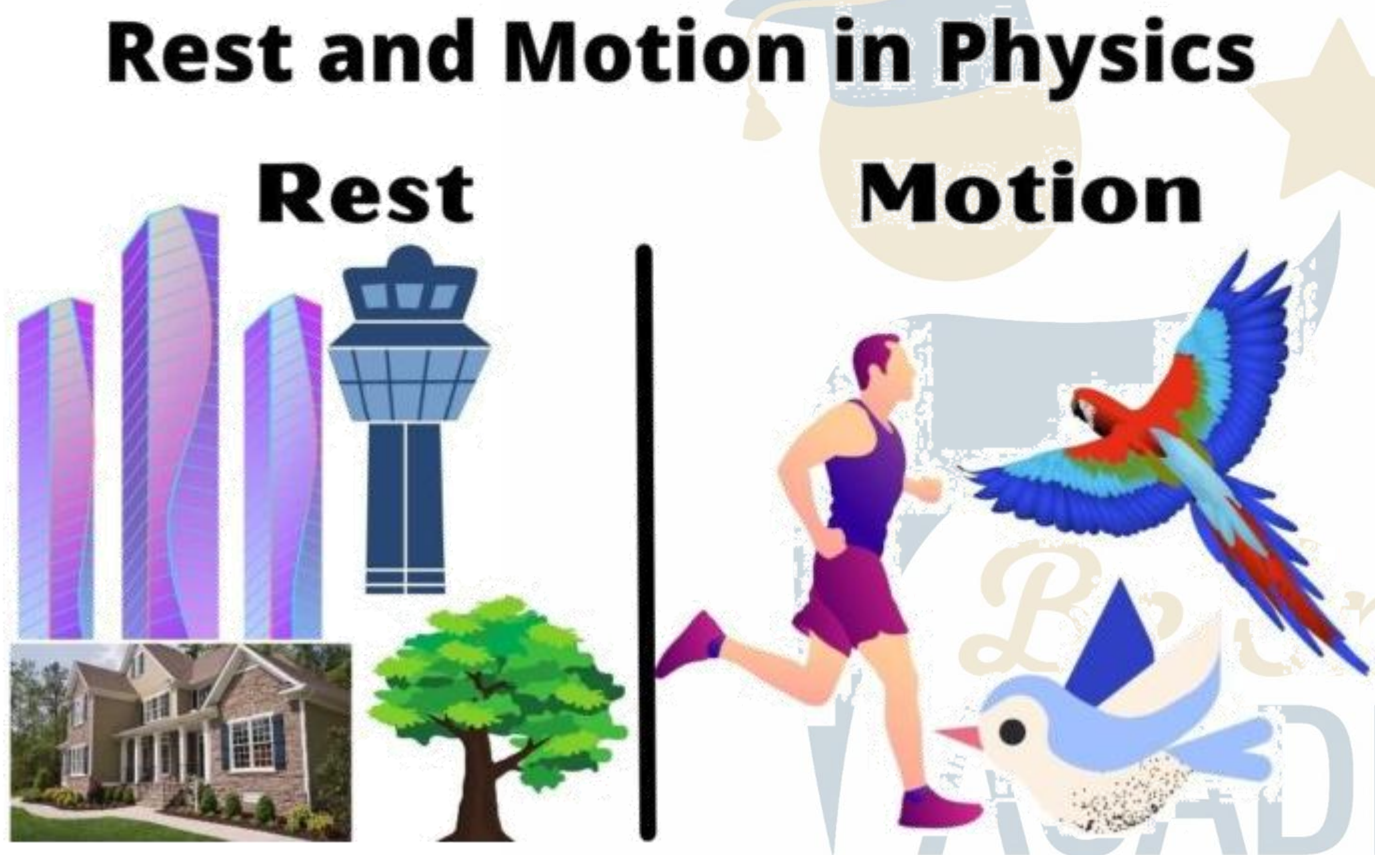
Physics – Grade 10



Unit Four
Mechanics

Chapter 14
Description of motion

Prepared & Presented by: Mr. Mohamad Seif

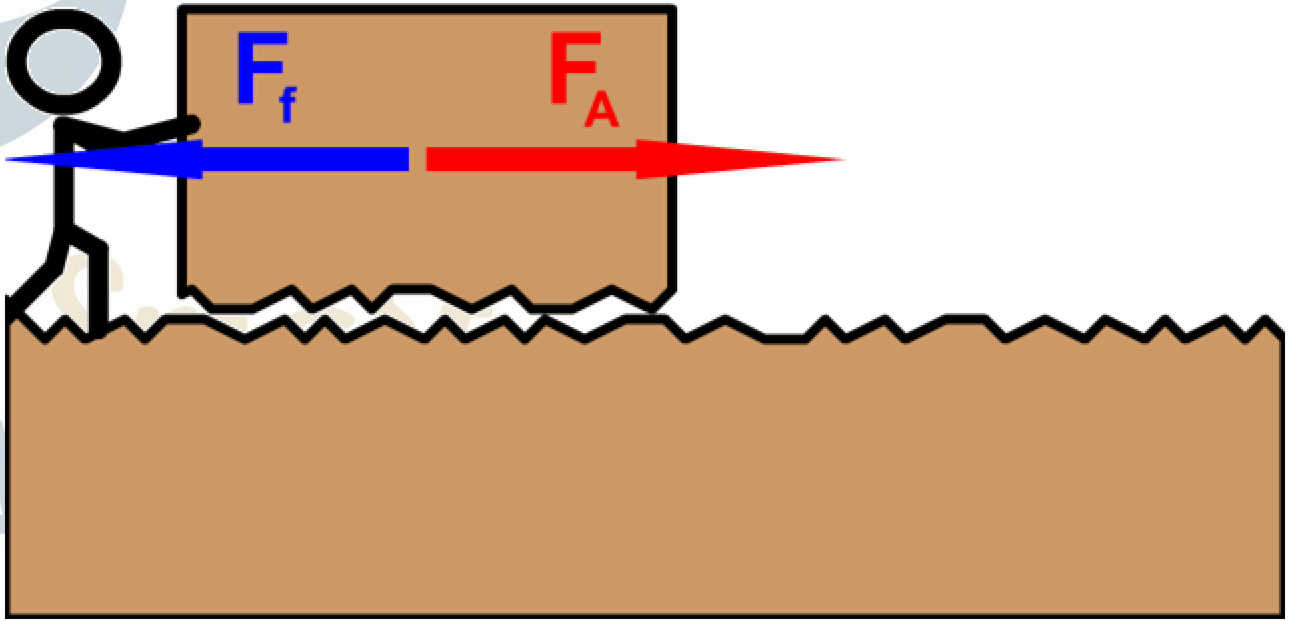
OBJECTIVES

1	Introduction about mechanics
2	Definition of motion
2	Space and time frames of reference:

Definition of mechanics

What is “Mechanics”?

Mechanics is a branch of physics that studies the state (motion or rest) of an object (or system) and taking into consideration its causes.



Definition of mechanics

Mechanics

- **Kinematics**: Concerned with the description of motion without reference to the cause of motion
- **Statics**: Concerned with analysis of loads (forces, torque…) acting on a system during static equilibrium
- **Dynamics**: Concerned with the study of motion with reference to the cause of motion (force, energy…)

Definition of mechanics

Types of motion

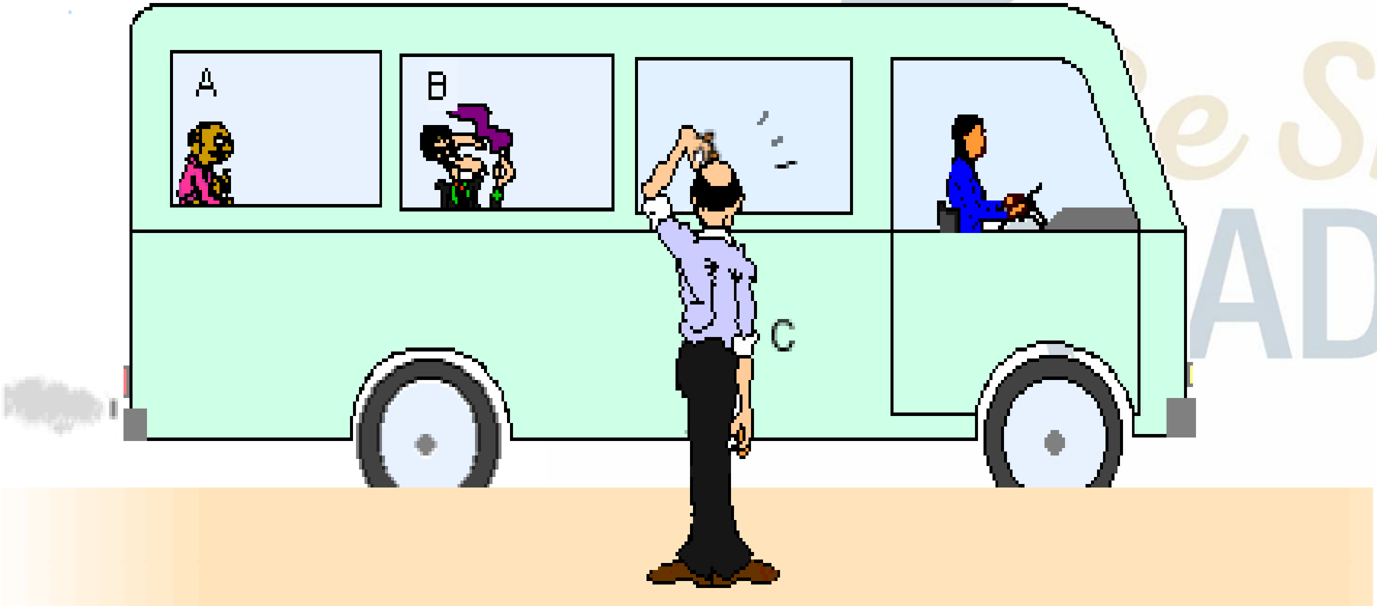
- Translational motion
  - Rectilinear motion
  - Curvilinear motion
  - Circular motion
- Rotational motion
- Combined motion

Definition of motion

Rest & motion:

The terms "at rest" or "in motion" are relative and depend on the chosen reference.

The same object may be at rest with respect to a certain observer and in motion with respect to another.



B is at rest relative to A

C is in motion relative to A

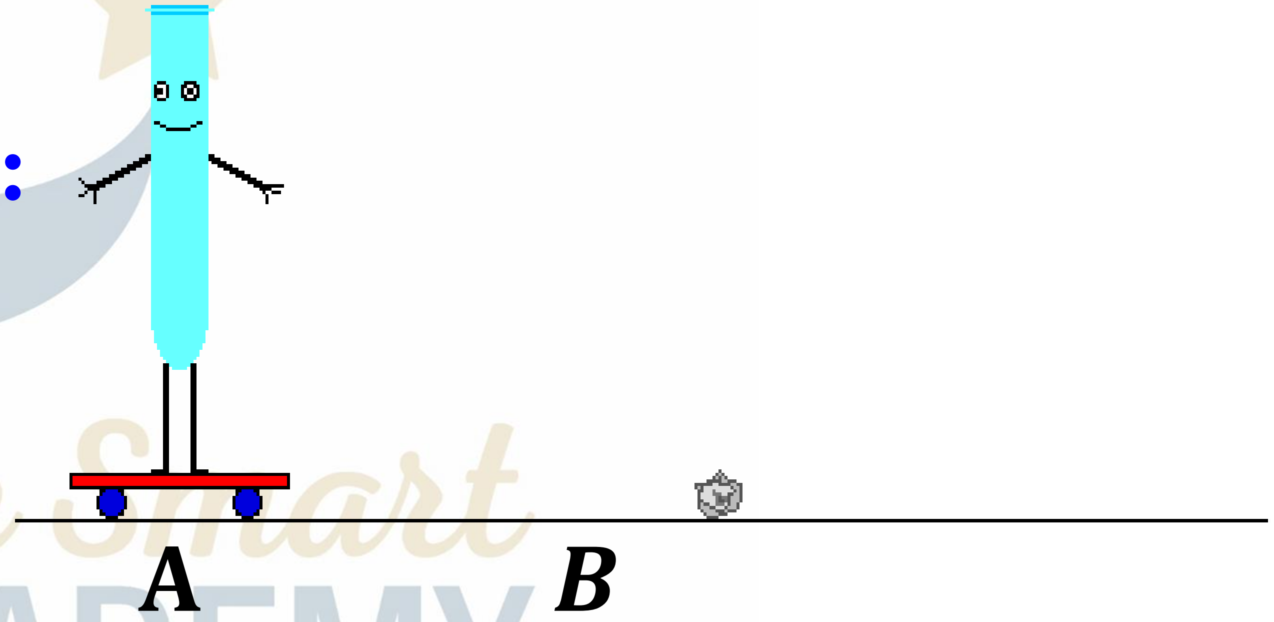
C is in motion relative to B

Definition of motion

Motion is defined as a change of position of a body relative to a **reference point**.

Trajectory of a moving object:

The trajectory of motion is the path described by this object during its motion.



The trajectory of rectilinear motion is **straight line**.

Space and time frames of reference:

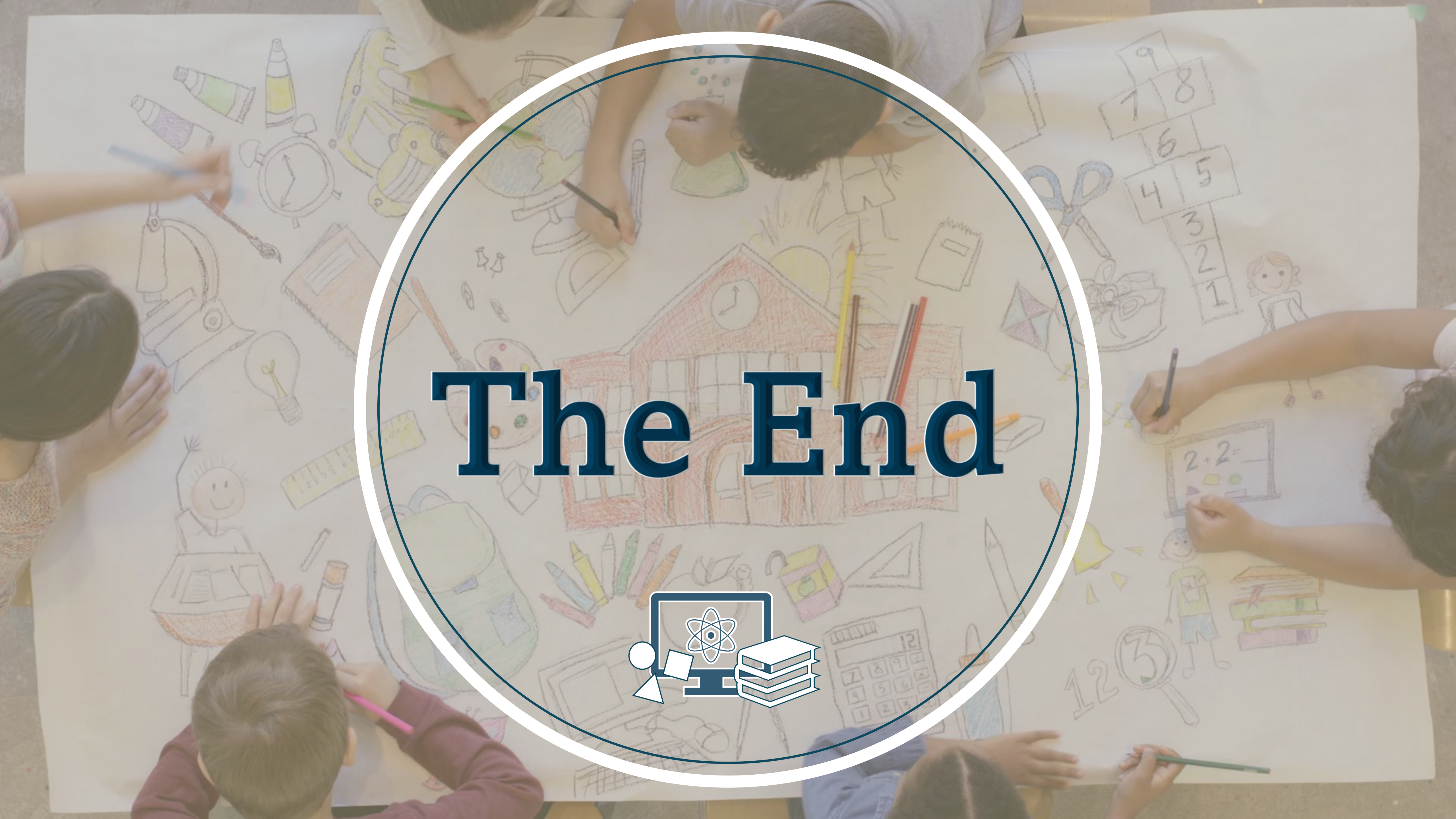
The space frame of reference is used to determine the position and the distance covered by a moving object in this frame.

The origin of the reference is the point of observation of the motion.

The space reference system of a particle moving on a rectilinear trajectory is denoted by $(0, \vec{i})$.

Space and time frames of reference:

- The choice of a time reference is used to know the instant of an event and to determine the duration of motion.
- The time $t_0 = 0s$ is taken to be the origin of time of most events, where it indicates the instant of starting the studying of the motion and not necessarily the instant of starting the motion.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Physics – Grade 10

Unit Four
Mechanics

Chapter 14
Description of motion

Prepared & Presented by: Mr. Mohamad Seif

OBJECTIVES

1	**Position vector**
2	**Distance and Displacement**

Position vector

- The rectilinear motion of a body M is studied with respect to the frame $(O, \vec{i}\,)$, of origin O.
- The position of the body at the origin of time $t_0 = 0$, is at O such that $x_0 = 0$ and its position at an instant t, is $x = OM$.
- The position vector, at an instant t, is:

$$\vec{r} = \overrightarrow{OM} = x\vec{i}$$

Position vector

Characteristic of the position vector $\overrightarrow{OM_1}$:

- **Origin:** O
- **Line of action:** The horizontal line holding O and M_1

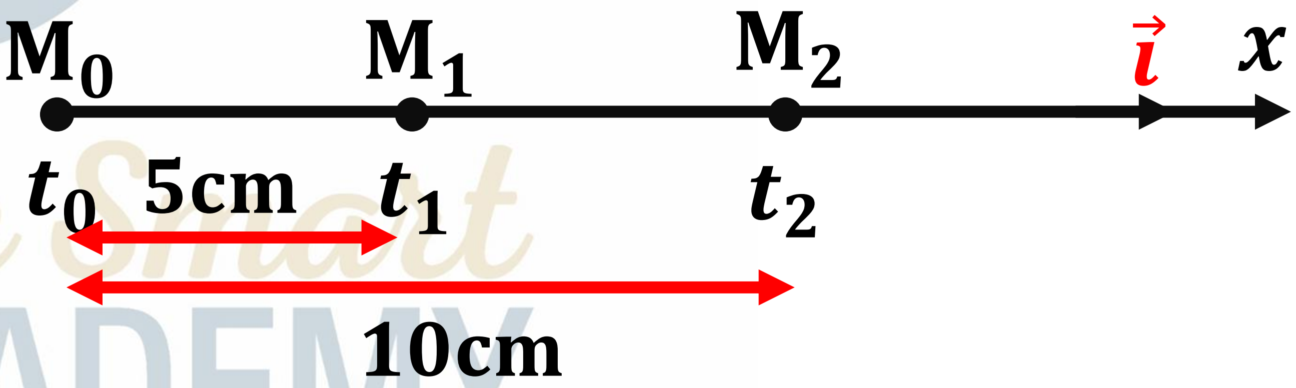
- **Direction:** The motion is from O to M_1: To right
- **Magnitude:** $|\vec{r}_1| = |\overrightarrow{OM_1}|$

Position vector

Application 1:

Consider a particle moving along the x-axis and starting from M_0 at $t_0 = 0$.

The particle passes through M_1 then M_2 as shown in the figure.



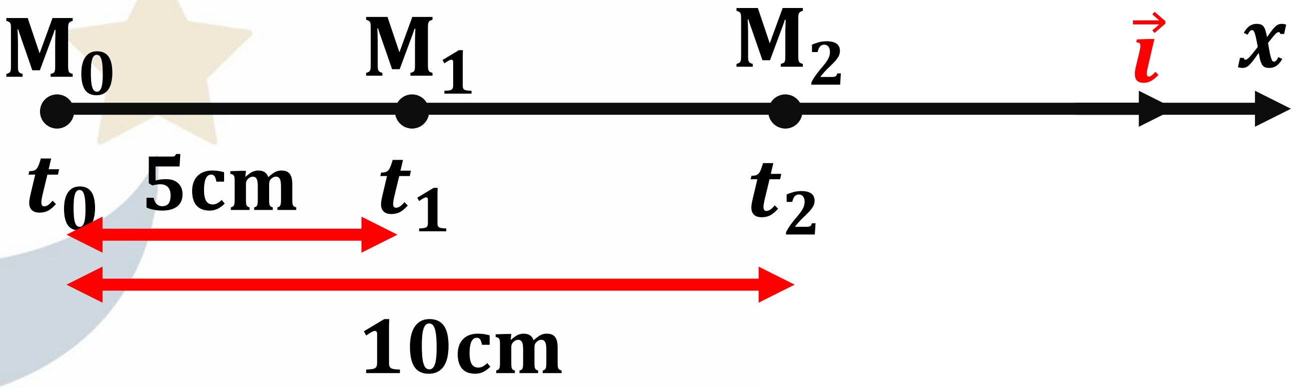
1. What is the nature of motion? Justify.

Since the particle moves on a straight line, the motion is rectilinear

Position vector

2.Determine the position vector $\overrightarrow{M_0 M_1}$.

$$\overrightarrow{M_0M_1} = \vec{r}_1 = x\vec{i} = 5\vec{i}$$



3. Determine the position vector $\overrightarrow{M_0M_2}$.

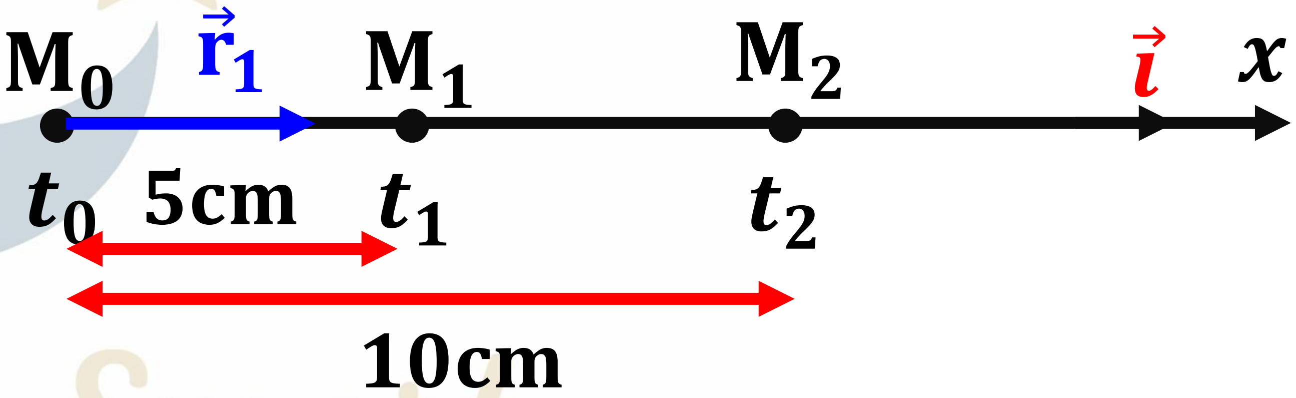
$$\overrightarrow{M_0M_2} = \vec{r}_2 = x\vec{i} = 10\vec{i}$$

Position vector

5. Determine the characteristics of the position vector $\overrightarrow{M_0M_1}$.

- **Origin:** M_0
- **Line of action:**

  The horizontal line holding M_0 and M_1

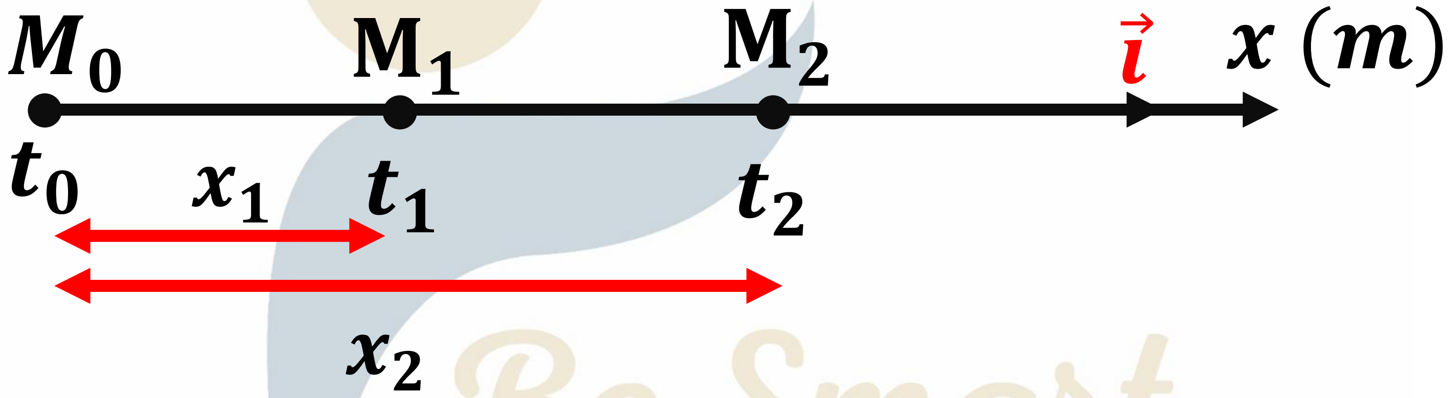


- **Direction:** To the right
- **Magnitude:** $|\vec{r}_1| = |\overrightarrow{M_0M_1}| = 5cm$

Distance and Displacement

The displacement:

The displacement is the change in position vector between two points.



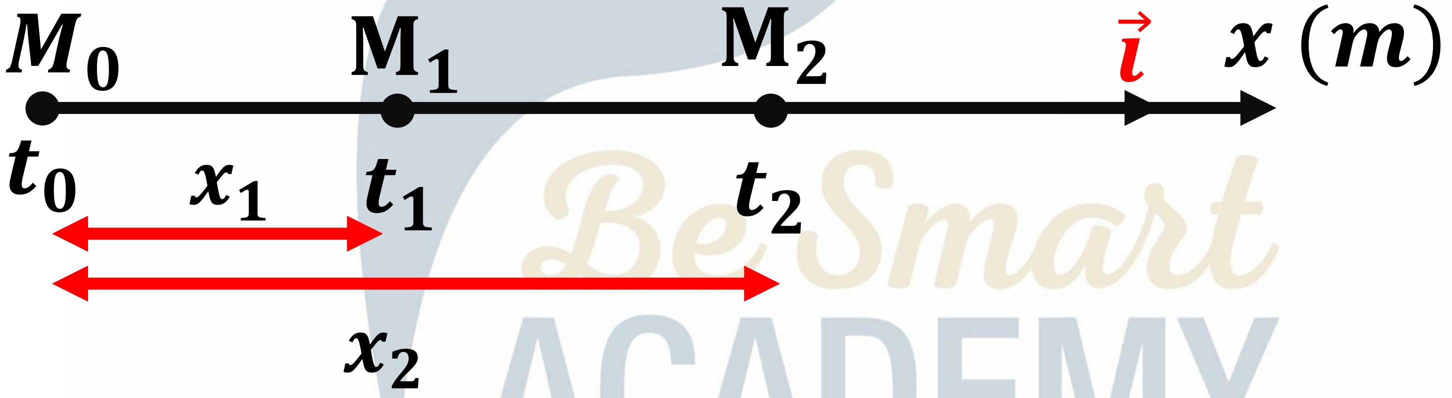
$$\overrightarrow{\Delta r} = \vec{r}_2 - \vec{r}_1 = \overrightarrow{M_0M_2} - \overrightarrow{M_0M_1} = (x_2 - x_1)\vec{i}$$

Distance and Displacement

Distance:

The actual distance covered by a moving particle in an interval of time.

The distance is a scalar quantity, and its SI unit is meter [m].

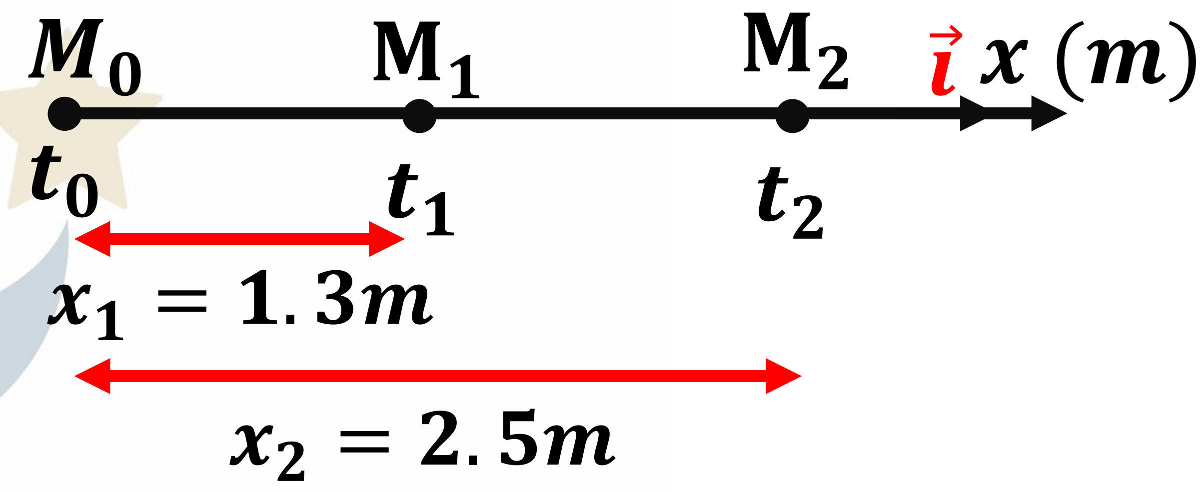


$$|\Delta x| = |\Delta \vec{r}| = \left|\overrightarrow{M_0M_2} - \overrightarrow{M_0M_1}\right| = |x_2 - x_1|$$

Distance and Displacement

Application 2:

1.Determine the displacement vector.



$$\overrightarrow{\Delta r} = \vec{r}_2 - \vec{r}_1 = \overrightarrow{M_0M_2} - \overrightarrow{M_0M_1}$$

$$\overrightarrow{\Delta r} = (x_2 - x_1)\vec{i}$$

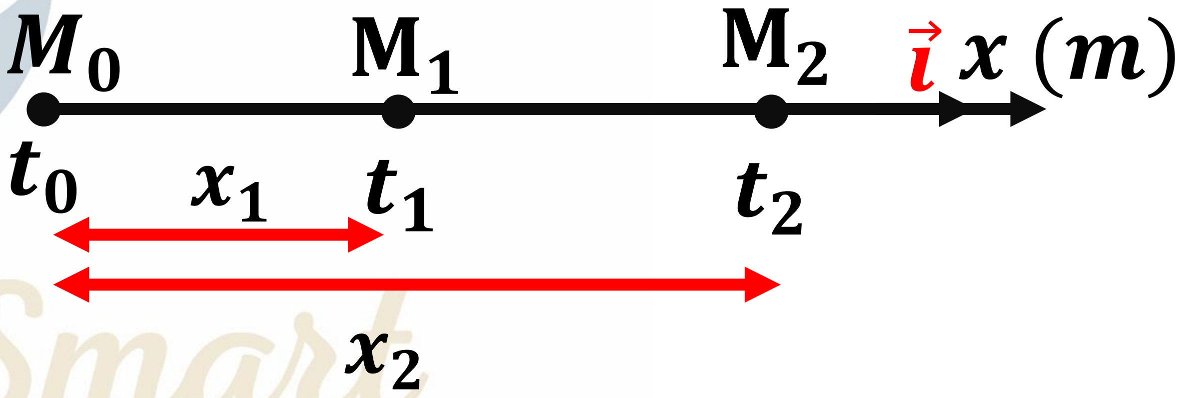
$$\overrightarrow{\Delta r} = (2.5 - 1.3)\vec{i}$$

$$\overrightarrow{\Delta r} = 1.2\vec{i}$$

Distance and Displacement

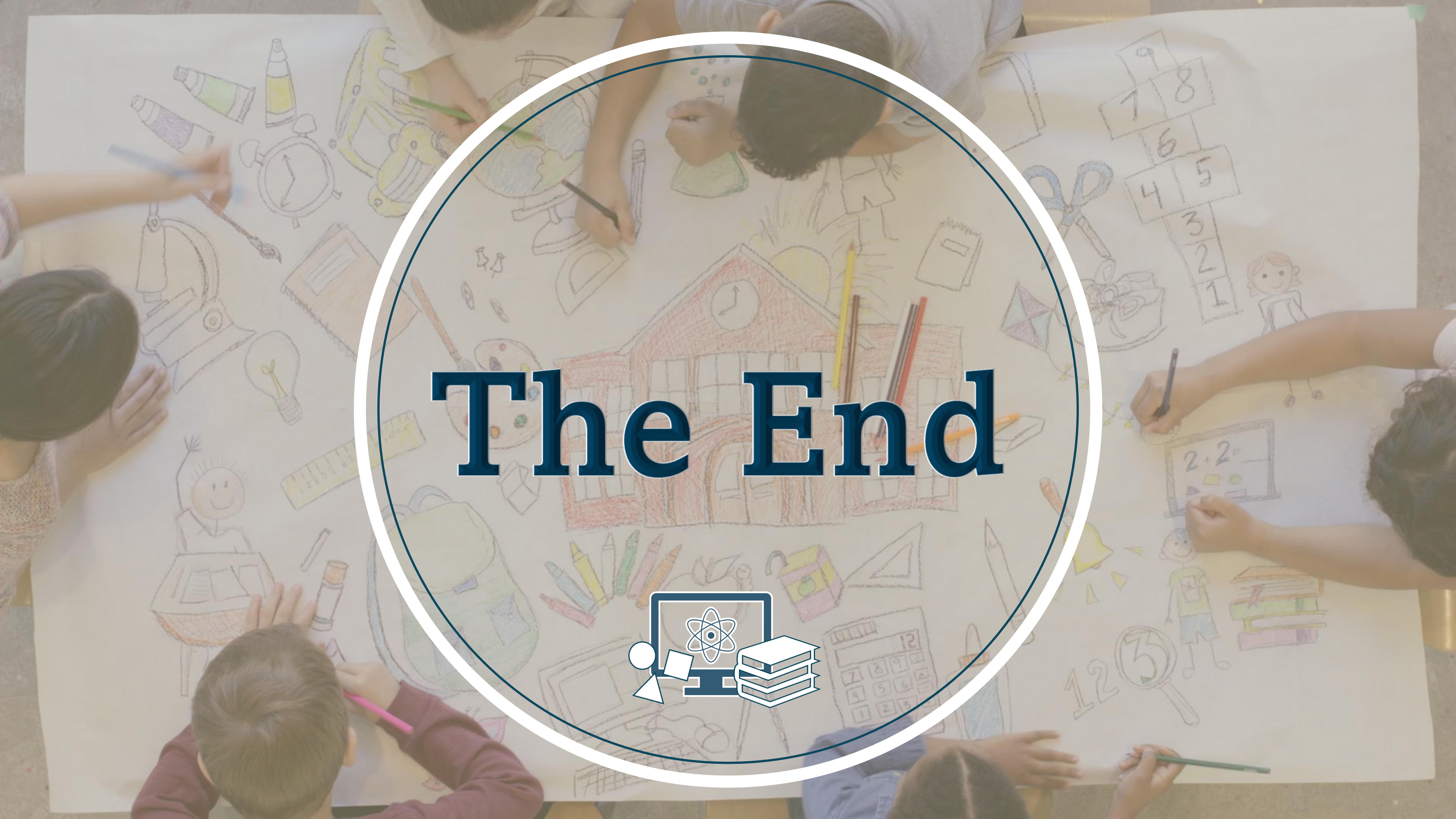
$\overrightarrow{\Delta r} = 1.2\vec{i}$

2.Determine the distance covered during the motion of the particle M between the two instants.



$$|\Delta x| = |\Delta\vec{r}| = \left|\overrightarrow{M_0M_2} - \overrightarrow{M_0M_1}\right| = |x_2 - x_1|$$

$$|\Delta x| = |\Delta\vec{r}| = 1.2m$$


The End

Physics – Grade 10

Unit Four
Mechanics

Chapter 14
Description of motion

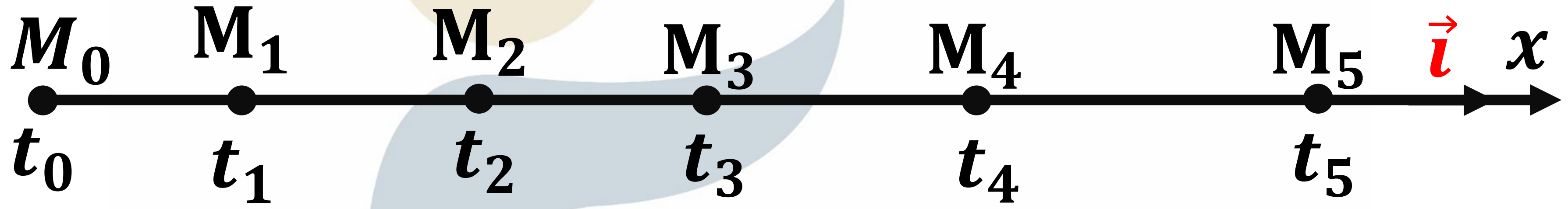
Prepared & Presented by: Mr. Mohamad Seif

OBJECTIVES

1. To calculate average & instantaneous speed
2. To determine the average & instantaneous velocity vector

Speed and velocity

To study the motion of a moving particle M, the positions of the particle designated by $M_0 \dots M_5$ are taken over regular time intervals τ.



We must distinguish between the following:

1. **The average speed.**
2. **Instantaneous speed.**
3. **The average velocity vector.**
4. **The instantaneous velocity vector**

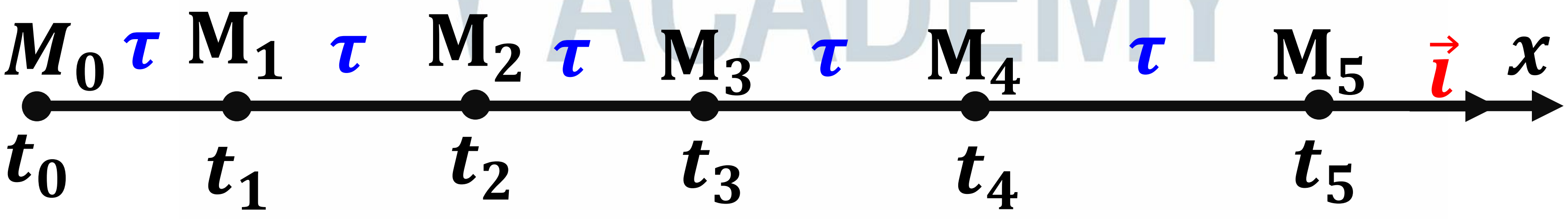
Speed and velocity

Average speed (V_{av}):

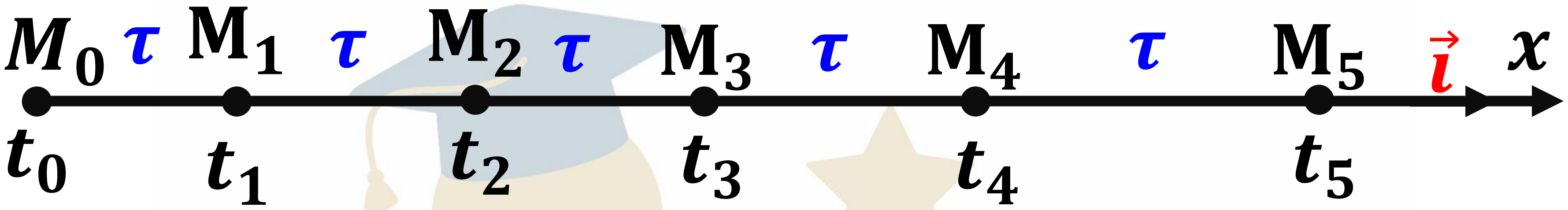
The average speed (m/s) **between two points** is the ratio of the total distance traveled to the total duration needed to travel this distance.

$$V_{av} = \frac{\text{distance traveled}}{\text{needed time}} = \frac{d}{\Delta t}$$

Consider a puck moving on an air table, with a time interval between two consecutive points is τ



Speed and velocity



The average speed between M_2 & M_4 is:

$$V_{2,4} = \frac{M_2M_4}{t_4 - t_2} = \frac{M_2M_4}{4\tau - 2\tau}$$

$$V_{2,4} = \frac{M_2M_4}{2\tau}$$

The average speed between M_1 & M_5 is:

$$V_{1,5} = \frac{M_1M_5}{t_5 - t_1} = \frac{M_1M_5}{5\tau - \tau}$$

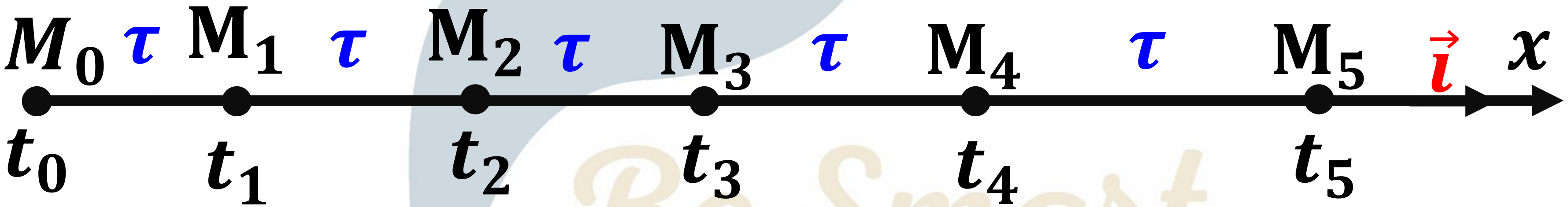
$$V_{1,5} = \frac{M_1M_5}{4\tau}$$

Speed and velocity

Instantaneous speed (V):

The average speed is not accurate to describe the motion.

The Instantaneous speed (V) at instant t is the speed of the moving body at specific time (t).



$$V_4 = \frac{M_3M_5}{t_5 - t_3} = \frac{M_3M_5}{2\tau}$$

$$V_2 = \frac{M_1M_3}{t_3 - t_1} = \frac{M_1M_3}{2\tau}$$

$$V_3 = \frac{M_2M_4}{t_4 - t_2} = \frac{M_2M_4}{2\tau}$$

Speed and velocity

Application 3:

A puck moves without initial speed on an air table. The time interval between two consecutive points is τ = 60ms.

1. Determine the average speed of the puck between $V_{1,2}$, $V_{2,5}$, and $V_{1,5}$.

2. Determine the instantaneous speeds V_3, & V_4 of the puck at the instants t_3, & at t_4.

M_0M_1	M_1M_2	M_2M_3	M_3M_4	M_4M_5
0.5cm	1.5cm	2.5cm	3.5cm	4.5cm

Speed and velocity

1.Determine the average speed of the puck between $V_{1,2}$, $V_{2,5}$, and $V_{1,5}$.

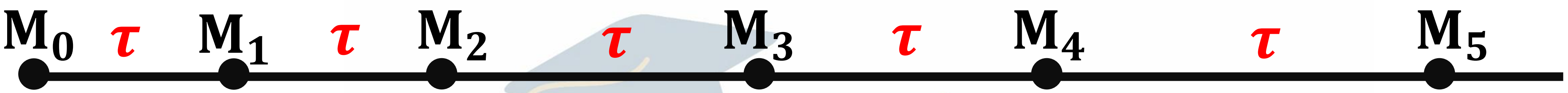
M_0M_1	M_1M_2	M_2M_3	M_3M_4	M_4M_5
0.5cm	1.5cm	2.5cm	3.5cm	4.5cm

$$V_{1,2} = \frac{M_1M_2}{t_2 - t_1} = \frac{M_1M_2}{\tau}$$

$$V_{1,2} = \frac{(1.5 \times 10^{-2})m}{(60 \times 10^{-3})s}$$

$$V_{1,2} = 0.25m/s$$

Speed and velocity



M_0M_1	M_1M_2	M_2M_3	M_3M_4	M_4M_5
0.5cm	1.5cm	2.5cm	3.5cm	4.5cm

$$V_{2,5} = \frac{M_2M_5}{t_5 - t_2} \Rightarrow V_{2,5} = \frac{M_2M_5}{3\tau}$$

$$V_{2,5} = \frac{(2.5 + 3.5 + 4.5) \times 10^{-2}}{(3 \times 60 \times 10^{-3})s} \Rightarrow V_{2,5} = \frac{10.5 \times 10^{-2}}{(180 \times 10^{-3})}$$

$$V_{2,5} = 0.583 m/s$$

Speed and velocity

M_0M_1	M_1M_2	M_2M_3	M_3M_4	M_4M_5
0.5cm	1.5cm	2.5cm	3.5cm	4.5cm

$$V_{1,5} = \frac{M_1M_5}{t_5 - t_1}$$

$$V_{1,5} = \frac{M_1M_5}{4\tau}$$

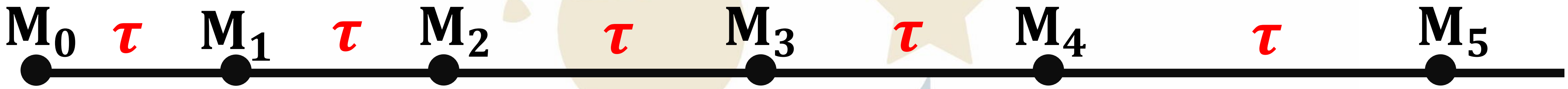
$$V_{1,5} = \frac{(1.5 + 2.5 + 3.5 + 4.5) \times 10^{-2} m}{4 \times 60 \times 10^{-3} s}$$

$$V_{1,5} = \frac{12 \times 10^{-2} m}{240 \times 10^{-3} s}$$

$$V_{1,5} = 0.5 m/s$$

Speed and velocity

2.Determine the instantaneous speeds V_3 & V_4 of the puck at the instants t_2, & at t_3.

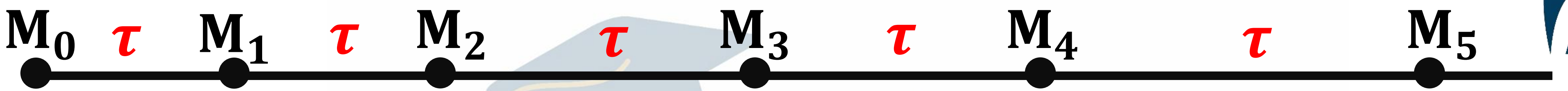


M_0M_1	M_1M_2	M_2M_3	M_3M_4	M_4M_5
0.5cm	1.5cm	2.5cm	3.5cm	4.5cm

$$V_3 = \frac{M_2M_4}{t_4 - t_2} \Rightarrow V_3 = \frac{M_2M_4}{2\tau}$$

$$V_3 = \frac{(1.5 + 2.5) \times 10^{-2} m}{(2 \times 60 \times 10^{-3}) s} \Rightarrow V_3 = 0.333 m/s$$

Speed and velocity



M_0M_1	M_1M_2	M_2M_3	M_3M_4	M_4M_5
0.5cm	1.5cm	2.5cm	3.5cm	4.5cm

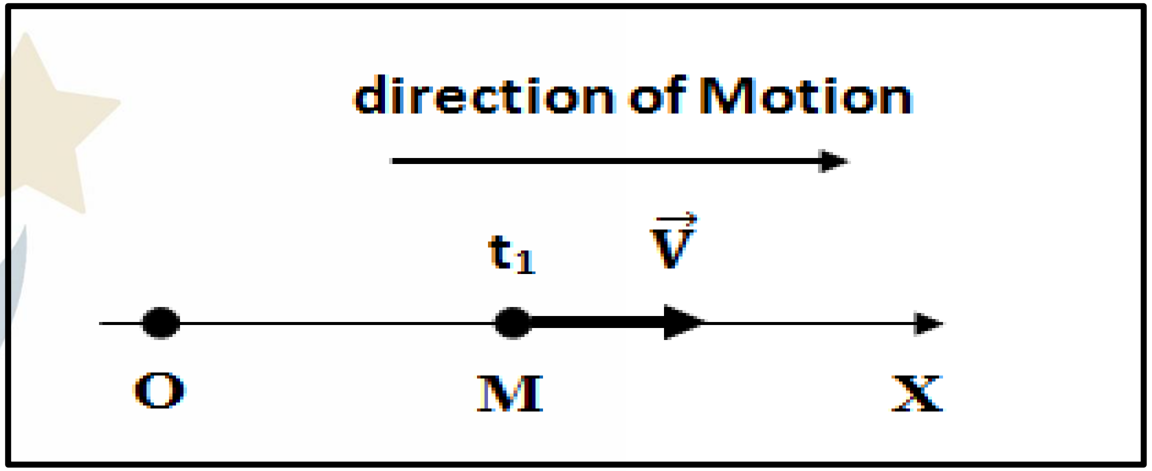
$$V_4 = \frac{M_3M_5}{t_5 - t_3} \Rightarrow V_4 = \frac{M_3M_5}{2\tau}$$

$$V_4 = \frac{(2.5 + 3.5) \times 10^{-2} m}{(2 \times 60 \times 10^{-3}) s} \Rightarrow V_4 = 0.5 m/s$$

Speed and velocity

The velocity vector ($\vec{V}$):

The velocity vector is the rate of change of position with respect to time.



Velocity (m/s) represents how fast an object moves with direction.

The velocity is a vector whose magnitude is called speed, and its sign depends on the direction of motion $\vec{V} = V.\vec{i}$.

Speed and velocity

The average velocity vector ($\vec{V}_{av}$):

The average velocity measures the variation of the position vector of a moving particle during an in interval of time

The average velocity is represented by the vector:

$$\vec{V}_{av} = \frac{\Delta\vec{r}}{\Delta t} = \frac{(x_2 - x_1).\vec{i}}{t_2 - t_1}$$

Speed and velocity

The instantaneous velocity vector ($\vec{V}_{av}$):

The instantaneous velocity measures the variation of the position vector of a moving particle w. r. t time at a given instant.

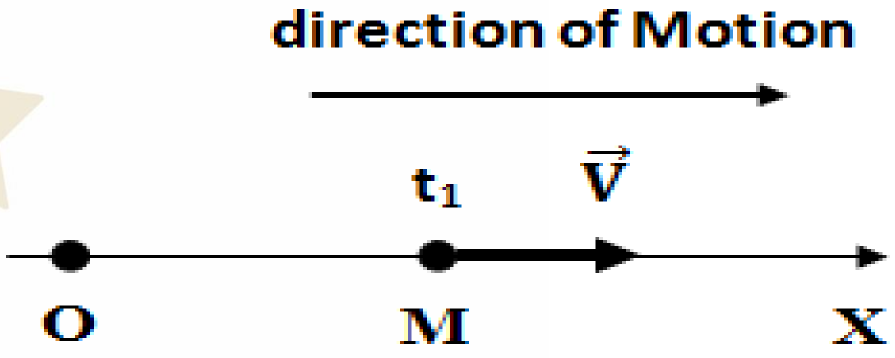
The instantaneous velocity is represented by the vector:

$$\vec{V} = V.\vec{i}$$

Where V is the instantaneous speed.

Speed and velocity

Characteristics of velocity vector:



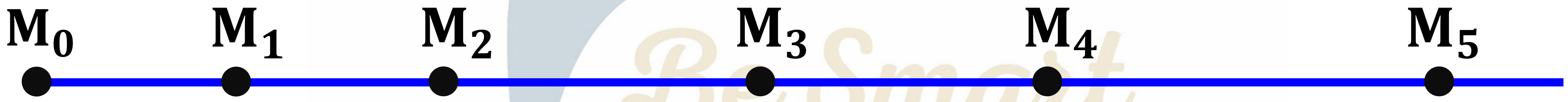
Origin	point M
Line of action	horizontal and rectilinear.
Direction:	To the right
Magnitude:	Is the speed at point M, to be calculated

Speed and velocity

Application 4: A puck moves without initial speed on an air table as shown.

The time interval between two consecutive points is $\tau = 60ms$.

1. Calculate the instantaneous speed at M_3.
2. Determine the characteristics of the velocity vector at t_3.

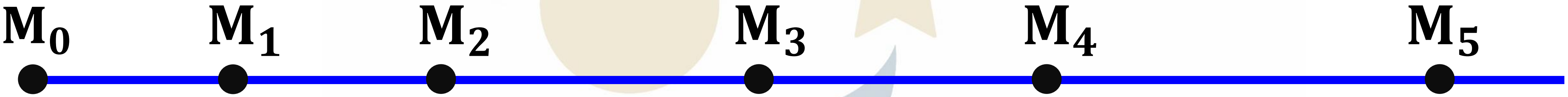


M_0M_1	M_1M_2	M_2M_3	M_3M_4	M_4M_5
0.5cm	1.5cm	2.5cm	3.5cm	4.5cm

Speed and velocity

$\tau = 60ms = (60 \div 1000) = 0.06\ s$

1. Calculate the instantaneous speed at M_3.



M_0M_1	M_1M_2	M_2M_3	M_3M_4	M_4M_5
0.5cm	1.5cm	2.5cm	3.5cm	4.5cm

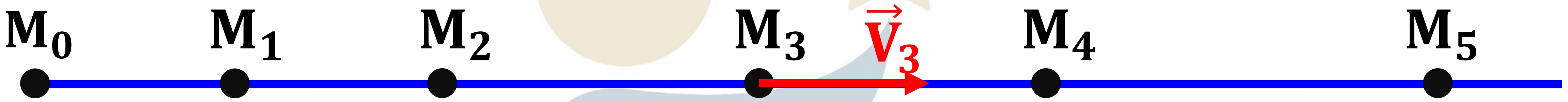
$$V_3 = \frac{M_2M_4}{t_4 - t_2} \Rightarrow V_3 = \frac{M_2M_4}{2\tau} \Rightarrow V_3 = \frac{(4 \times 10^{-2})m}{(2 \times 0.06)}$$

$$V_3 = 0.333 m/s$$

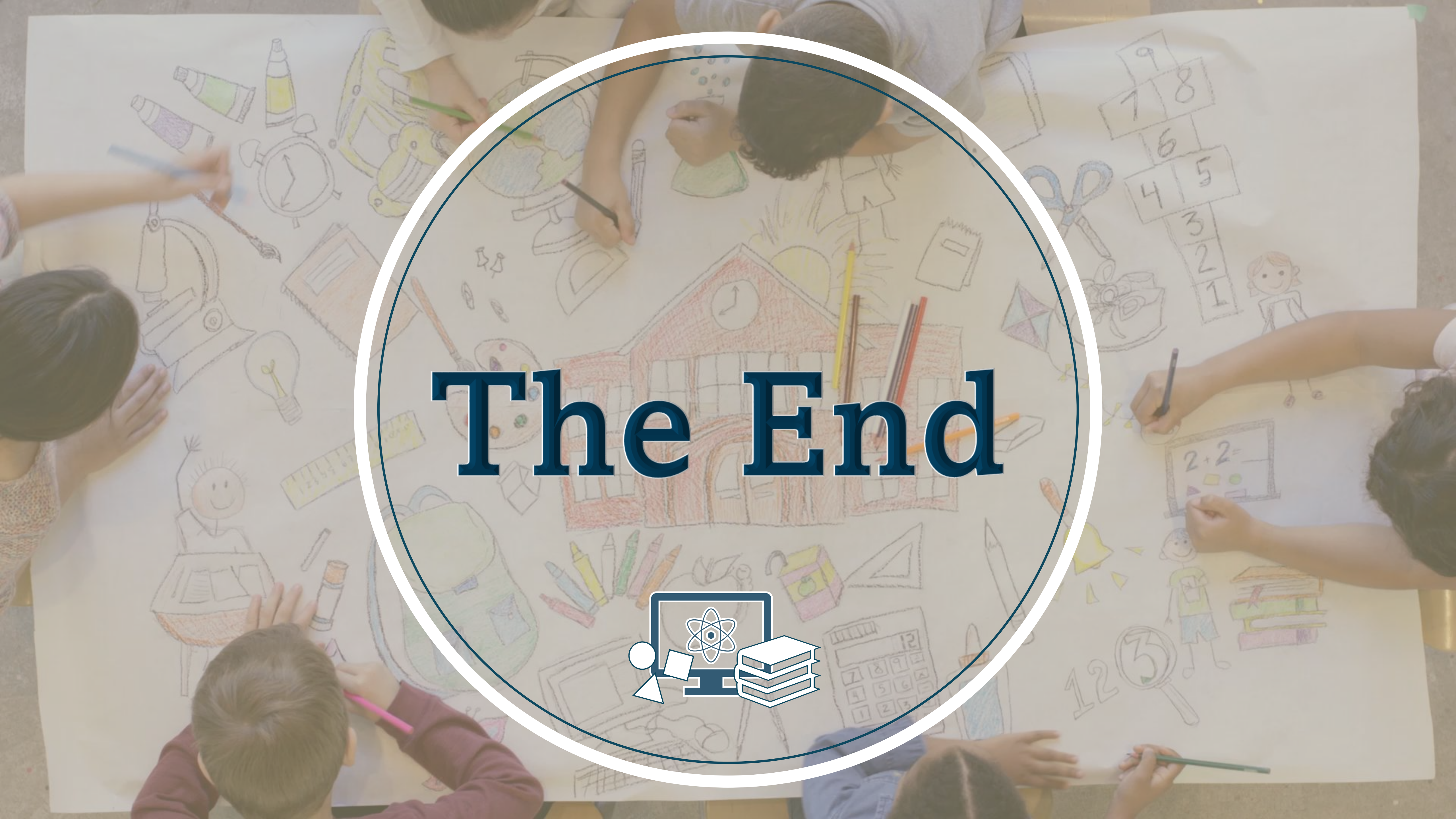
Speed and velocity

$\tau = 0.06\ s$; $V_3 = 0.375 m/s$

2. Determine the characteristics of the velocity vector at t_3.



Origin	point M_3
Line of action	horizontal and rectilinear.
Direction:	To right
Magnitude:	$V_3 = 0.333 m/s$



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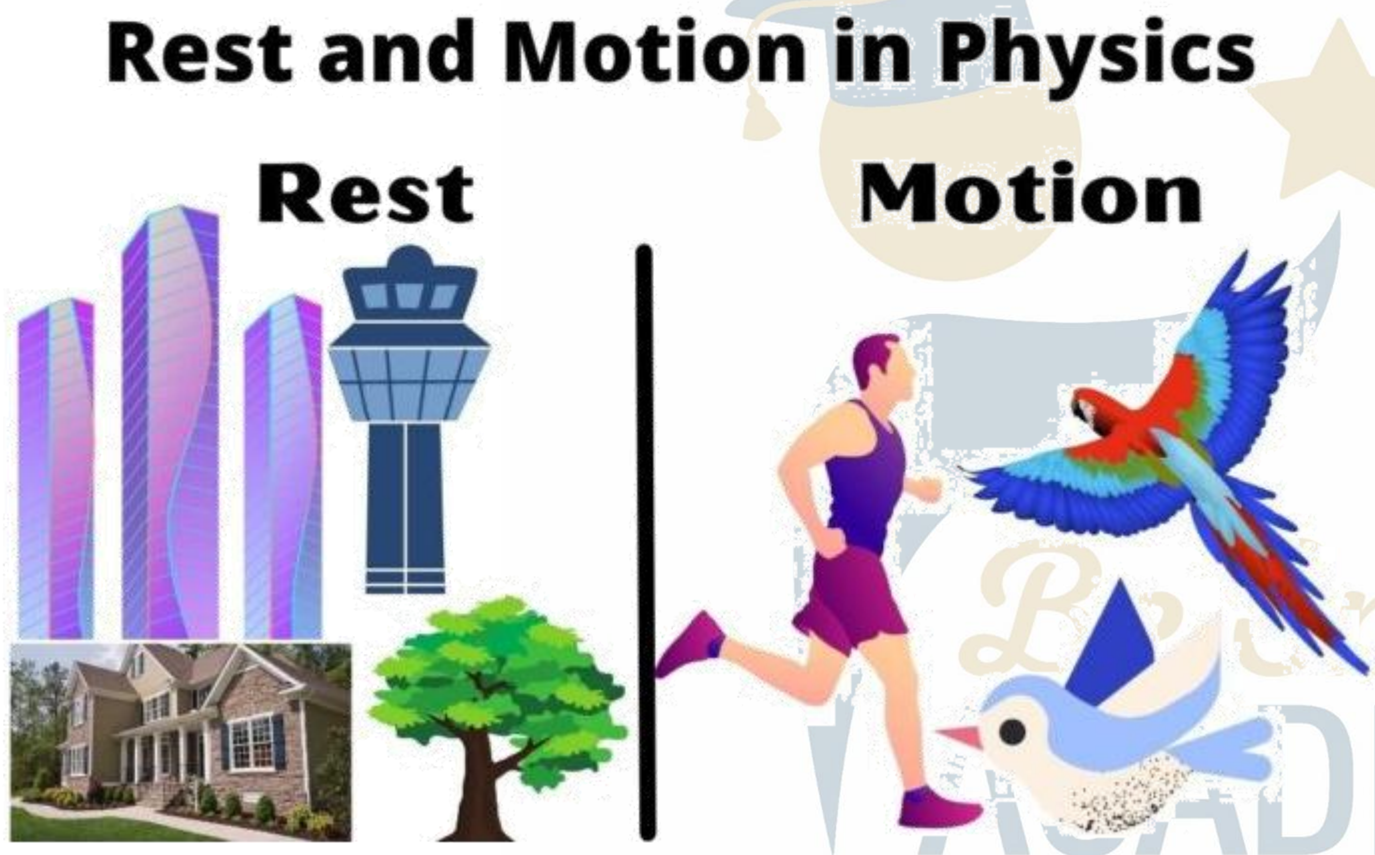
Physics – Grade 10



Unit Four
Mechanics

Chapter 14
Description of motion

Prepared & Presented by: Mr. Mohamad Seif

OBJECTIVES

1. To calculate average & instantaneous acceleration
2. To determine the characteristics of acceleration vector.

Acceleration and acceleration vector

Acceleration (a):

Acceleration is a quantity used to describe the variations of the speed of a moving particle with respect to time.

$$a = \frac{change\ of\ velocity}{change\ of\ time} = \frac{\Delta V}{\Delta t}$$

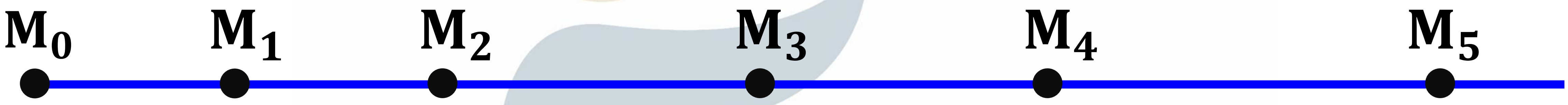
The acceleration expressed in is m/s^2

1.Average acceleration.
2.Instantaneous acceleration.
3.Acceleration vector (average and Instantaneous) .

Acceleration and acceleration vector

Average acceleration:

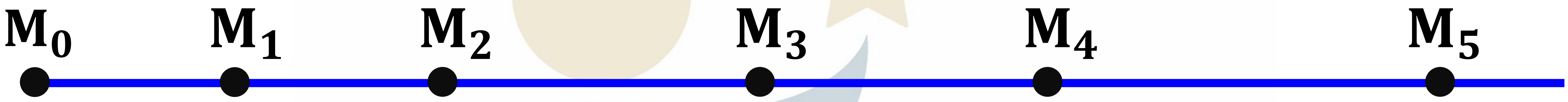
Average acceleration is the variation of the speed of a moving particle between two instants with respect to time.



$$a_{av} = \frac{\Delta V}{\Delta t} = \frac{V_f - V_i}{t_f - t_i}$$

Acceleration and acceleration vector

$$\mathbf{a}_{\mathbf{av}} = \frac{\Delta V}{\Delta t} = \frac{V_f - V_i}{t_f - t_i}$$



The average acceleration between M_1 & M_4 is:

$$a_{1,4} = \frac{V_4 - V_1}{t_4 - t_1}$$

The average acceleration between M_2 & M_5 is:

$$a_{2,5} = \frac{V_5 - V_2}{t_5 - t_2}$$

Acceleration and acceleration vector

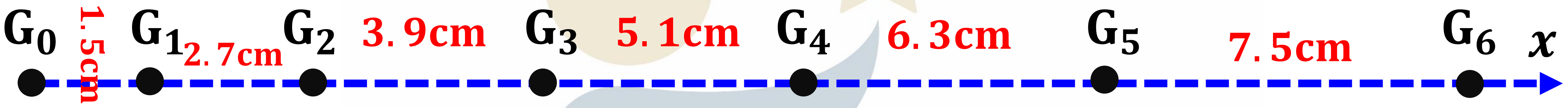
Average acceleration vector ($\vec{V}_{av}$):

Average acceleration vector is a vector represent the variation of the speed of a moving particle between two instants with respect to time.

$$\vec{a}_{av} = \frac{\Delta\vec{V}}{\Delta t} = \frac{\vec{V}_f - \vec{V}_i}{t_f - t_i}$$

Acceleration and acceleration vector

Application 5: The figure below shows the positions of a puck during an intervals of time $\tau = 60ms$.

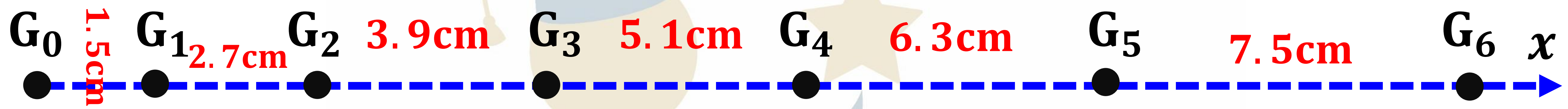


At $t_0 = 0s$, the puck starts from G_0 and is initially at rest.

1. Calculate the instantaneous speeds V_1; V_3 and V_5.
2. Calculate the average acceleration between G_1 & G_3 and between G_3 & G_5.
3. Deduce the average acceleration vector between G_1 & G_3.

Acceleration and acceleration vector

$\tau = 60ms = (60 \div 1000) = 0.06\ s$; $V_0 = 0$



1.Calculate the instantaneous speeds V_1; V_3 and V_5.

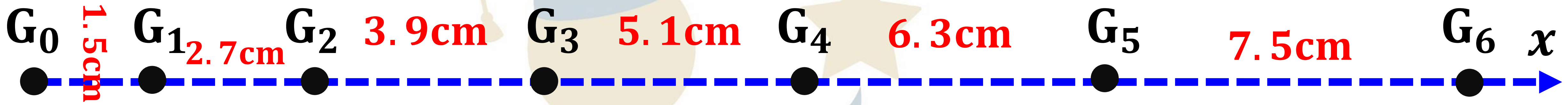
$$V_1 = \frac{G_0G_2}{t_2 - t_0} \Rightarrow V_1 = \frac{G_0G_1 + G_1G_2}{2\tau - 0}$$

$$V_1 = \frac{(1.5 + 2.7) \times 10^{-2}}{2\tau} \Rightarrow V_1 = \frac{4.2 \times 10^{-2}}{2 \times 0.06}$$

$$V_1 = 0.35m/s$$

Acceleration and acceleration vector

$\tau = 60ms = (60 \div 1000) = 0.06\ s$; $V_0 = 0$



1.Calculate the instantaneous speeds V_1; V_3 and V_5.

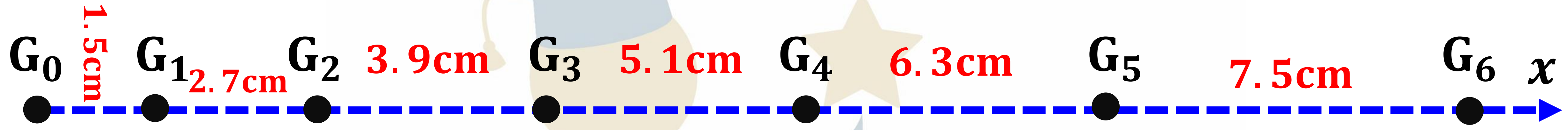
$$V_3 = \frac{G_2G_4}{t_4 - t_2} \Rightarrow V_3 = \frac{G_2G_3 + G_3G_4}{4\tau - 2\tau}$$

$$V_3 = \frac{(3.9 + 5.1) \times 10^{-2}}{2\tau} \Rightarrow V_3 = \frac{9 \times 10^{-2}}{2 \times 0.06}$$

$$V_3 = 0.75m/s$$

Acceleration and acceleration vector

$\tau = 60ms = (60 \div 1000) = 0.06\ s$; $V_0 = 0$



1.Calculate the instantaneous speeds V_1; V_3 and V_5.

$$V_5 = \frac{G_4G_6}{t_6 - t_4} \Rightarrow V_5 = \frac{G_4G_5 + G_5G_6}{6\tau - 4\tau}$$

$$V_5 = \frac{(6.3 + 7.5) \times 10^{-2}}{2\tau} \Rightarrow V_5 = \frac{13.8 \times 10^{-2}}{2 \times 0.06}$$

$$V_5 = 1.15m/s$$

Acceleration and acceleration vector

$\tau = 0.06\ s$; $V_0 = 0$; $V_1 = 0.35 m/s$; $V_3 = 0.75 m/s$; $V_5 = 1.15 m/s$

2. Calculate the average acceleration between G_1 & G_3 and between G_3 & G_5

$$a_{1,3} = \frac{V_3 - V_1}{t_3 - t_1} \Rightarrow a_{1,3} = \frac{0.75 - 0.35}{2\tau} \Rightarrow a_{1,3} = \frac{0.4}{2 \times 0.06}$$

$$a_{1,3} = 3.33 m/s^2$$

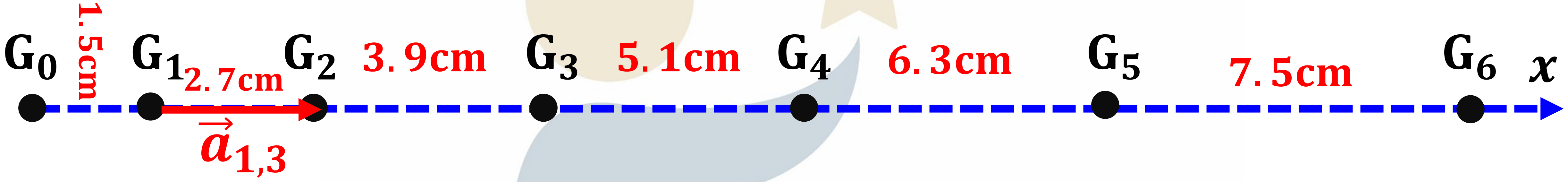
$$a_{3,5} = \frac{V_5 - V_3}{t_5 - t_3} \Rightarrow a_{3,5} = \frac{1.15 - 0.75}{2\tau} \Rightarrow a_{3,5} = \frac{0.4}{2 \times 0.06}$$

$$a_{3,5} = 3.33 m/s^2$$

Acceleration and acceleration vector

$\tau = 0.06\ s$; $V_0 = 0$; $V_1 = 0.35 m/s$; $V_3 = 0.75 m/s$; $V_5 = 1.15 m/s$

3. Represent the average acceleration vector between G_1 & G_3.



$\vec{a}_{1,3} = a_{1,3}.\vec{i}$ ⇒ $\vec{a}_{1,3} = 3.33.\vec{i}\ (m/s^2)$

$$1cm \rightarrow 1.65 m/s^2$$

$$x = ??\ \rightarrow 3.33 m/s^2$$

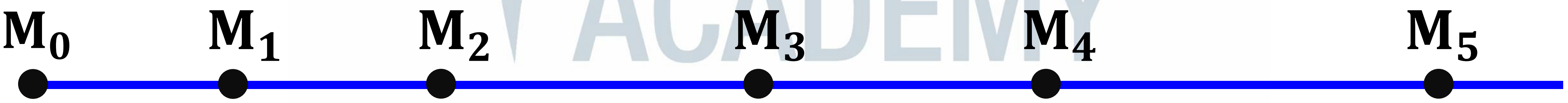
$$x = \frac{1cm \times 3.33}{1.65} \approx 2cm$$

Acceleration and acceleration vector

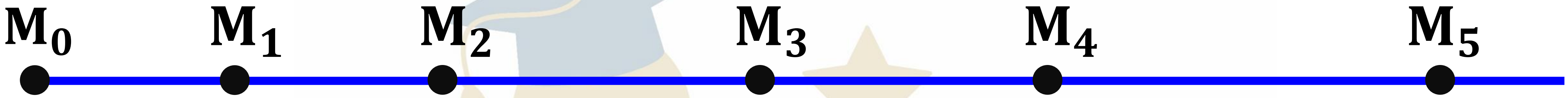
Instantaneous acceleration:

The average acceleration does not give an accurate value to describe the motion of a mobile.

Instantaneous acceleration is the exact description of the variation of the speed at a <u>given instant</u>.



Acceleration and acceleration vector



The instantaneous acceleration at M_2:

$$a_2 = \frac{V_3 - V_1}{t_3 - t_1}$$

The instantaneous acceleration at M_4

$$a_4 = \frac{V_5 - V_3}{t_5 - t_3}$$

Acceleration and acceleration vector

Instantaneous acceleration vector:

The instantaneous acceleration vector describes the variation of the speed at a given instant in a given direction.

$$\vec{V}_2 = V_2 . \vec{i}$$

Acceleration and acceleration vector

Application 6: The figure below shows the positions of a puck during an intervals of time $\tau = 40ms$. At $t_0 = 0s$.

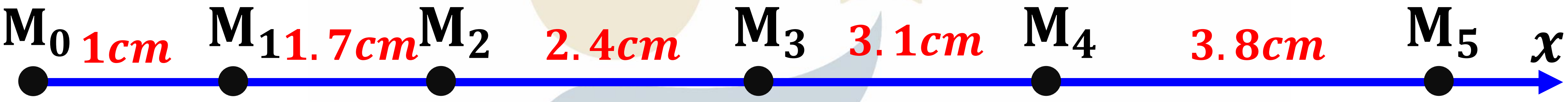
At $t_0 = 0s$, the puck starts from from M_0 with $V_0 = 0.1625 \text{m/s}$.

1. Calculate the instantaneous speeds V_2; V_3 and V_4.
2. Calculate the instantaneous acceleration at M_1 and at M_3.
3. Determine the characteristics of instantaneous acceleration vector at M_3.

Acceleration and acceleration vector

$\tau = 40ms = (40 \div 1000) = 0.04\ s$; $V_0 = 0.1625 m/s$

1.Calculate the instantaneous speeds V_2; V_3 and V_4.



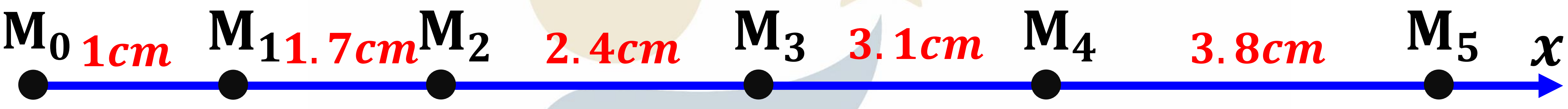
$$V_2 = \frac{M_1M_3}{t_3 - t_1} \Rightarrow V_2 = \frac{M_1M_2 + M_2M_3}{3\tau - \tau} \Rightarrow V_2 = \frac{(1.7 + 2.4) \times 10^{-2}}{2\tau}$$

$$V_2 = \frac{4.1 \times 10^{-2}}{2 \times 0.04} \Rightarrow V_2 = 0.5125 m/s$$

Acceleration and acceleration vector

$\tau = 40ms = (40 \div 1000) = 0.04\ s;\ V_0 = 0.1625 m/s$

1.Calculate the instantaneous speeds V_2; V_3 and V_4.



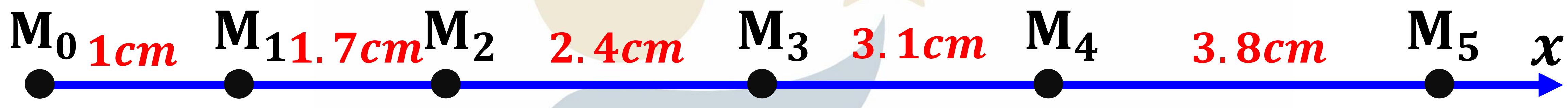
$$V_3 = \frac{M_2M_4}{t_4 - t_2} \Rightarrow V_3 = \frac{M_2M_3 + M_3M_4}{4\tau - 2\tau} \Rightarrow V_3 = \frac{(2.4 + 3.1) \times 10^{-2}}{2\tau}$$

$$V_3 = \frac{5.5 \times 10^{-2}}{2 \times 0.04} \Rightarrow V_3 = 0.6875 m/s$$

Acceleration and acceleration vector

$\tau = 40ms = (40 \div 1000) = 0.04\ s$; $V_0 = 0.1625 m/s$.

1.Calculate the instantaneous speeds V_2; V_3 and V_4.



$$V_4 = \frac{M_3M_5}{t_5 - t_3} \Rightarrow V_4 = \frac{M_3M_4 + M_4M_5}{5\tau - 3\tau} \Rightarrow V_4 = \frac{(3.1 + 3.8) \times 10^{-2}}{2\tau}$$

$$V_4 = \frac{6.9 \times 10^{-2}}{2 \times 0.04}$$

$$V_4 = 0.8625 m/s$$

Acceleration and acceleration vector

$\tau = 0.04\, s$; $V_0 = 0.1625 m/s$; $V_2 = 0.5125 m/s$; $V_3 = 0.6875 m/s$; $V_4 = 0.8625\, m/s$

2. Calculate the instantaneous acceleration at M_1 and at M_3.

$$a_1 = \frac{V_2 - V_0}{t_2 - t_0} \Rightarrow a_1 = \frac{0.5125 - 0.1625}{2\tau - 0}$$

$$a_1 = \frac{0.35}{2 \times 0.04} \Rightarrow a_1 = 4.375 m/s^2$$

Acceleration and acceleration vector

$\tau = 0.04\,s$; $V_0 = 0$; $V_2 = 0.5125 m/s$; $V_3 = 0.6875 m/s$; $V_4 = 0.8625\, m/s$

2. Calculate the instantaneous acceleration at M_1 and at M_3.

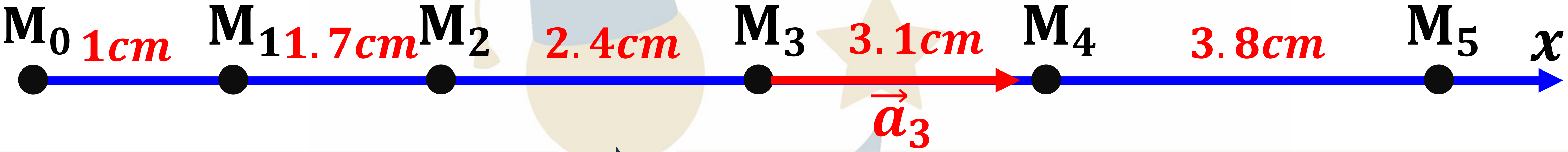
$$a_3 = \frac{V_4 - V_2}{t_4 - t_2} \Rightarrow a_3 = \frac{0.8625 - 0.5125}{4\tau - 2\tau}$$

$$a_3 = \frac{0.35}{2 \times \tau} \Rightarrow a_3 = \frac{0.35}{2 \times 0.04}$$

$$a_1 = 4.375 m/s^2$$

Acceleration and acceleration vector

3. Determine the characteristics of instantaneous acceleration vector at M_3.



$$\vec{a}_3 = a_3.\vec{i} \Rightarrow \vec{a}_3 = 4.375.\vec{i}\,(m/s^2)$$

Origin: M_3

Line of action: Horizontal

direction: Right

magnitude: $a_3 = 4.375m / s^2$

$$1cm \rightarrow 1.45m/s^2$$

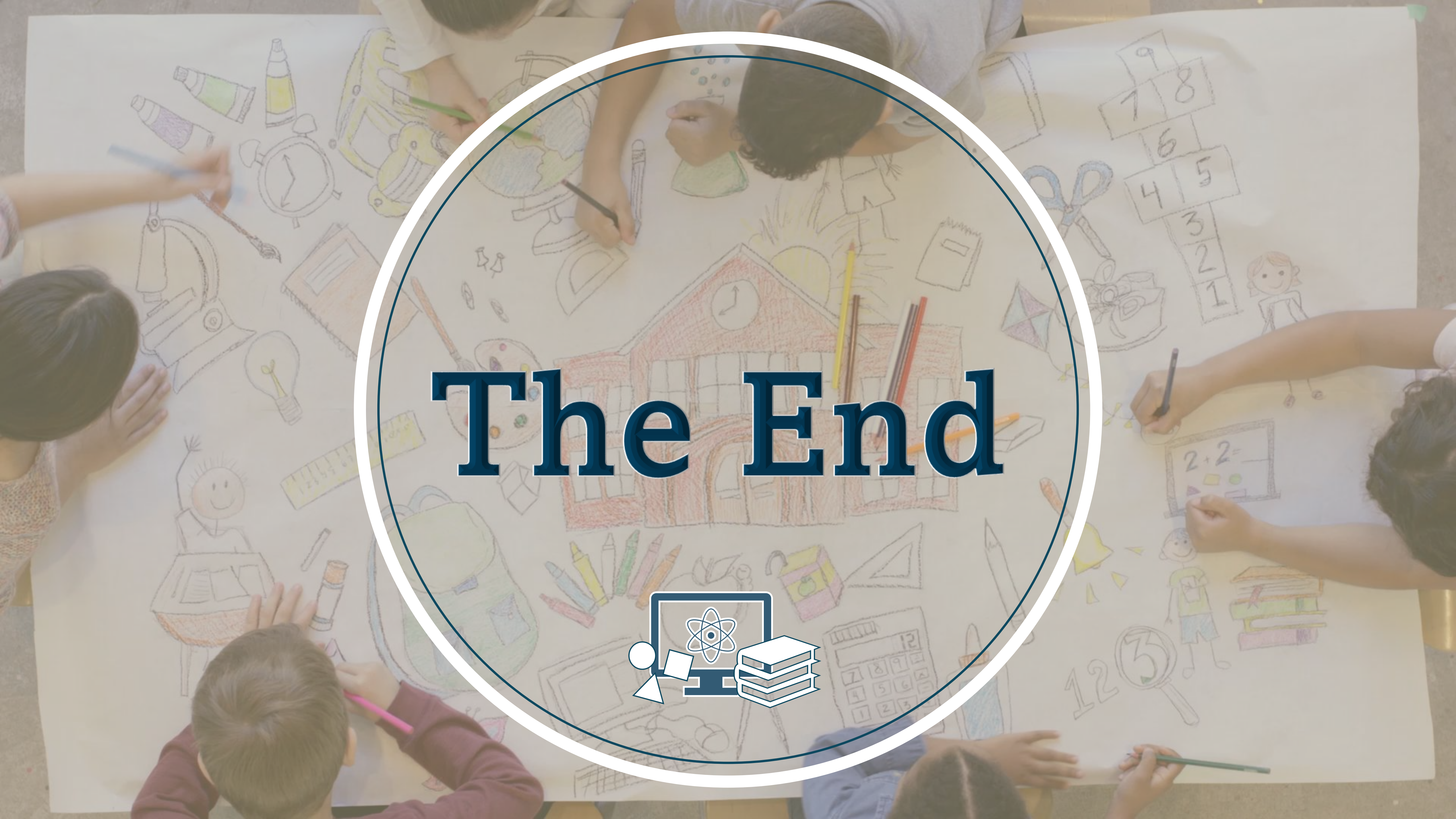
$$x = ?? \rightarrow 4.375m/s^2$$

$$x = \frac{1cm \times 4.375}{1.45} \approx 3cm$$

Acceleration and acceleration vector

Important notes

If the value of a is positive ($a>0$)	If the value of a is negative ($a<0$):
The motion called accelerated. V and a have same sense).	The motion called decelerated. V and a have opposite sense).


The End