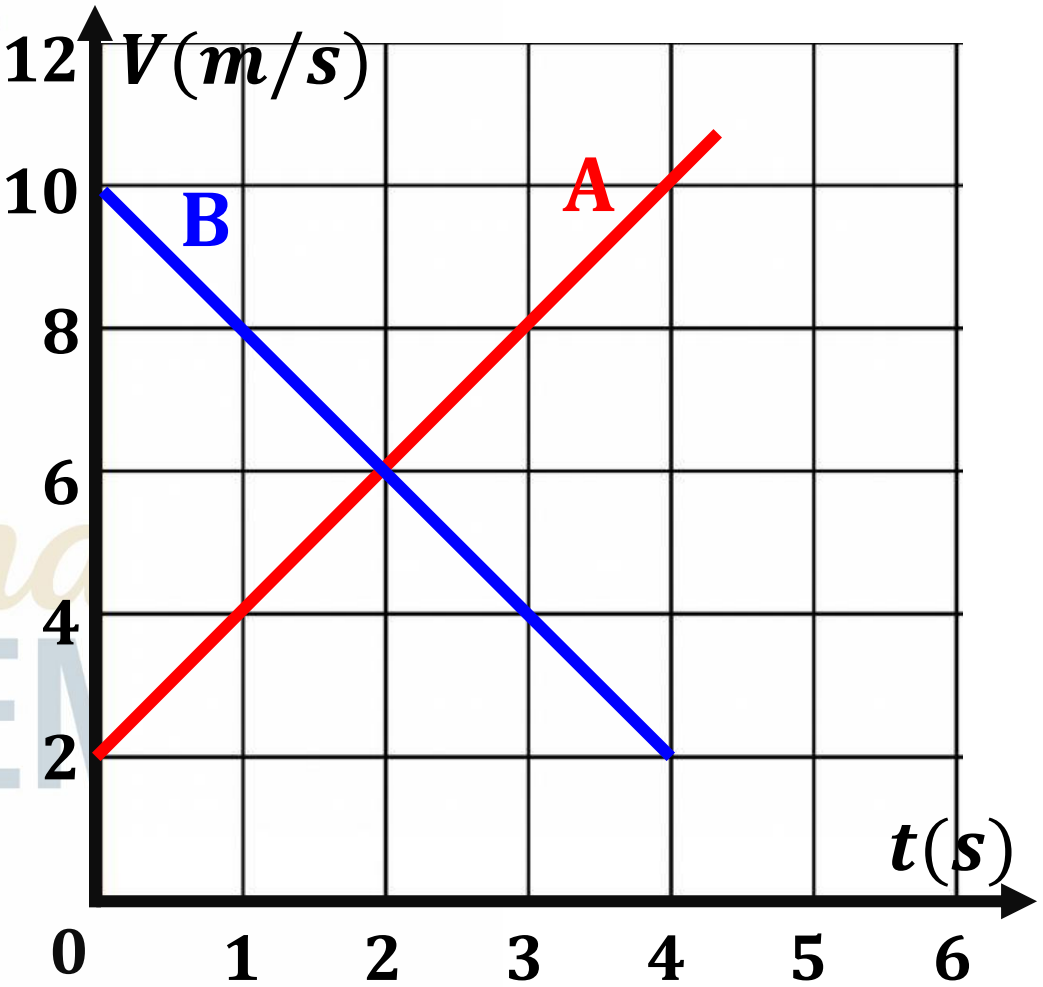
For car (B): The motion is U.D.R.M, because the curve of its speed decreases with time.

Exercise 1

2. Indicate the initial speed V_0 of each car.

For car (A): $V_0 = 2m/s$.

For car (B): $V_0 = 10m/s$.



Exercise 1

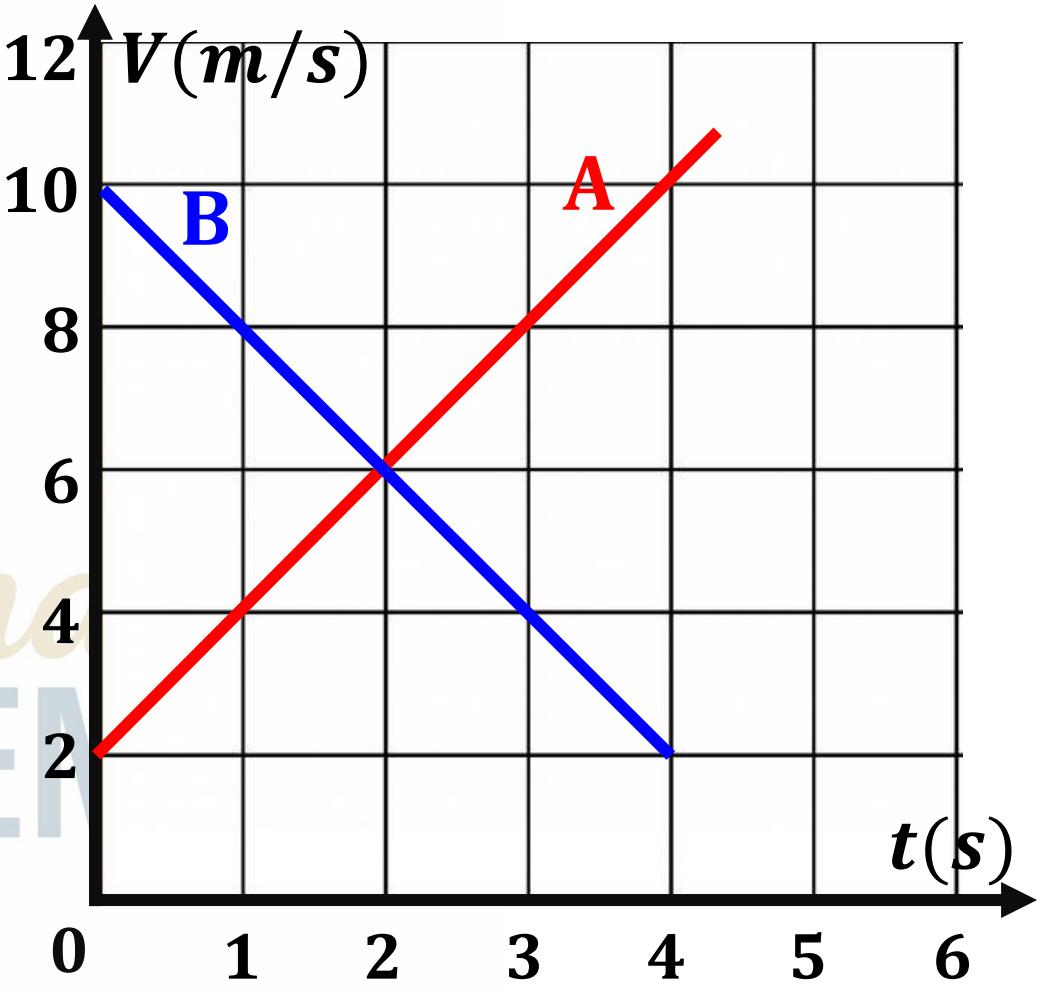
3. Determine the acceleration a_A and a_B of car (A) and car (B) respectively.

$$a_A = \frac{V_2 - V_1}{t_2 - t_1} = \frac{6 - 2}{2 - 0}$$

$$a_A = 2m / s^2$$

$$a_B = \frac{V_2 - V_1}{t_2 - t_1} = \frac{6 - 10}{2 - 0}$$

$$a_B = -2m / s^2$$



Exercise 1

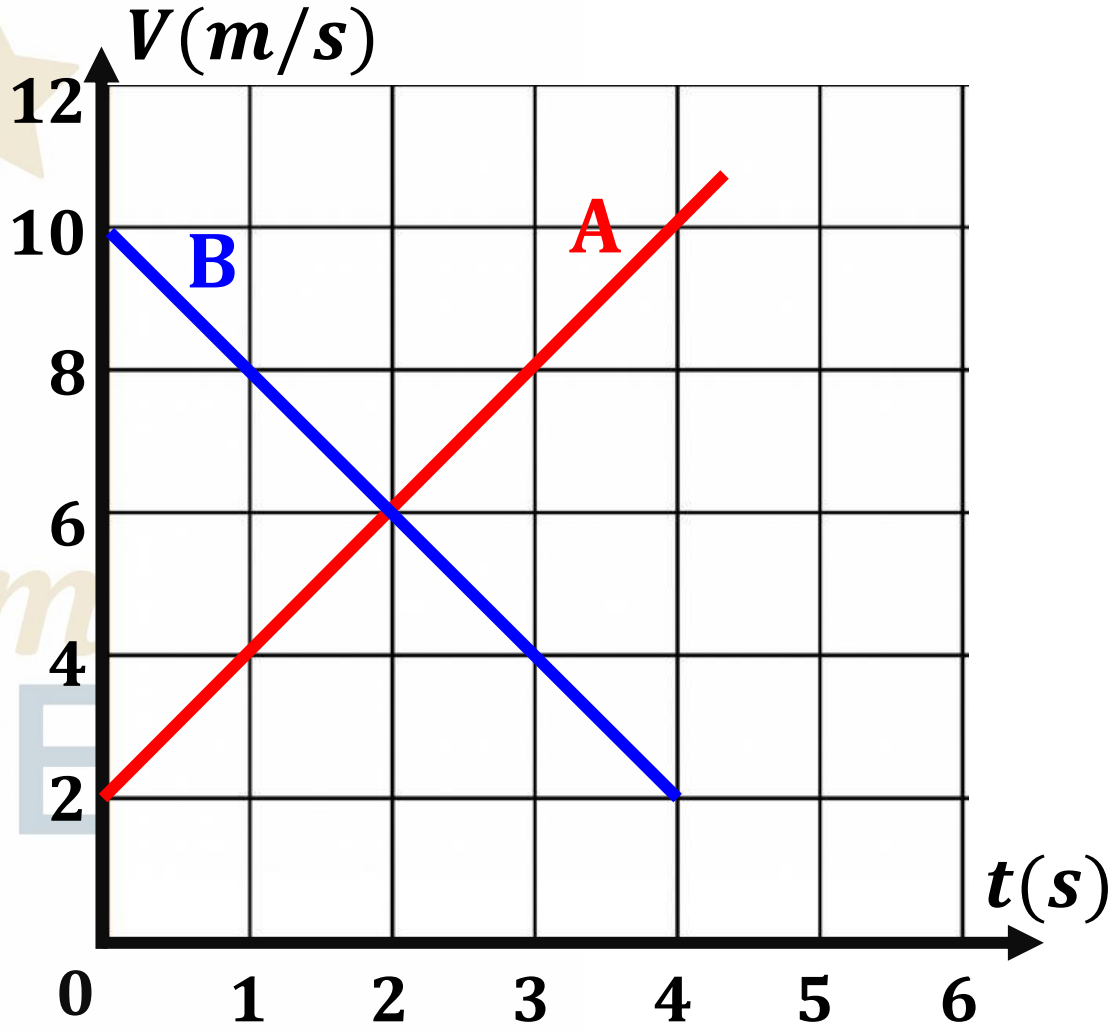
4. Write as a function of time the equation of speed of each car.

For car A: $\mathbf{V = at + V_0}$

$\mathbf{V = 2t + 2}$

For car B: $\mathbf{V = at + V_0}$

$\mathbf{V = -2t + 10}$



Exercise 1

5. Show that the time equation of motion of each car is:

$$X_A = t^2 + 2t \text{ and } X_B = -t^2 + 10t$$

For car A:

$$X_A = \frac{1}{2} a_A t^2 + V_0 t + x_0$$

$$X_A = \frac{1}{2}(2)t^2 + 2t + 0$$

$$X_A = t^2 + 2t$$

For car B:

$$X_B = \frac{1}{2} a_B t^2 + V_{B0} t + x_0$$

$$X_B = \frac{1}{2}(-2)t^2 + 10t + 0$$

$$X_B = -t^2 + 10t$$

Exercise 1

6.Determine the position of each car at the instant when the two cars have same speed.

From the graph the two cars have the same speed at $t = 2s$

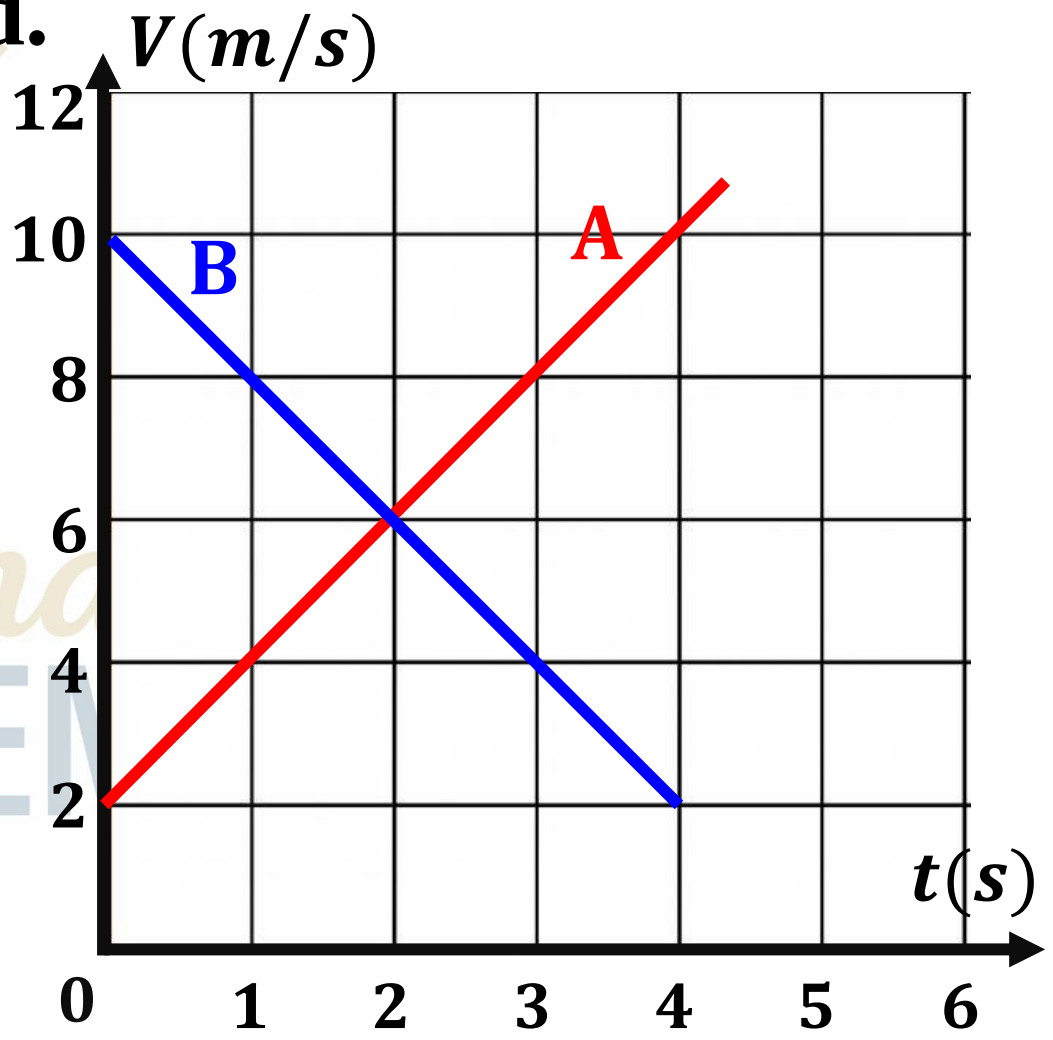
$$X_A = t^2 + 2t \Rightarrow X_A = (2)^2 + 2(2)$$

$$X_A = 8\text{m}$$

$$X_B = -t^2 + 10t$$

$$X_B = -(2)^2 + 10(2)$$

$$X_B = 16m$$



Exercise 1

7. Deduce the distance separates the two cars the instant when the two cars have same speed.

$X_A = 8\text{m}$ $X_B = 16m$

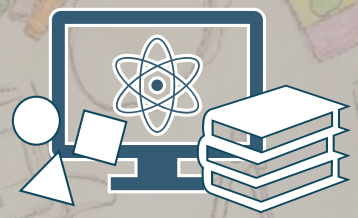
The distance d separating the two cars is:

$$d = X_B - X_A$$

$$\text{d} = 16m - 8m$$

$$d = 8m$$

The End



Think then Solve

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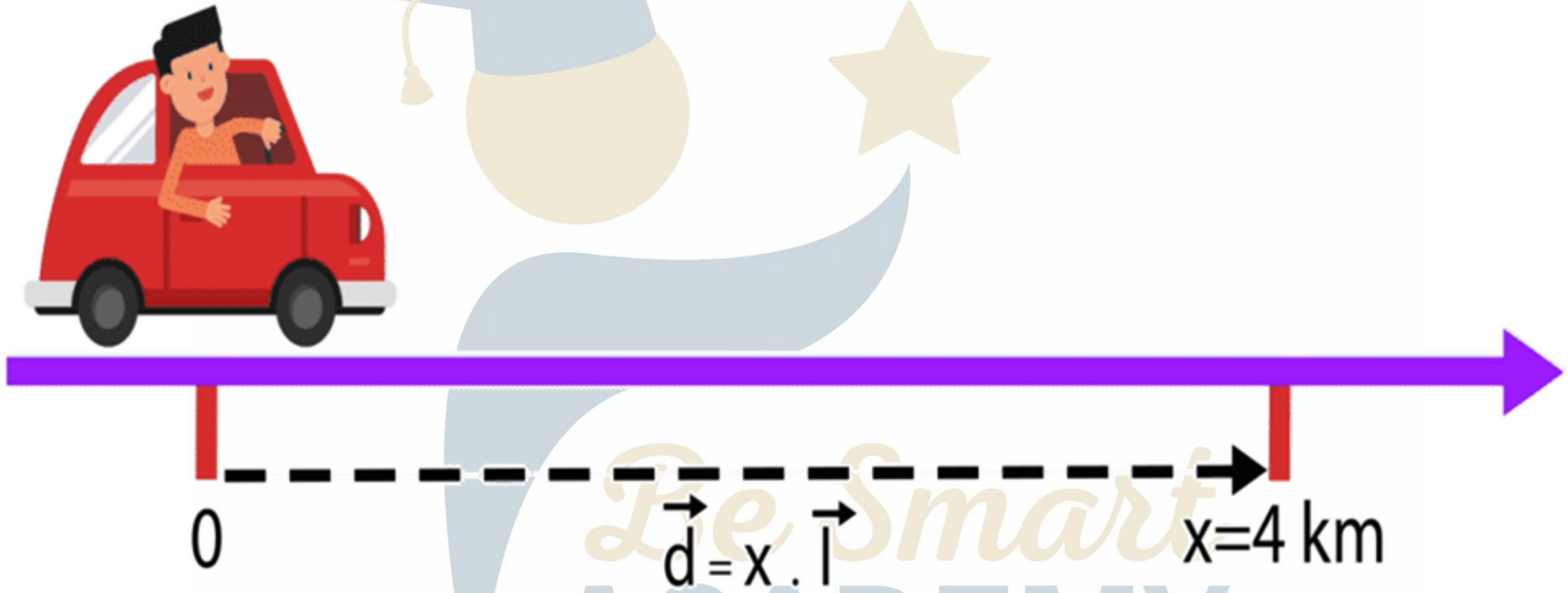
Unit Four – Mechanics



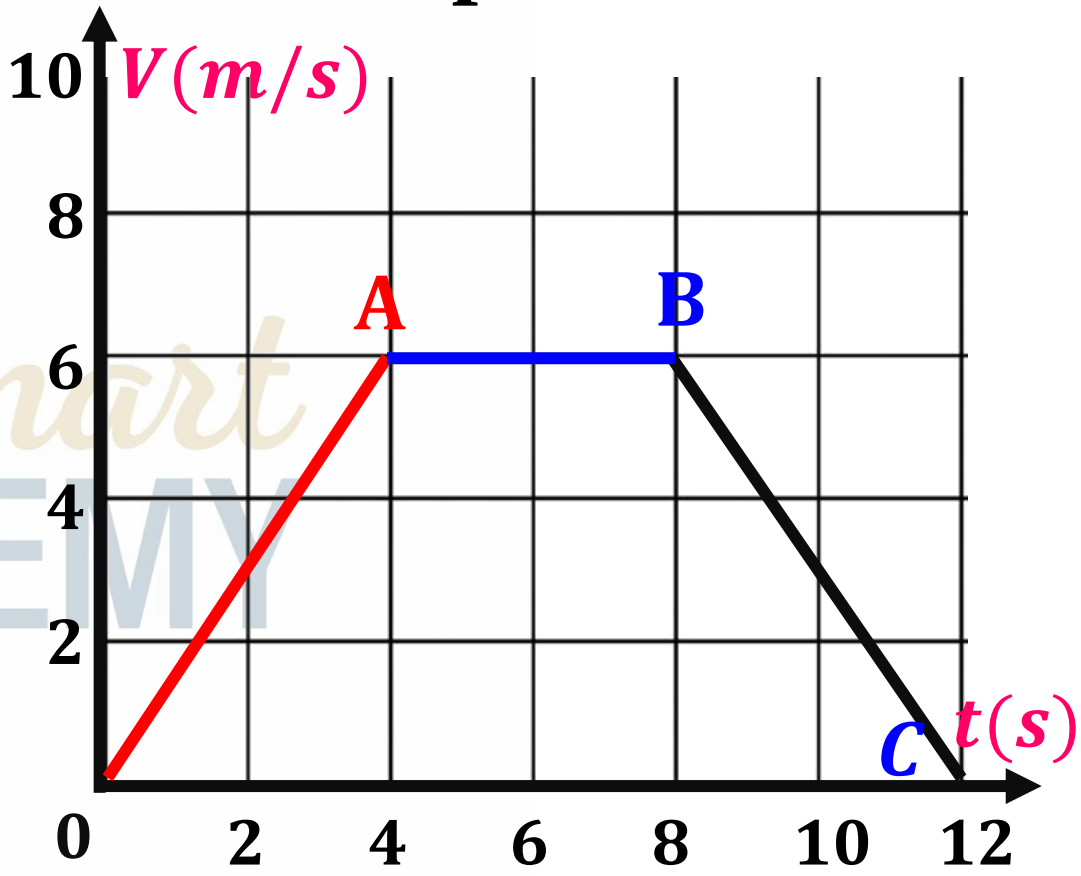
Chapter 15 – Rectilinear motion

Prepared & Presented by: Mr. Mohamad Seif

Exercise 2

The graph below shows the variation of speed as a function of time for a moving body.

1. Calculate the acceleration of the car in each phase.



Along OA:

$$a_1 = \frac{\Delta V}{\Delta t} = \frac{V_A - V_O}{t_A - t_O}$$

$$a_1 = \frac{6 - 0}{4 - 0}$$

$$a_1 = 1.5 m / s^2$$

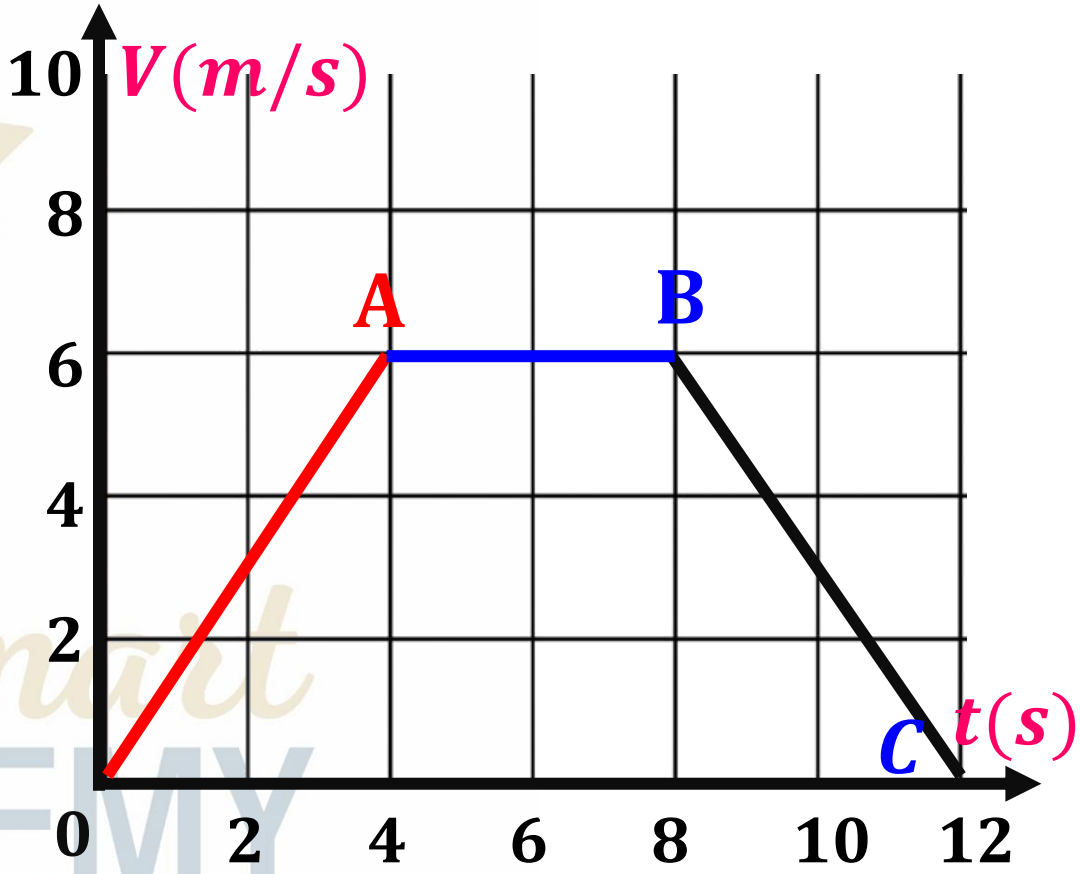
Exercise 2

Along AB:

$$a_2 = \frac{\Delta V}{\Delta t} = \frac{V_B - V_A}{t_B - t_A}$$

$$a_2 = \frac{6 - 6}{8 - 4} = \frac{0}{4}$$

$$a_2 = 0\ m/s^2$$



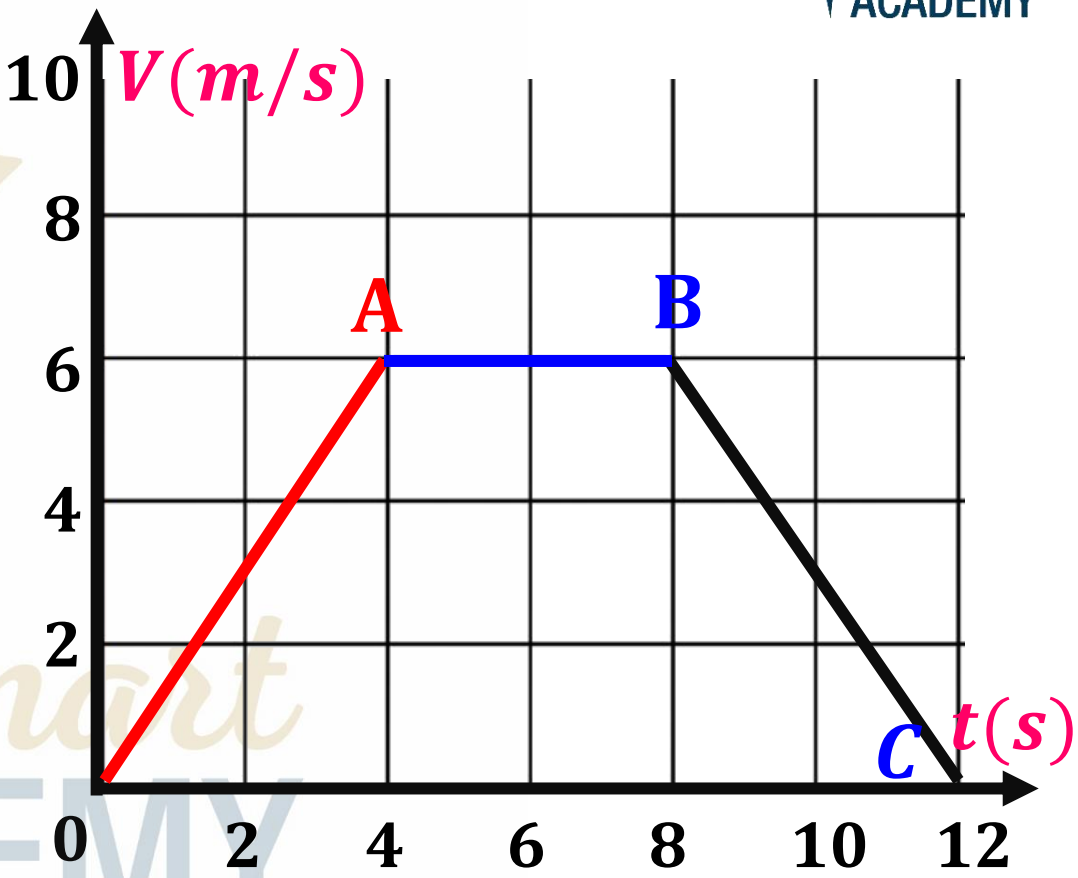
Exercise 2

Along BC:

$$a_3 = \frac{\Delta V}{\Delta t} = \frac{V_C - V_B}{t_C - t_B}$$

$$a_3 = \frac{0 - 6}{12 - 8}$$

$$a_3 = -1.5\ m/s^2$$



Exercise 2

2. What is the nature of the motion of the car in each phase.

Along OA:

$a_1 = 1.5\,m/s^2 > 0$ **then the motion is UARM.**

Along AB:

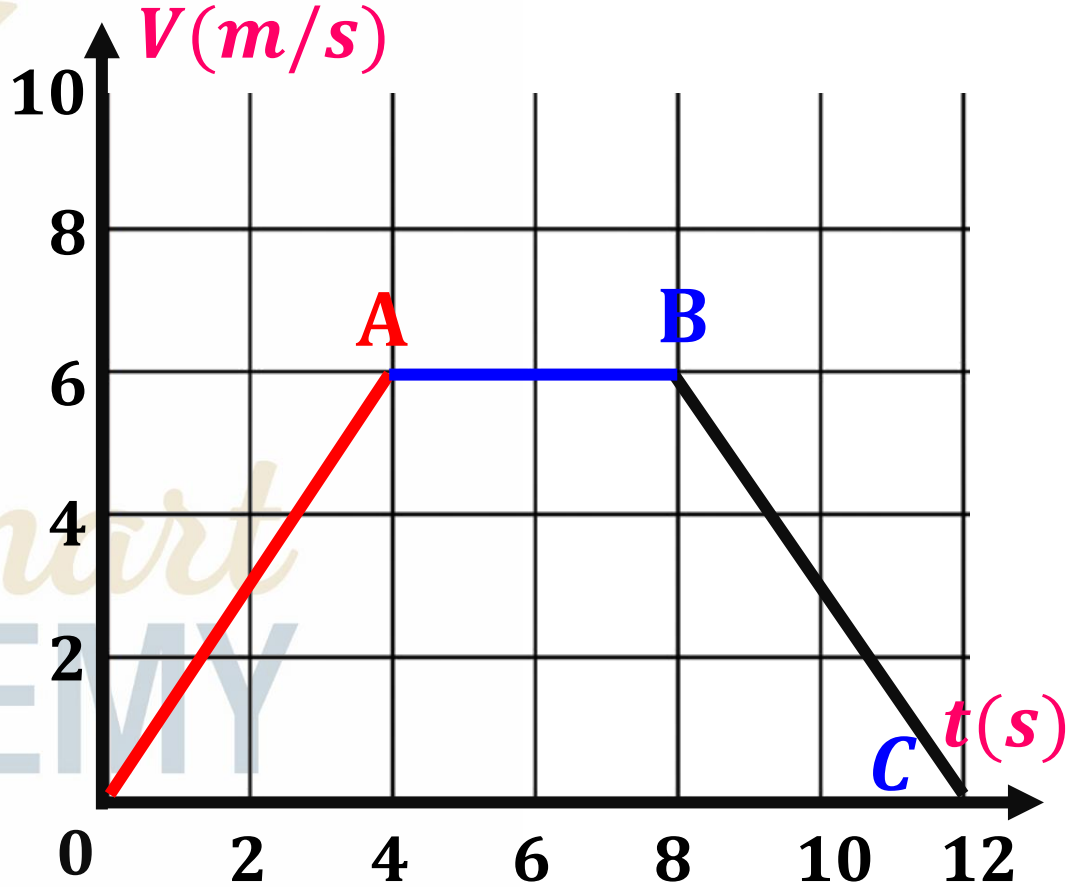
$a_2 = 0m\,/\,s^2$ **then the motion is URM.**

Along BC:

$a = -1.5\,m/s^2 < 0$ **then the motion is UDRM.**

Exercise 2

3. Calculate the distance covered by the car in each phase (OA, AB and BC).



For OA: UARM

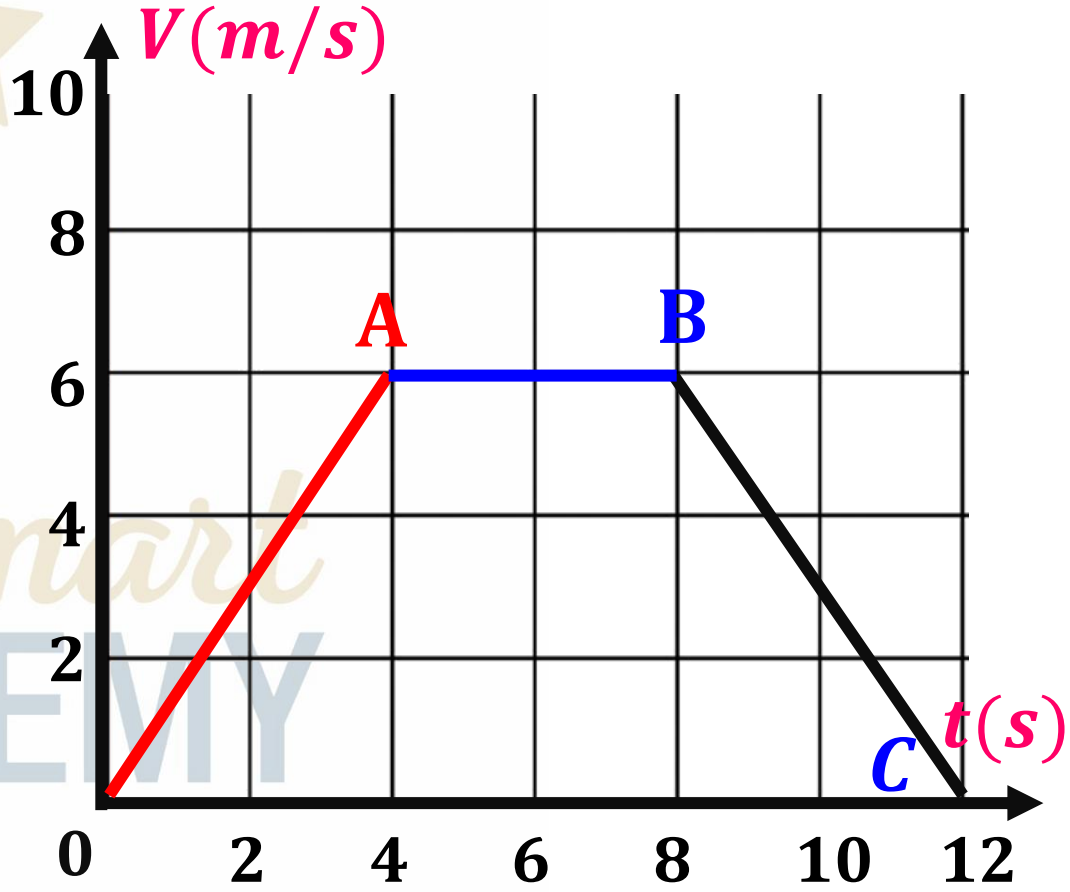
$$x_1 = \frac{1}{2} a_1 t^2 + V_0 t + x_0$$

$$x_1 = \frac{1}{2} (1.5)\,(4)^2 + (0)(4) + 0$$

$$x_1 = 12m$$

Exercise 2

3. Calculate the distance covered by the car in each phase (OA, AB and BC).



For AB: U.R.M

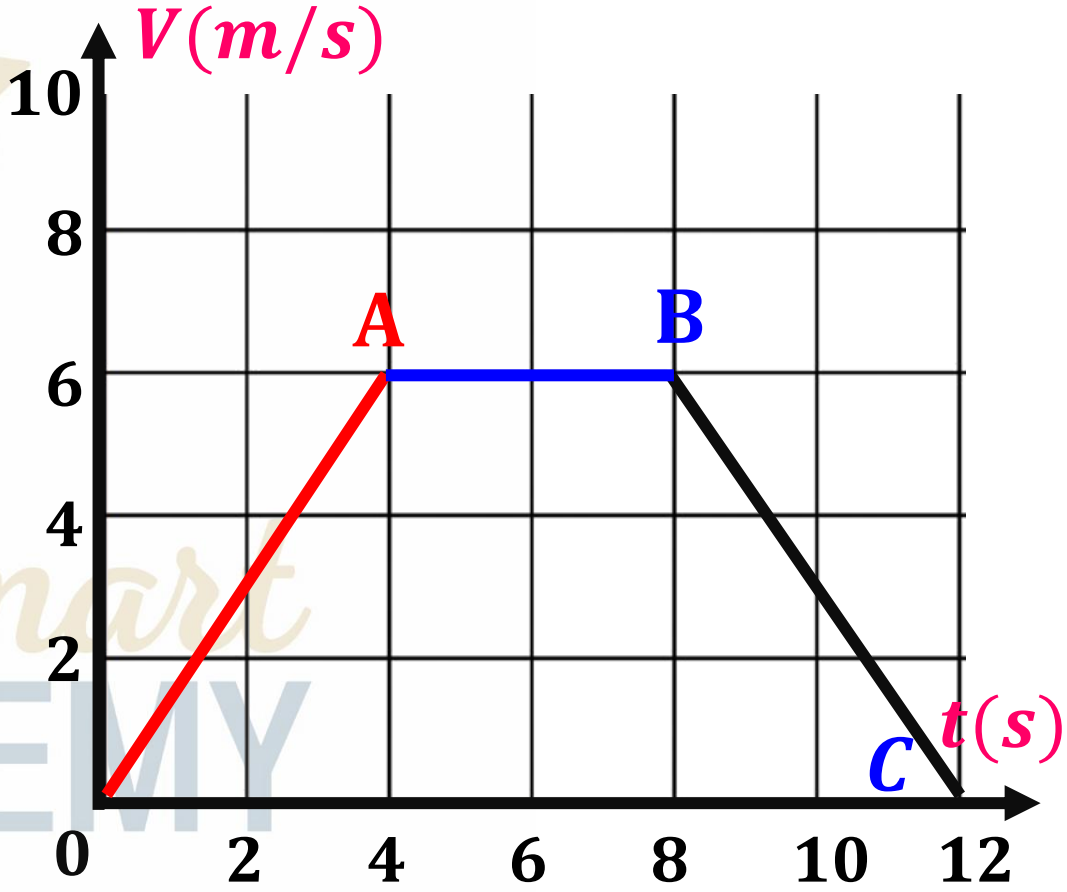
$$x_2 = Vt + x_0$$

$$x_2 = 6 \times (4) + 0$$

$$x_2 = 24\ m$$

Exercise 2

3. Calculate the distance covered by the car in each phase (OA, AB and BC).



For BC: U.D.R.M

$$x_3 = \frac{1}{2} a_3 t^2 + V_0 t + x_0$$

$$x_3 = \frac{1}{2}(-1.5)\,(4)^2 + (6)(4) + 0$$

$$x_3 = 12m$$

Exercise 2

4. Deduce the total distance covered by the car.

$$x = x_1 + x_2 + x_3$$

$$x = 12m + 24m + 12m$$

$$x = 48m$$

5. Calculate the average speed of the car.

$$V_{av} = \frac{\Delta d}{\Delta t} = \frac{x}{\Delta t}$$

$$V_{av} = \frac{48}{12}$$

$$V_{av} = 4m/s$$

The End