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King Saud University
College of Science
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PHYS 103 (GENERAL PHYSICS)

LECTURE NO. 2

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2.0 Motion in One Dimension

- From everyday experience we recognize that motion represents a continuous change in the position of an object.
- In physics we can categorize motion into three types: ***translational***, ***rotational***, and ***vibrational***.
- A car moving down a highway is an example of ***translational*** motion, the Earth's spin on its axis is an example of ***rotational*** motion, and the back-and-forth movement of a pendulum is an example of ***vibrational*** motion.
- In this and the next few chapters, we are concerned only with ***translational*** motion. (Later in the course we shall discuss rotational and vibrational motions.)

2.1 Position, Velocity, and Speed

- When a particle moves from its (initial) position x_i to its (final) position x_f ; it has what we call: a displacement.
- Displacement is defined as follows:

$$\Delta x = x_f - x_i \qquad (2.1)$$

- There are 3 cases:

$$\Delta x > 0 \ or \ x_f > x_i \ \text{:motion to the right} \rightarrow$$

$$\Delta x < 0 \ or \ x_f < x_i \ \text{:motion to the left} \leftarrow$$

$$\Delta x = 0 \ or \ x_f = x_i \ \text{: object returned to its initial position, or there was no motion.}$$

- *Selecting (right) as +tive and (left) as –tive is a convention in this course and we shall stick to it all over the course.*

2.1 : The average velocity

- *It is defined as particle's displacement Δx divided by the time interval Δt during which that displacement occurs:*

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t} \qquad (2.2)$$

- There are 3 cases:

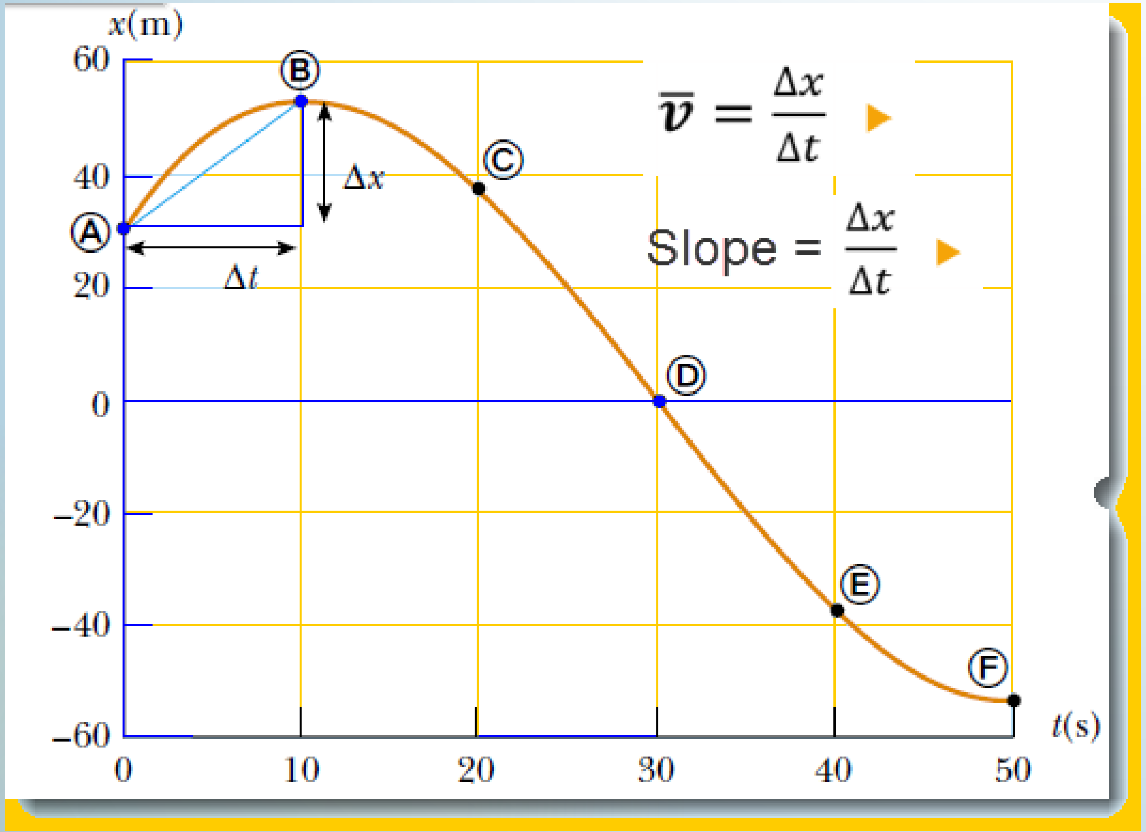
$\Delta x > 0 \rightarrow \bar{v} > 0$:motion to the right $\rightarrow$

$\Delta x < 0 \rightarrow \bar{v} < 0$:motion to the left $\leftarrow$

$\Delta x = 0 \rightarrow \bar{v} = 0$: object returned to its initial position, or there was no motion.

In the next slide; we show how to calculate $\bar{v}$ from charts. Take 2 points and draw a line between them and find the slope of that line. The first point (e.g. A) represents x_i (initial position) while the second point (e.g B) represents the final position or x_f.

2.1 : The average velocity



This grapgh is called: Position–time graph for the motion of the "particle."

- When the line is point above horizontal: $\rightarrow \bar{v} > 0$
- When the line is point below horizontal: $\rightarrow \bar{v} < 0$

In the graph:

A to B: + (Increasing x)
A to C: + (Increasing x)
A to D: - (Decreasing x)
C to D: - (Decreasing x)

2.1 : The average Speed

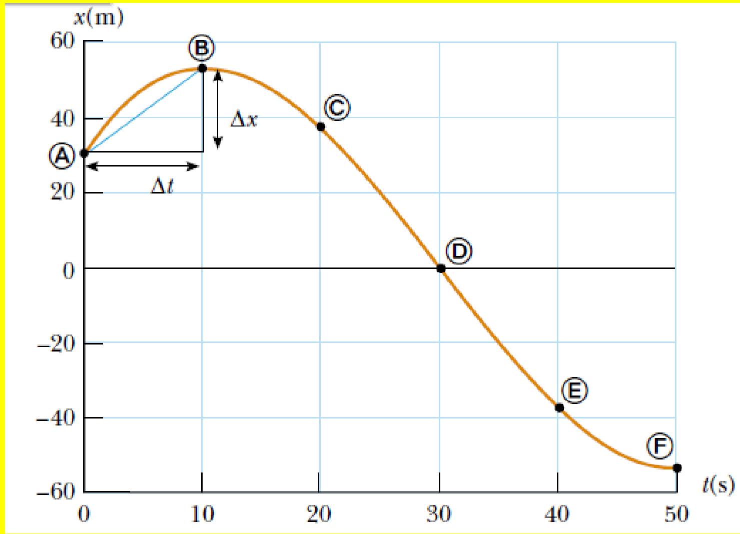
- In everyday usage, the terms speed and velocity are interchangeable. In physics, however, there is a clear distinction between these two quantities.:
- *The average speed of a particle, is defined as the total distance traveled divided by the total time interval required to travel that distance:*

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}} \qquad (2.3)$$

- The SI unit of average speed is the same as the unit of average velocity: m/s. However, unlike average velocity, average speed has *no direction* and hence carries *no algebraic sign*. Average velocity (Eq. 2.2) is the *displacement* divided by the time interval, while average speed (Eq. 2.3) is the *distance* divided by the time interval.

Example 2.1

- Find the displacement, average velocity, and average speed of the car in Figure 2.1 between positions A and F.
- Solution:



In this example:

$$x_i = x_A = 30\,m \;\; and \;\; x_f = x_F = -53m$$

$$\rightarrow \Delta x = x_f - x_i = -53 - 30 = -83m$$

$$t_i = 0\,s \;\; and \;\; t_f = 50\,s$$

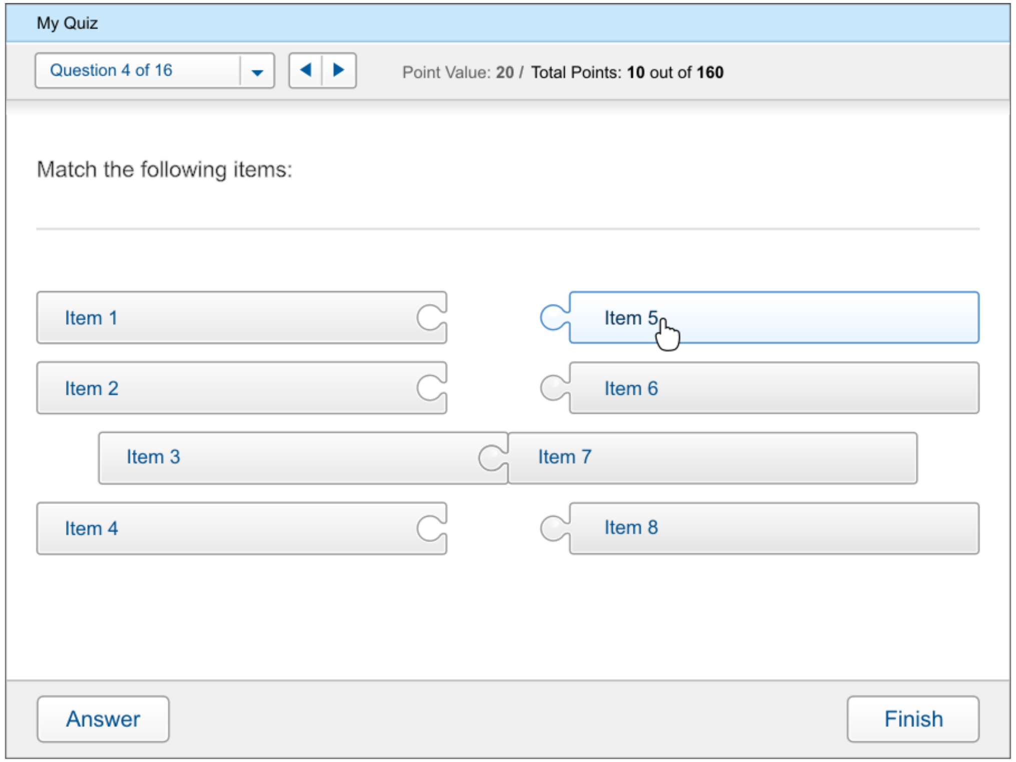
$$\therefore \Delta t = 50 - 0 = 50\,s$$

$$\therefore \bar{v} = \frac{\Delta x}{\Delta t} = \frac{-83}{50} = -1.7\,m/s$$

- For average speed: distance is 22 m (A to B) +105 m (B to F) =127 m

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}} = \frac{127}{50} = 2.5\,m/s$$

Quiz



Click the **Quiz** button on
iSpring Pro toolbar to edit your

2.1 : Interactive Flash

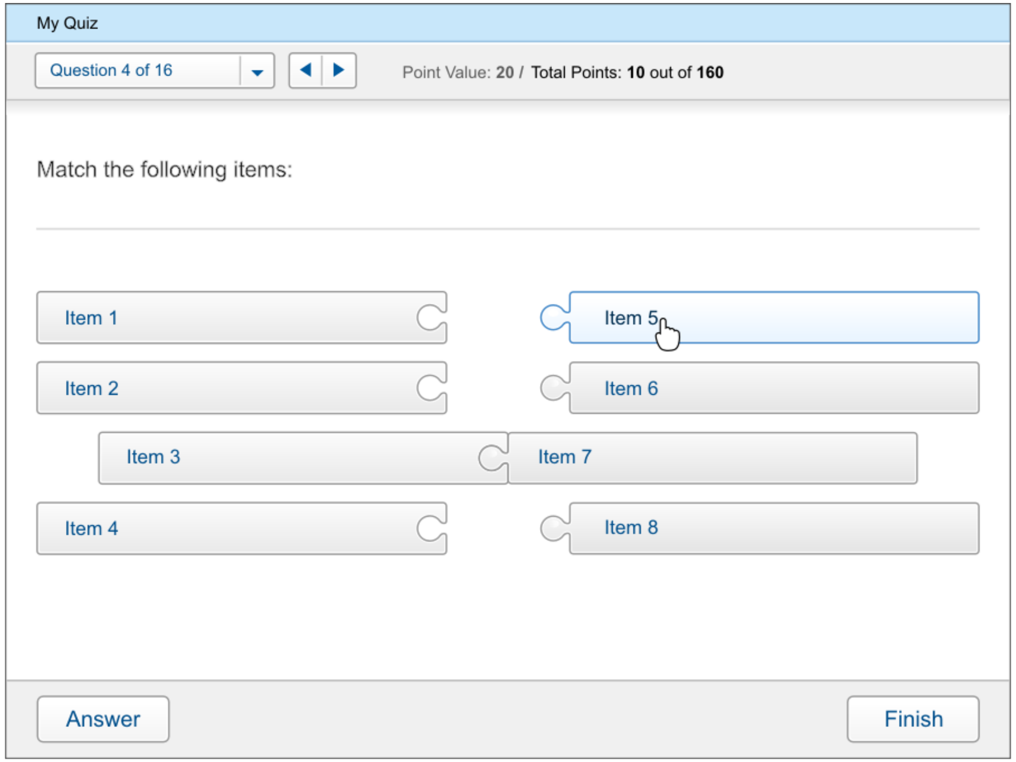
- In the **next slide**, please find an Interactive Flash. In this component you can use your mouse to discover.
- Please drag at the bottom of the grap and watch the following:

1. *There are two values: time (always +tive and increasing) and position (+ or – with decreasing or increasing vlaues)*
2. *While dragging; Please watch for the Speed and Velocity below the graph.*
3. *You notice that speed keeps increasing, while velocity changes in value and sign.*
4. *Please pay attention to velocity at the t =375 s and after?*
5. *We call this point in graph: turning point.*
6. *At turning points, velocity starts changing sign (direction)*

Reference: InterActaGram.com

Interactive Quiz

Interactive Quiz



Click the **Quiz** button on iSpring Pro toolbar to edit your quiz

Lecture Summary

- After a particle moves along the x axis from some initial position x_i to some final position x_f , its displacement is

$$\Delta x = x_f - x_i \qquad (2.1)$$

- The average velocity of a particle during some time interval is the displacement Δx divided by the time interval Δt during which that displacement occurs:

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t} \qquad (2.2)$$

- The average speed of a particle is equal to the ratio of the total distance it travels to the total time interval during which it travels that distance:

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}} \qquad (2.3)$$

Please read the attachment ....