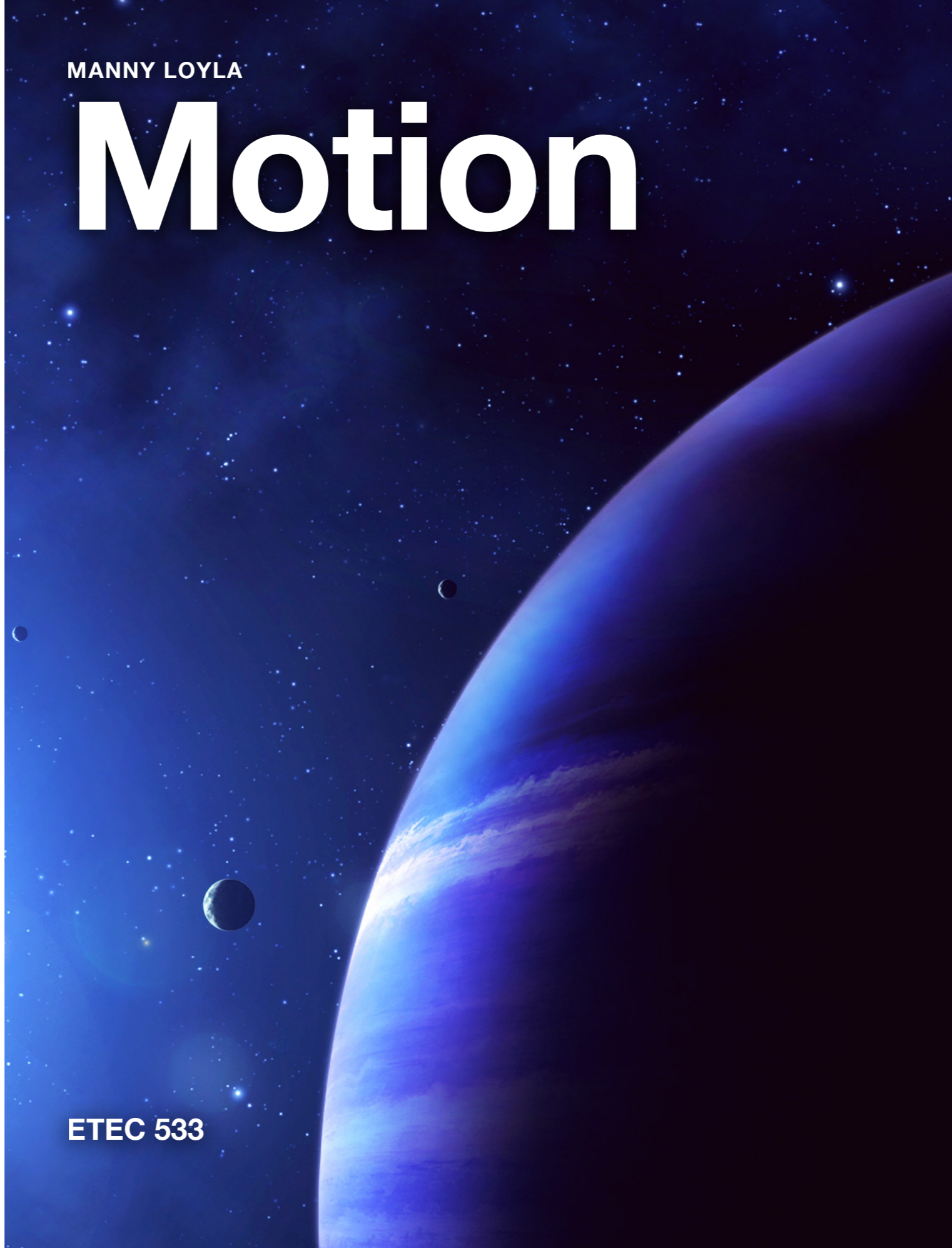MANNY LOYLA

Motion

Kinematics:
One Dimension

Kinematics is the study of the motion of objects.

In physics we need to consider both the size (or magnitude) of values, and also their direction.

Scalar quantities have magnitude only.

Vector quantities have both magnitude and direction.

Review 1.1 Identify whether the following examples are scalar or vectors
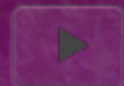
Question 1 of 4

A squirrel runs 7m east of a tree.

○ **A.** Scalar

✅ **B.** Vector

Check Answer

Distance vs. Position

OBJECTIVES

1. Distinguish between distance and position in linear motion

2. Determine the distance and position in linear motion

3. Determine the relationship between position and displacement

Distance is the length of a linear path between two points.

Position is the location of a specific point relative to a point of origin or a reference point.

Displacement is the distance and direction from one point to another.

Review 1.2 Match the Description to the Definition

Displacement

only accounts for the beginning and the end

the difference between the final and initial position

Position

the location of an object in a moment of time

a scalar measured in meters

Distance

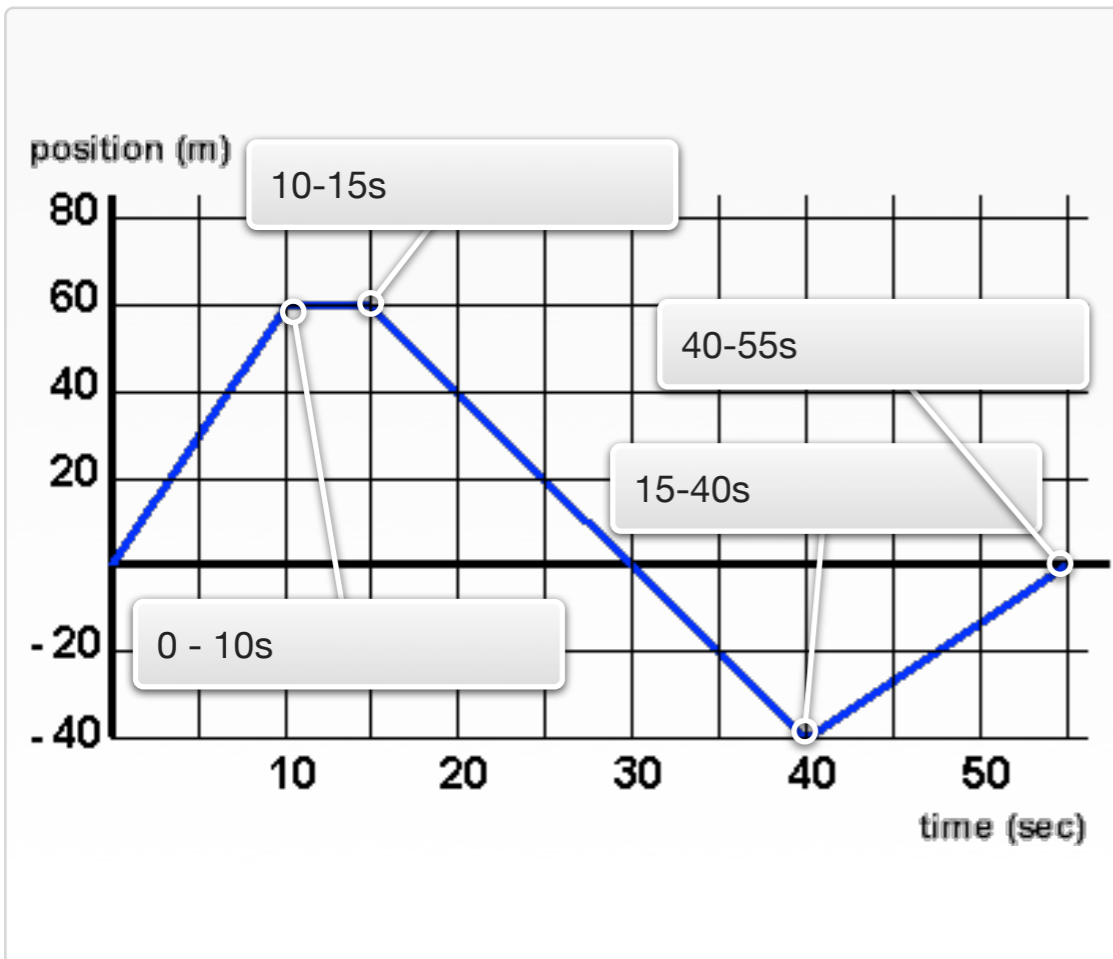every unit of measurement counts

Distance

Position

Displacement

Check Answer

2

Position vs. Time Graph

OBJECTIVE

1. **Interpret the results (position, distance, displacement and movement) of a graph.**

Graph 1.1 Interpreting a position time graph

One method of representing position is on a position time graph. The position is graphed on the y-axis and time is graphed on the x-axis.

Try to identify what is going on in **Graph 1.1**. Click on the time intervals to see what is happening.

The graph the position of the object at each moment in time, but what is the **total distance** travelled in the **Graph 1.1**?

Click on the ruler to find out.

What is the displacement in the **Graph 1.1**?

Click on the **measuring tape** to find out.

When graphed in this manner, slope represents a very special physical quantity - **velocity**.

For instance, the object moved 60m in 10s or in other words 6m/s.

Velocity & Position-Time Graphs

OBJECTIVES

1. **Calculate velocity in a linear system using a graph and formula**

2. **express velocity using appropriate units**

Velocity is the rate of change in the position of an object. As a result, velocity is a vector quantity and will have both magnitude and direction.

Formula 1.1 The formula for calculating velocity is:

Velocity

Displacement

$$V = \frac{\Delta d}{t}$$
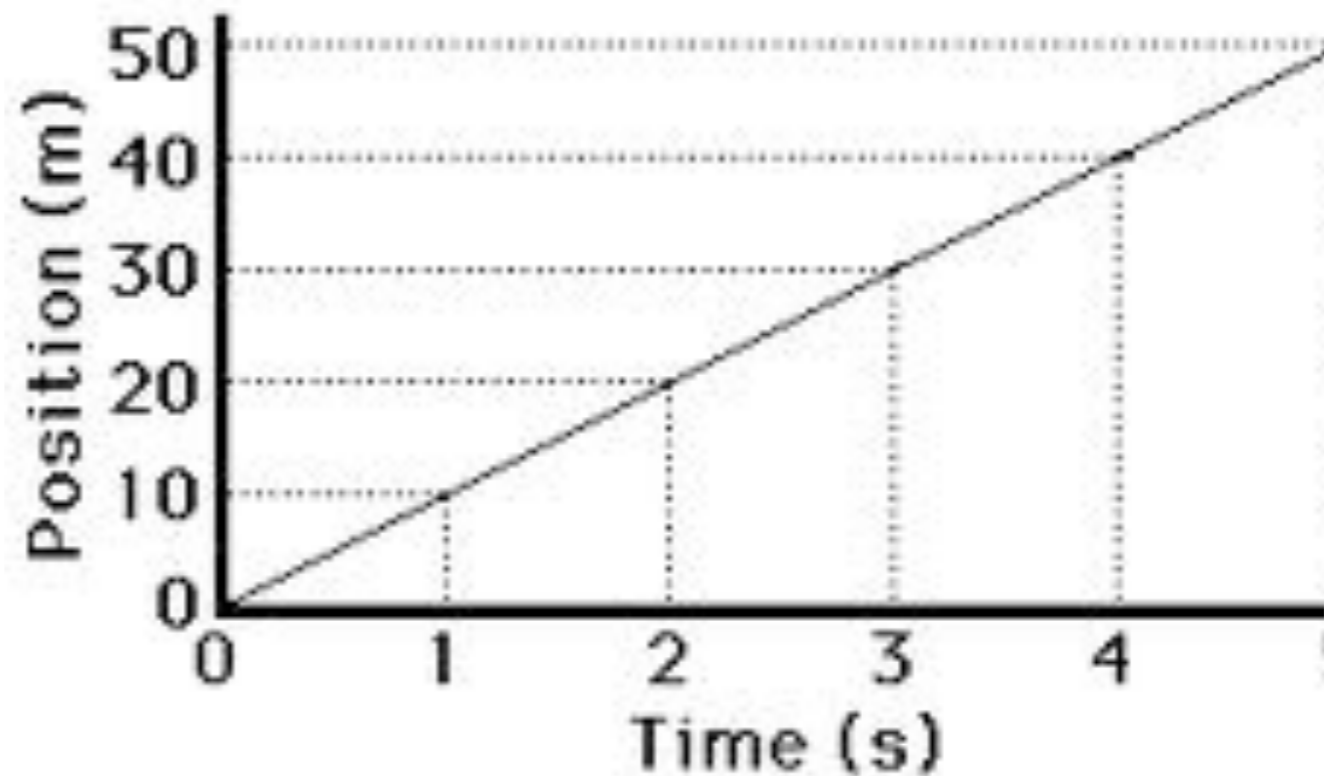
time interval

What is the velocity of the following graphs?

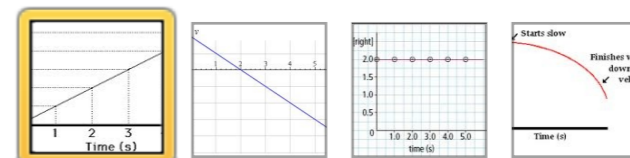Note that the velocity is also the slope of the graph.

Slope = <u>rise</u>

$$v_x = \frac{x(t) - x_i}{t - t_i}$$

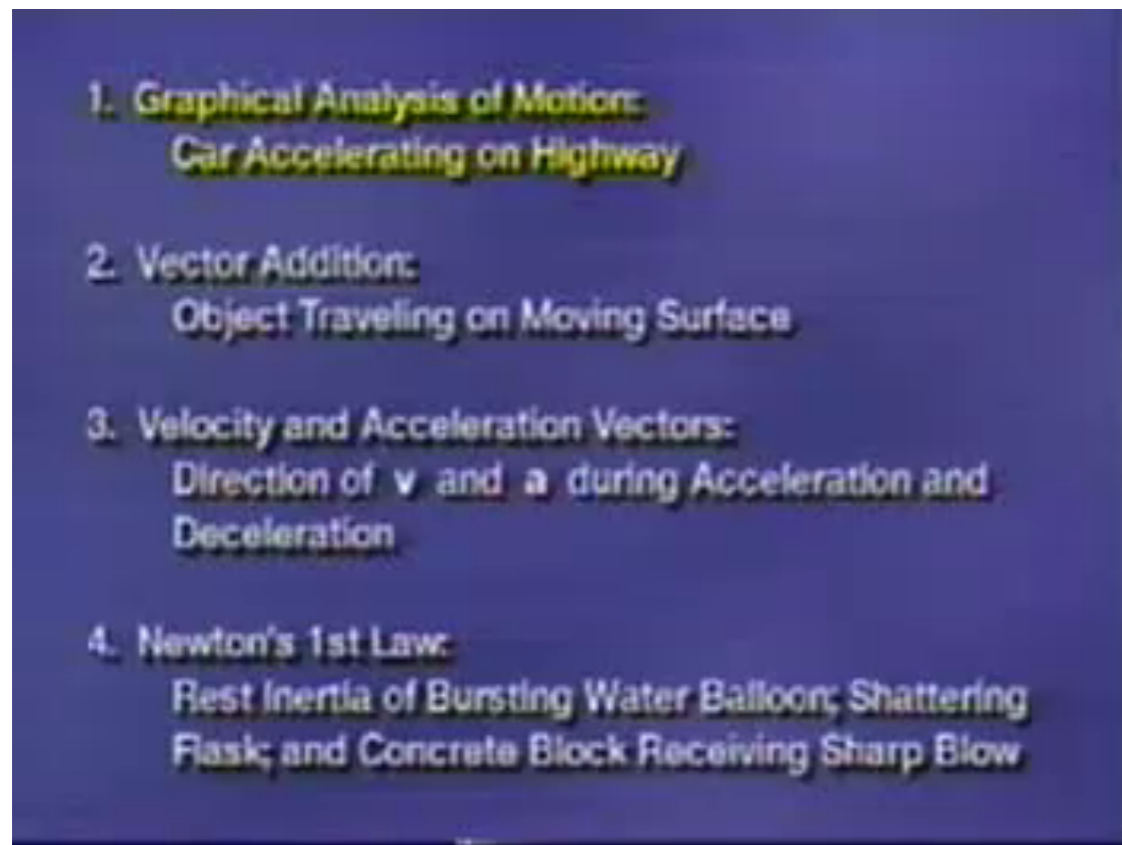**Graph 1.2** Identify the slope of the following series of position-time graphs.

The velocity is positive 10m/s.

4

Extension of the Position Time Graph

The data from a position time graph can be used to create a velocity time graph and then the resulting velocity time graph can be used to create an acceleration graph. Watch the video to find out how.

Using what you learned in the video, try relating the movement of the arrow to the different position time graphs.
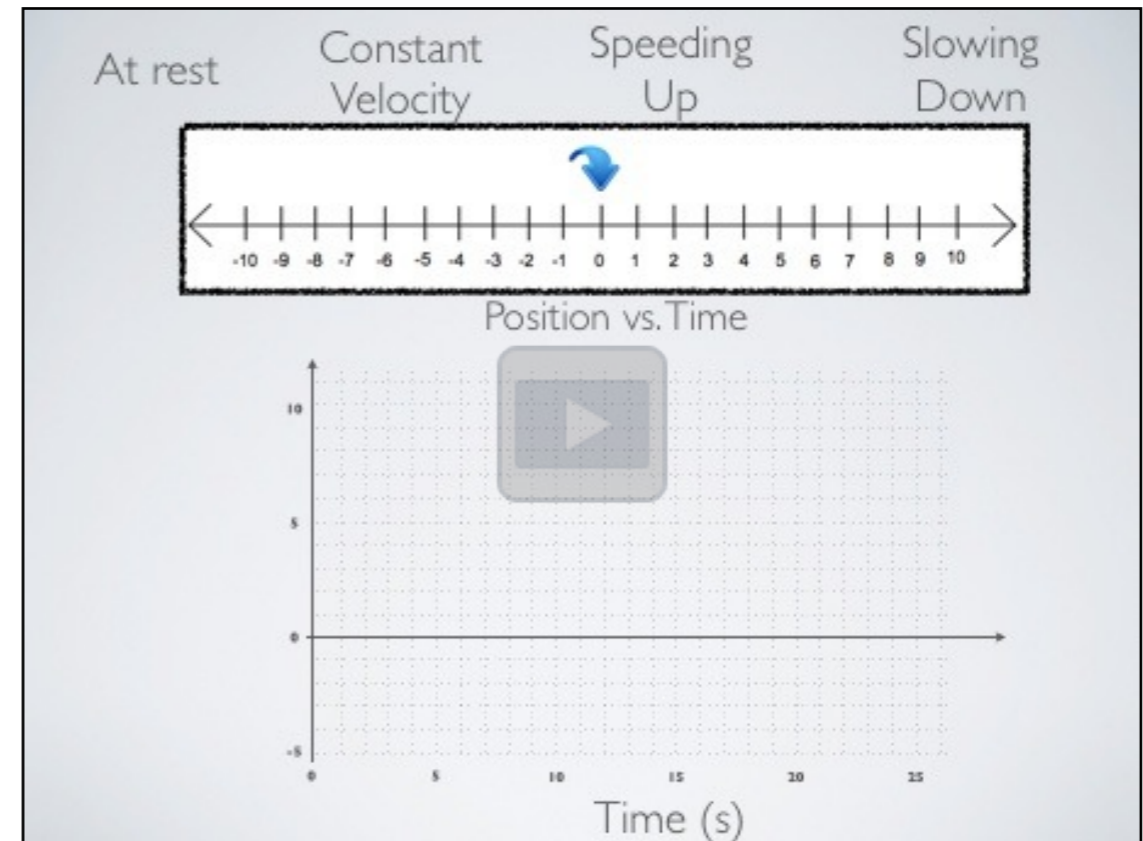
Movie 1.1 Graphical Analysis of the Motion of Car on the Highway

Watch the speedometer of the car and the direction the car is going in in order to produce the graphs.

Graph 1.3 Click on the descriptions of the different graphs on the top and see what happens to the arrow.

Applications

Interactive 1.1 Show your work and email it to your instructor for marks.

Interactive 1.2 Scientific Calculator

Review Questions:

Plot the position time graph for the following situations:

1. A car is traveling north at a velocity of 50 km/h. It slows down to 30 km/h when it enters a school zone.

2. A boy walks away from the kitchen table, 4m to the right with a velocity of 2m/s. He spends 6s getting a bowl of fruit salad out of the refrigerator and then walks back to the table at a velocity of 1m/s.

3. At soccer practice, the coach makes the players run back and forth between two lines four times.

4. A student leaves home, driving east towards his school at 9:!1am. Arriving at the school, 1.5 km away at 9:15 am, he realizes that the school is closed. It is Saturday! He travels on to the library, 1.5 km east of the school, to return a book. He arrives at the library at 9:25am, drops off the book and continues east for another 0.5km to his favourite fast food restaurant, arrive there at 9:28am. He leaves the restaurant at 9:45am arriving at home at 10:00am.

   i. Plot the position time graph.
   ii. What was the total distance travelled by the student?
   iii. What was the total displacement?
   iv. Calculate the average velocity (in m/s) of the entire trip.
   v. Calculate the velocity of each part of his trip
      1. home to school
      2. school to library
      3. library to restaurant
      4. at restaurant
      5. restaurant to home

Acceleration

The rate at which the velocity of an object changes.

Related Glossary Terms

Average Acceleration, Velocity

Index   Find Term

Acceleration due to Gravity

The acceleration of an object in free fall, resulting from the influence of Earth's gravity; acceleration due to gravity on Earth, g, is 9.80 m/s2 toward the center of Earth.

Related Glossary Terms

Free Fall

Index   Find Term

Average Acceleration

The change in an object's velocity during a measurable time interval, divided by that specific time interval; is measured in m/s2.

Related Glossary Terms

Acceleration

Index   Find Term

Average Speed

How fast an object is moving; is the absolute value of the slope of an object's position-time graph.

Related Glossary Terms

Speed

Index   Find Term

Average Velocity

The change in position, divided by the time during which the change occurred; is the slope of an object's position-time graph.

Related Glossary Terms

Instantaneous velocity, Velocity, Velocity-time graph

Index   Find Term

Displacement

A change in position having both magnitude and direction; is equal to the final position minus the initial position.

Related Glossary Terms

Position

Index   Find Term

Distance

A scalar quantity that describes how far an object is from the another point.

Related Glossary Terms

Scalars, Speed

Index   Find Term

Free Fall

The motion of a body when air resistance is negligible and the motion can be considered due to the force of gravity alone.

Related Glossary Terms

Acceleration due to Gravity, Projectile

Index   Find Term

Instantaneous acceleration

The change in an object's velocity at a specific instant of time.

Related Glossary Terms

Velocity

Index   Find Term

Instantaneous position

The position of an object at any particular instant in time.

Related Glossary Terms

Position, Position-time graph

Index   Find Term

Instantaneous velocity

A measure of motion that tells the speed and direction of an object at a specific instant in time.

Related Glossary Terms

Average Velocity

Index   Find Term

Position

The separation between an object and the origin; it can be either positive or negative.

Related Glossary Terms

Displacement, Instantaneous position, Position-time graph, Vectors, Velocity

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Index   Find Term

Position-time graph

A graph that can be used to determine an object's velocity and position, as well as where and when two objects meet, by plotting the time data on a horizontal axis and the position data on a vertical axis.

Related Glossary Terms

Instantaneous position, Position

Index   Find Term

Projectile

An object shot through the air, such as a football, that has independent vertical and horizontal motions and, after receiving an initial thrust, travels through the air only under the force of gravity.

Related Glossary Terms

Free Fall

Index   Find Term

Scalars

Quantities, such as temperature or distance, that are just numbers without any direction.

Related Glossary Terms

Distance

Index   Find Term

Speed

The rate at which distance changes with time. THe magnitude of velocity.

Related Glossary Terms

Average Speed, Distance

Index   Find Term

Vectors

Quantities, such as position, that have both magnitude and direction.

Related Glossary Terms

Position

Index   Find Term

Velocity

The rate at which position changes with time.

Related Glossary Terms

Acceleration, Average Velocity, Instantaneous acceleration, Position

Index   Find Term

Velocity-time graph

A graph that can be used to plot the velocity of an object versus time and to determine the sign of an object's acceleration.

Related Glossary Terms

Average Velocity

Index   Find Term