

MOTION

TOPIC 14



DESCRIBING MOTION

- **Frame of reference**
 - System of objects that are not moving relative to each other
 - For comparison
 - Allows us to see a change of position



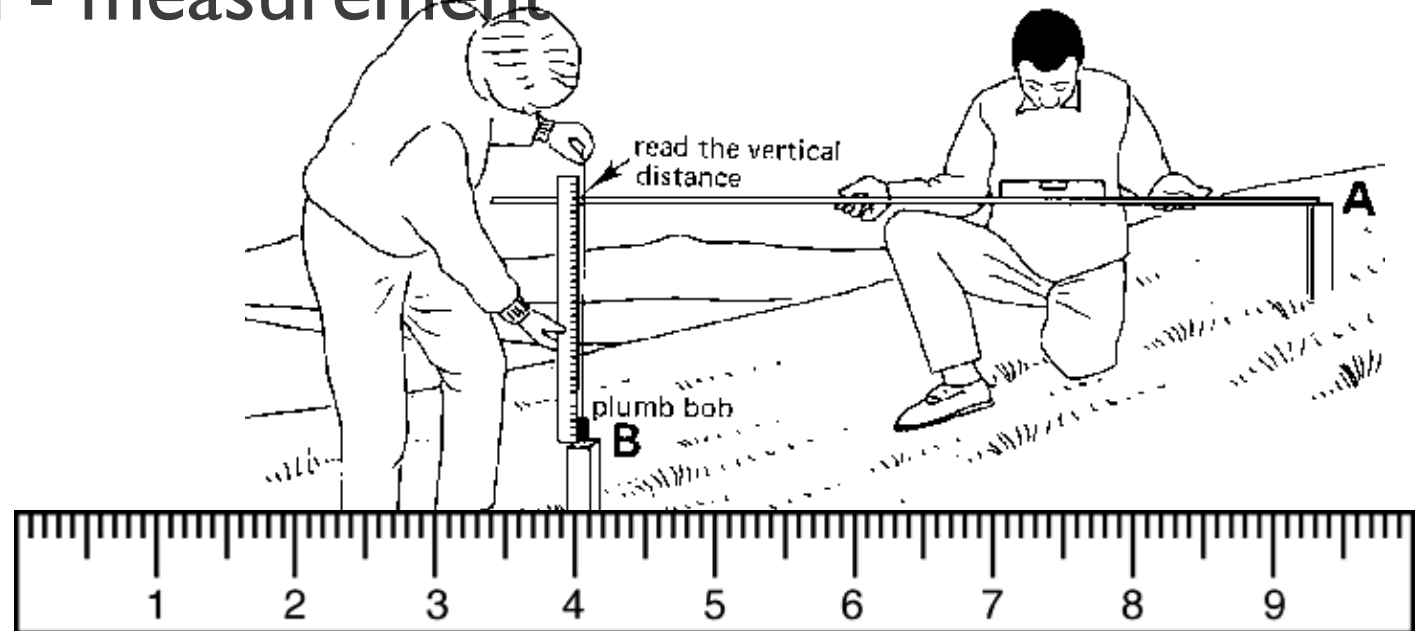
SENSE OF MOTION

- How fast are you moving?
- In what direction are you moving?
- **Relative motion**
 - Movement in relation to a frame of reference
 - Choose frame of reference based on motion you want to describe



DISTANCE

- Length of path between two points
- How far the object moved
- Numerical description - measurement
- Distance units in SI
 - Meter
 - Kilometer
 - Centimeter



DISTANCE COMPARED TO DISPLACEMENT

■ Distance

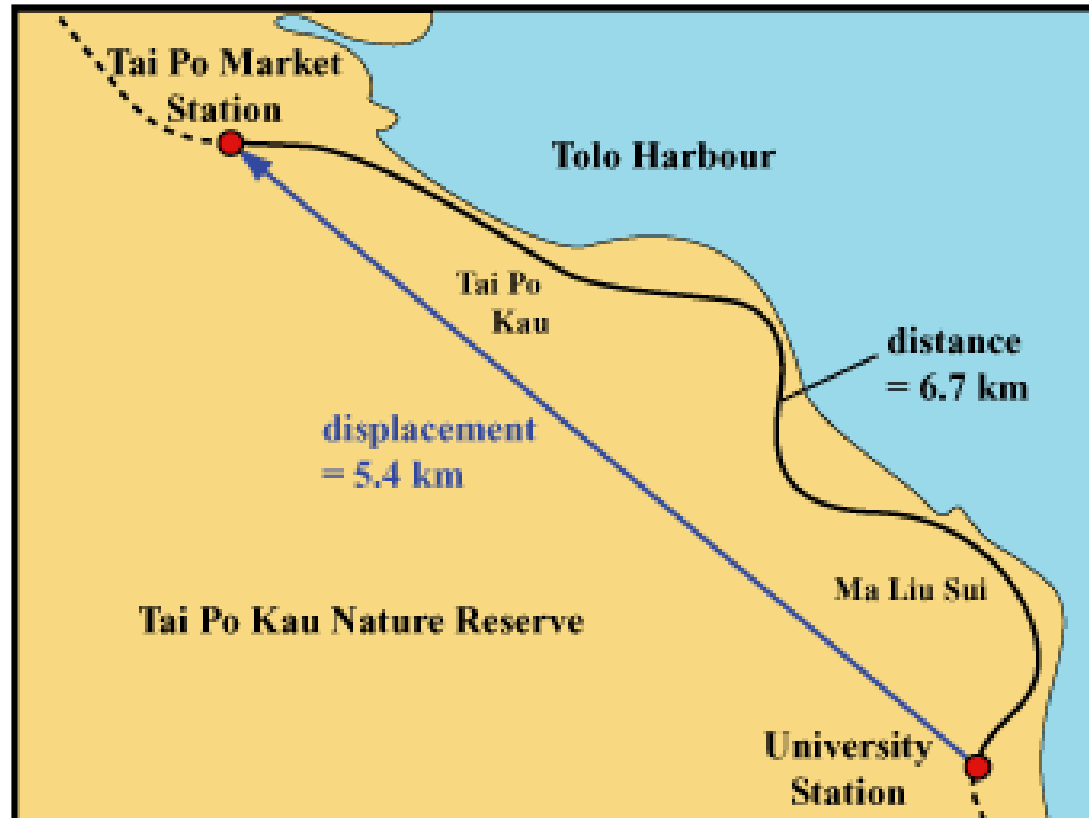
- Length of path object moved

■ Displacement

- Direction from starting point and length of straight line from starting point to ending point



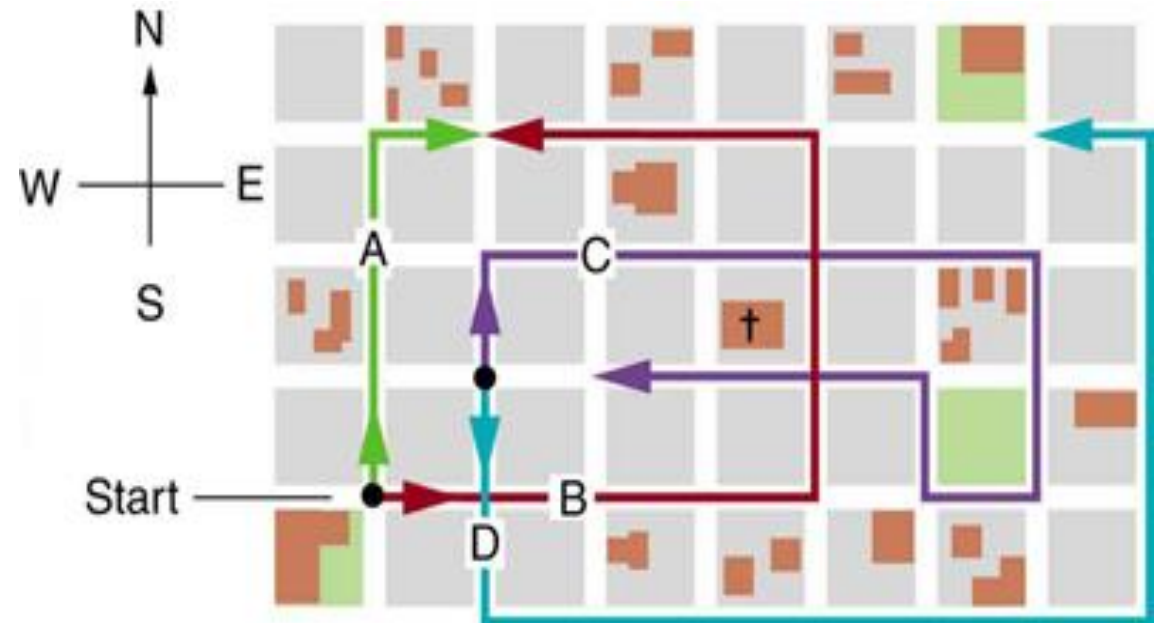
DISTANCE VS DISPLACEMENT



VECTORS

■ Vectors

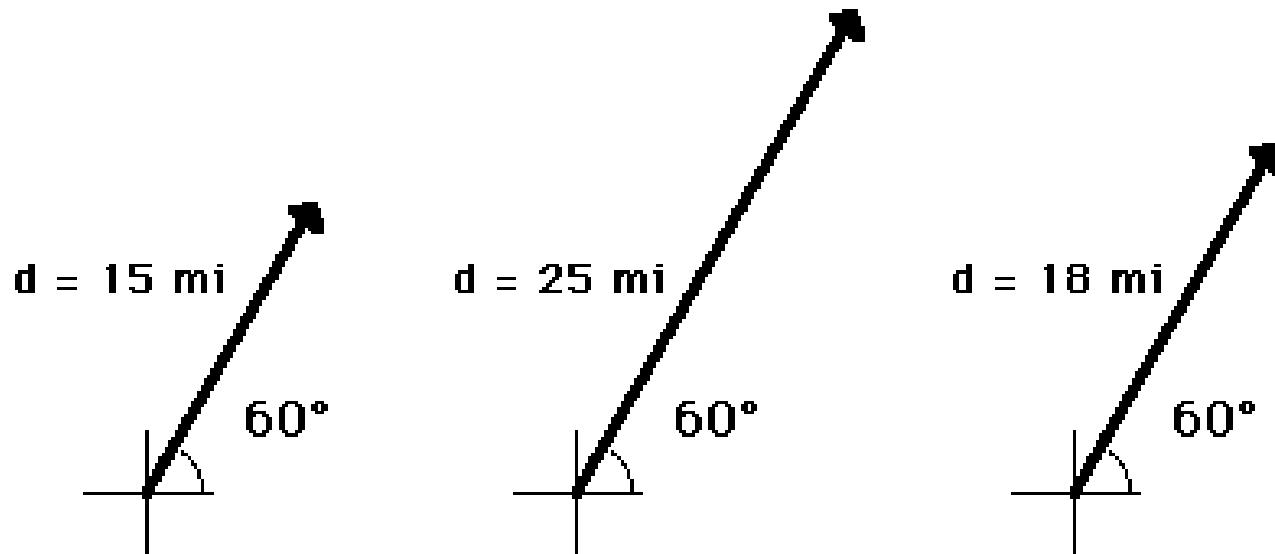
- Have magnitude & direction
 - Show direction & size
 - Represented by an arrow
- Describe motion



VECTORS AND DISTANCE

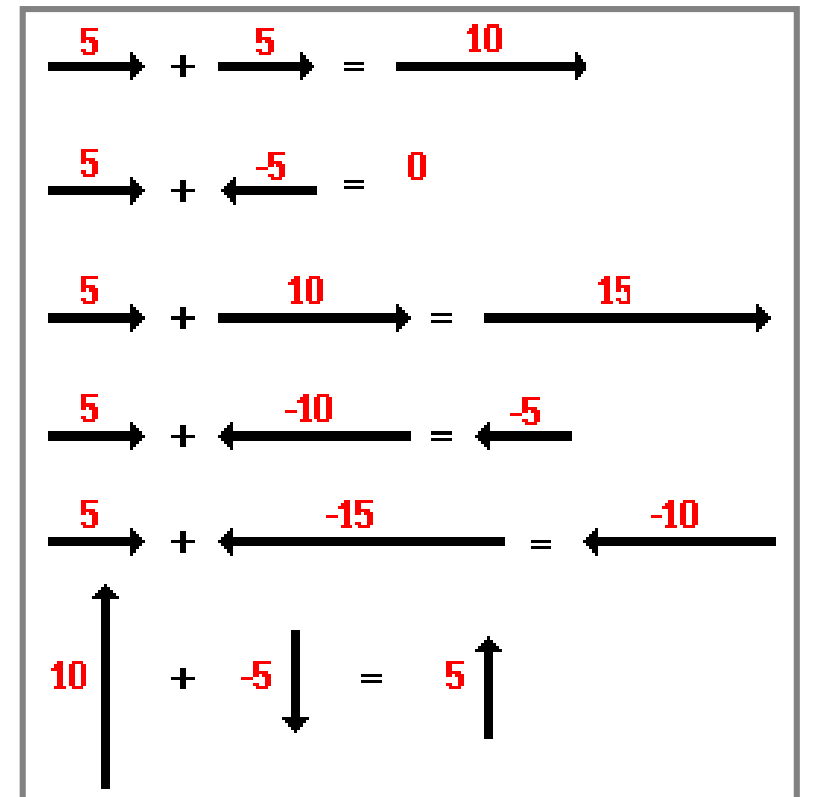
- Distance corresponds to length of arrow
- Direction shown by tip of arrow

SCALE: 1 cm = 5 miles



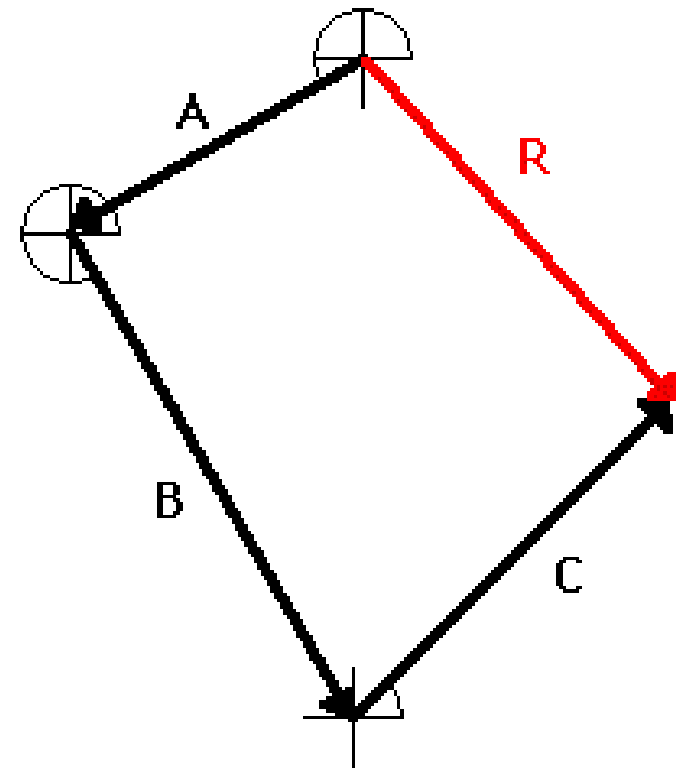
DISPLACEMENT IN A STRAIGHT LINE

- Two displacements = two vectors
- Vectors in the same direction
 - Add
- Vectors in the opposite direction
 - Subtract
- Point in direction of larger vector



DISPLACEMENT NOT IN A STRAIGHT LINE

- More than one vector
- Vectors not in the same direction
- **Resultant vector**
 - Vector sum of two or more vectors
 - Points from starting to ending points



DESCRIBING MOTION - SPEED

■ Speed

- The ratio of the distance an object moves to the amount of time the object moves
- How fast
- Rate of motion



SPEED AND DIRECTION

■ Velocity

- Basically rate of motion, but includes direction
- More info about motion
- Tells us speed and direction

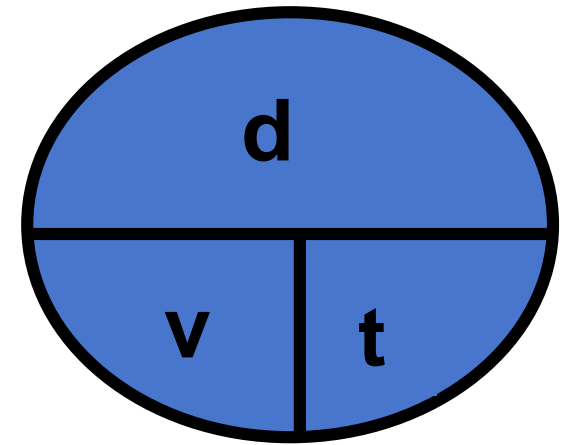
■ Vector

- Magnitude and direction
- Arrows



SPEED CALCULATIONS

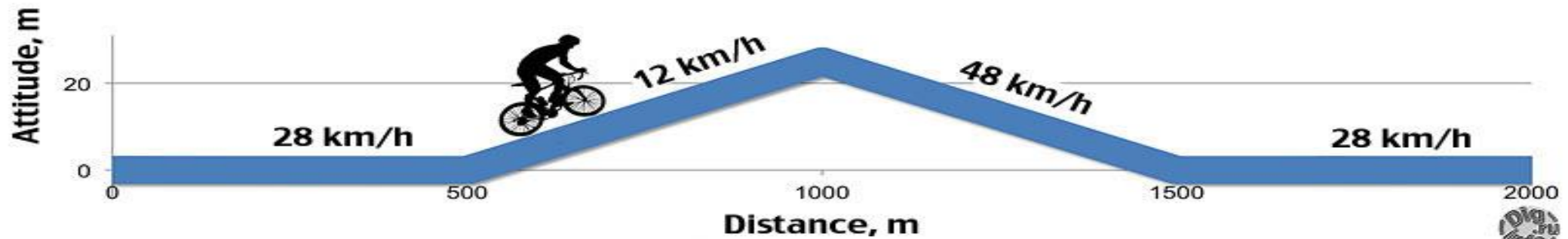
- **Speed**
- Speed symbol is “v”
- Velocity
- Use pie chart
- List all three possible equations



$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

MORE THAN ONE TYPE OF SPEED

■ Average Speed



$$\text{Average speed} = \frac{\text{Total distance covered}}{\text{Total time taken}}$$

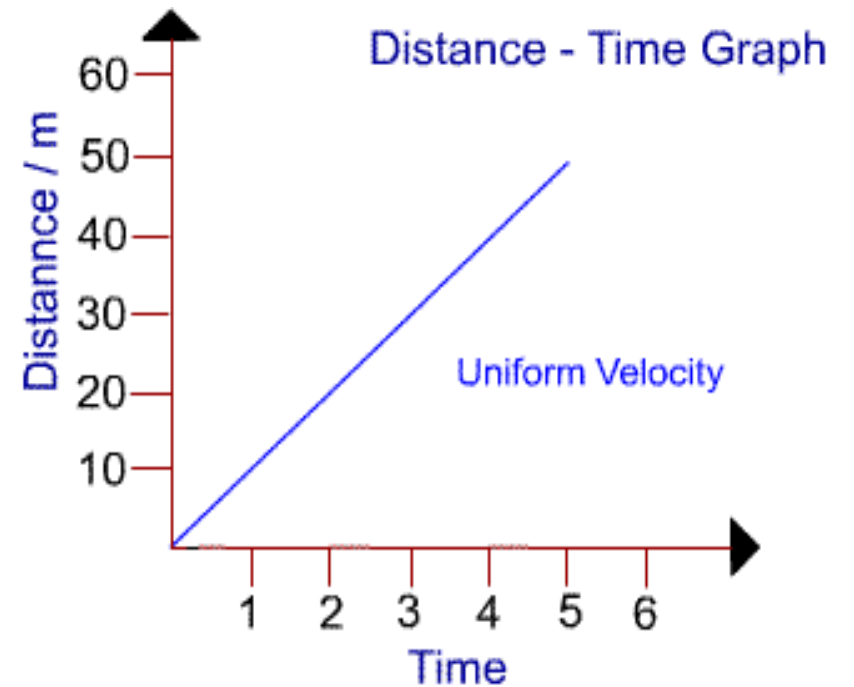
MORE THAN ONE TYPE OF SPEED

- **Instantaneous Speed**
- Speed at a given moment
- The rate at which an object is moving at a given moment in time
- Speedometer



DISTANCE – TIME GRAPHS

- **Time on x-axis**
- **Distance on y-axis**
- **Slope**
 - Rise/Run
 - $\Delta Y / \Delta X$
 - Change in distance divided by change in time
- **Slope is speed (velocity)**



CONSTANT SPEED – ON DISTANCE – TIME GRAPH

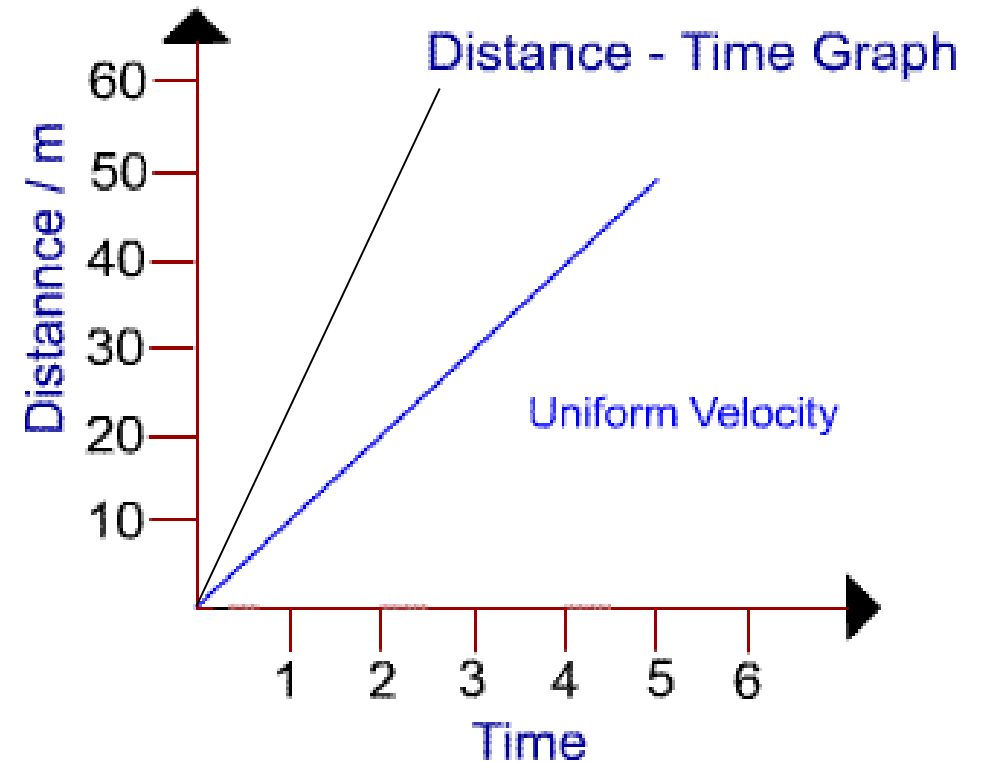
■ Constant speed

■ Straight line

- Indicates speed does not change

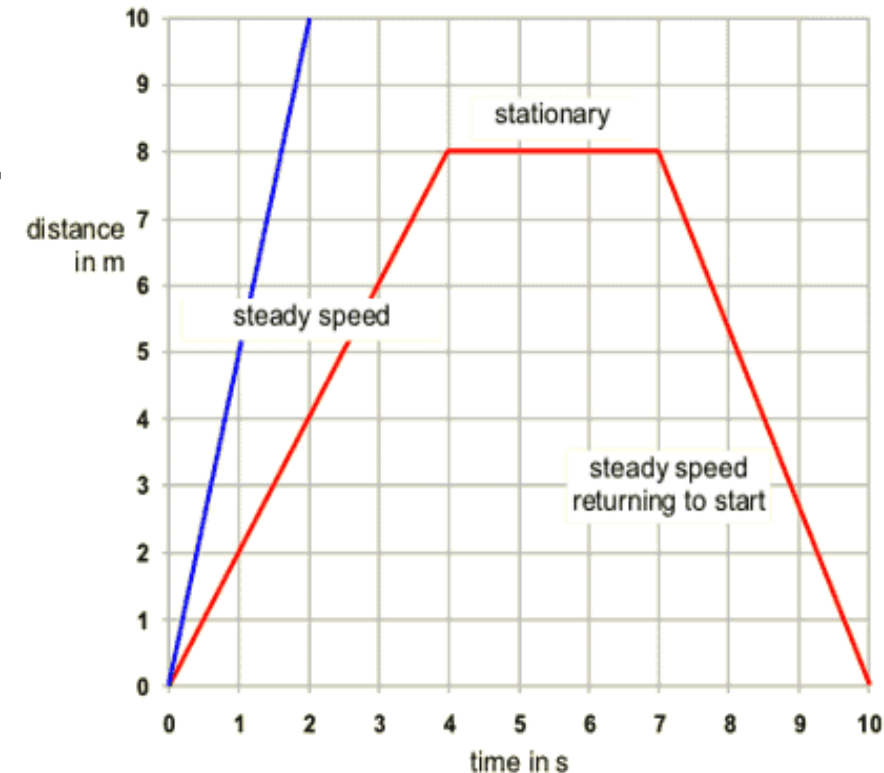
■ Rate of motion

- Slope = Speed
- Steeper the slope
- Faster the speed



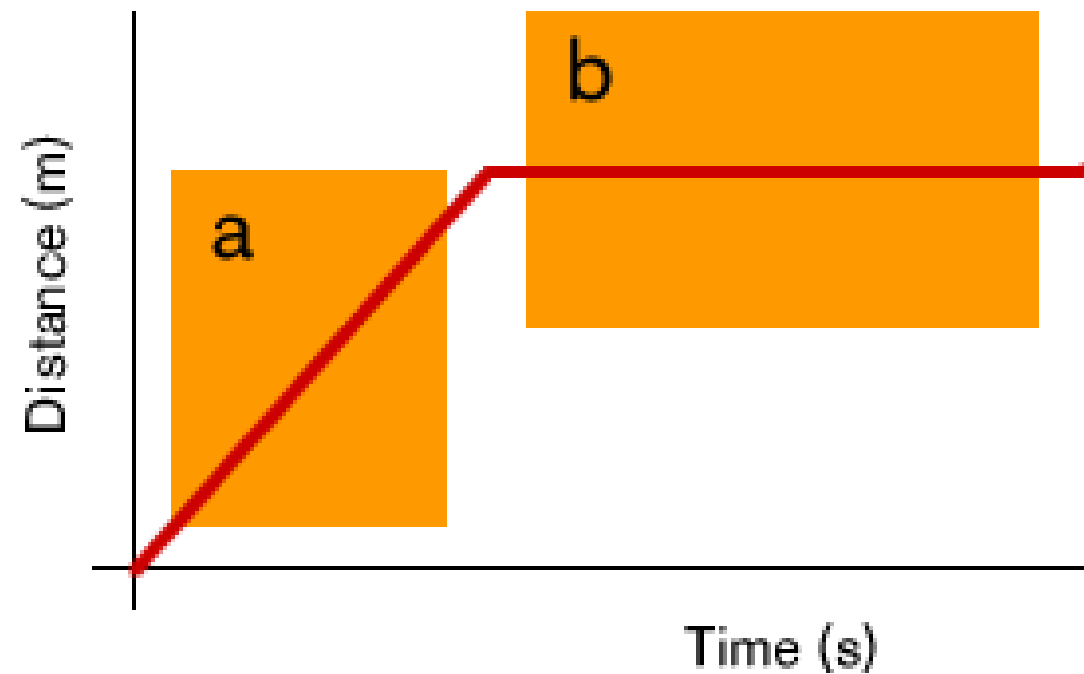
VARYING SPEED ON DISTANCE – TIME GRAPH

- Speed changes indicated by line direction changes
- Line going **upward**
 - Constant speed away from starting point
- Line going **downward**
 - Constant speed toward starting point
- **Level line**
 - Object is stationary
 - Not moving



WHAT DOES THE GRAPH TELL US?

Distance-Time Graph



CHANGES IN SPEED OR VELOCITY

■ Acceleration

- A change in velocity over a period of time
- Rate at which velocity changes
- Often used to describe increasing speed
- “Zero to sixty in 5.2 seconds”
- Really any change in an objects velocity
- Can be an **increase or decrease** in speed



TYPES OF ACCELERATION

■ Acceleration

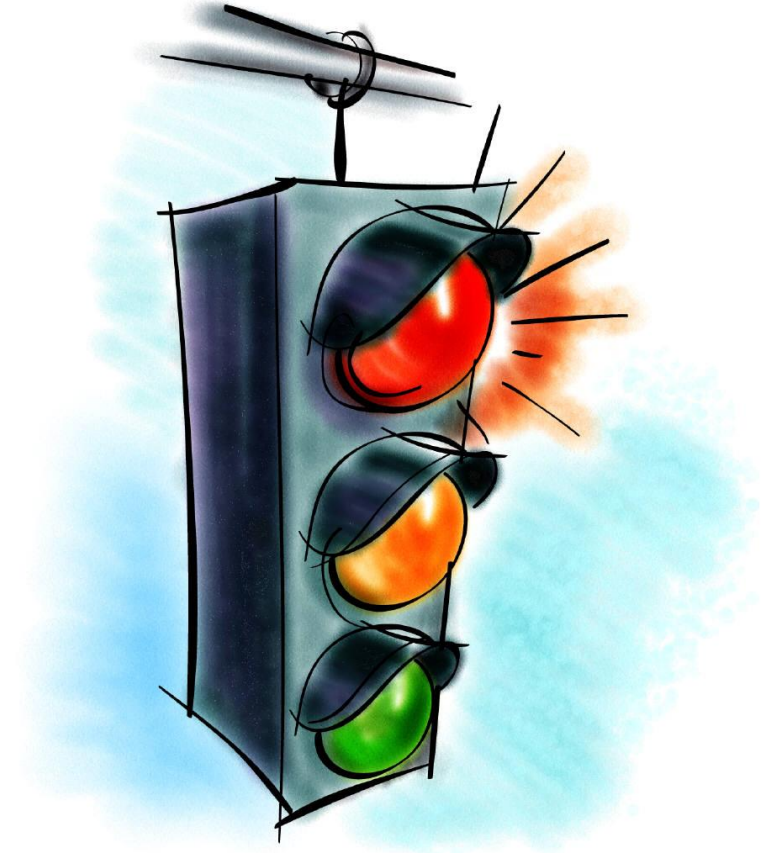
- Can be an **increase or decrease** in speed
- A change in velocity over time

■ Positive acceleration

- Speeding up
- Increase in velocity over time

■ Negative acceleration

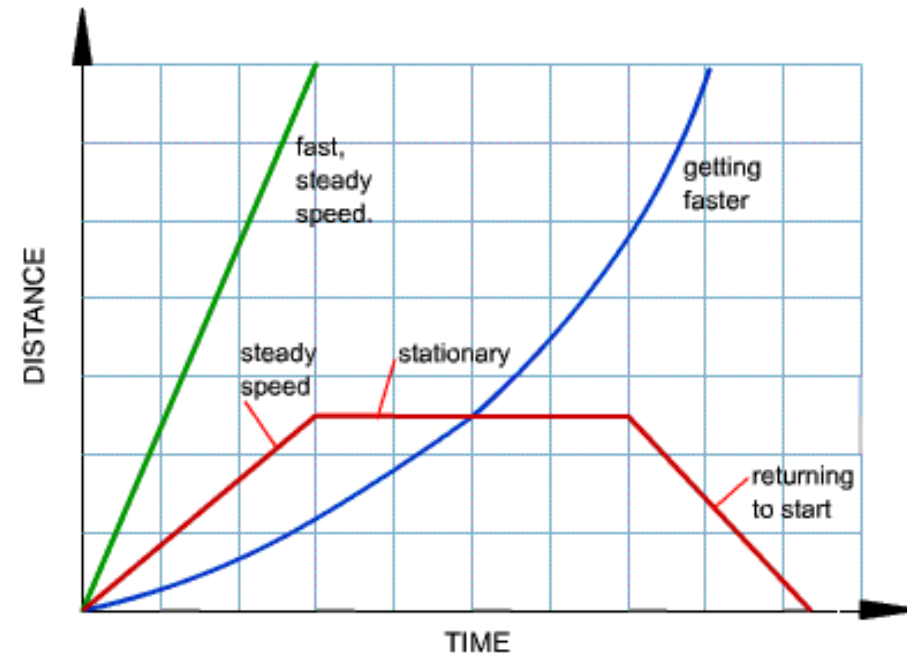
- Slowing down
- Decrease in velocity over time
- Also called deceleration



DISTANCE –TIME GRAPH OF ACCELERATION

■ Acceleration

- A change in velocity over time
- Speed is not constant
- Since constant speed has a straight line
- Acceleration is not a straight line
- Acceleration is a curved line



ACCELERATION DUE TO GRAVITY

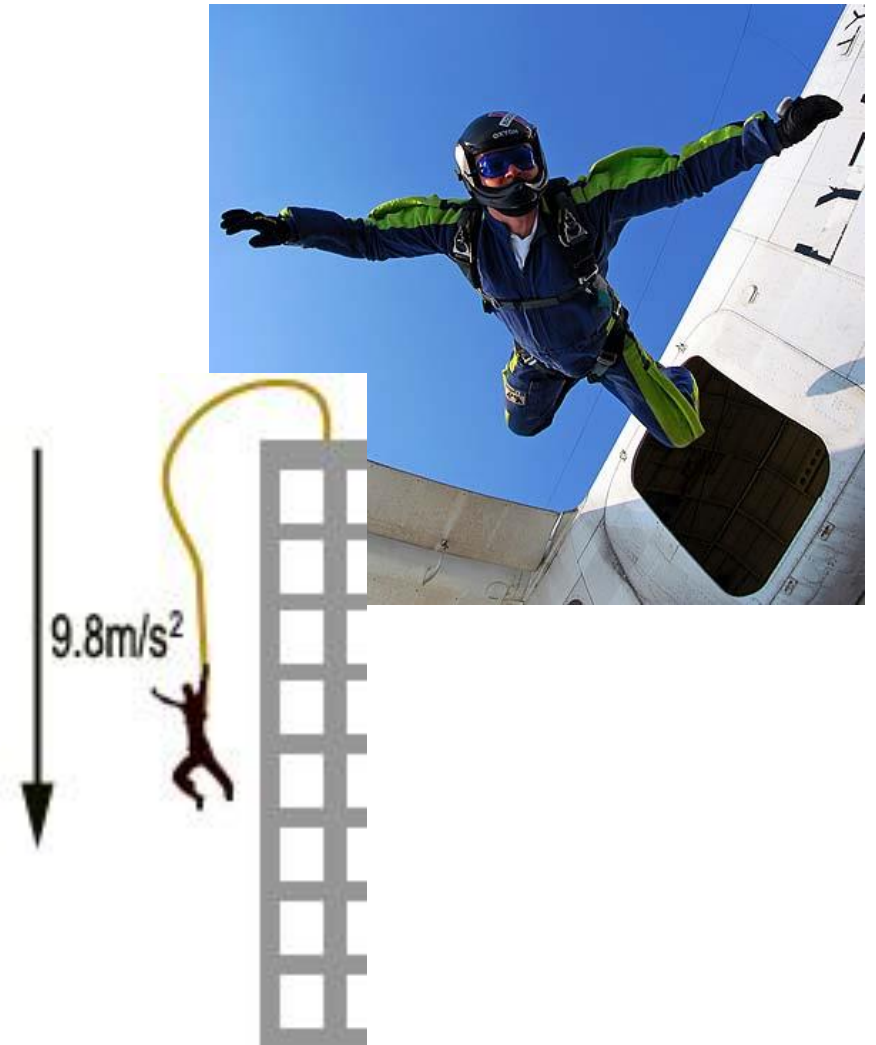
■ Gravity

- A force of attraction between objects with mass
- Larger the mass the more attraction it has
- Earth has a large mass and a large force of attraction
- Earth pulls objects toward itself



ACCELERATION DUE TO GRAVITY

- **Free fall**
 - An object that is dropped
 - Velocity increases as object falls
 - Falls at an increasing rate due to gravity
- **Acceleration due to gravity**
 - On Earth = **9.8 m/s^2**
 - Every second an object falls it's speed increases by 9.8 m/sec



ACCELERATION DUE TO GRAVITY

