POSITION-TIME GRAPHS
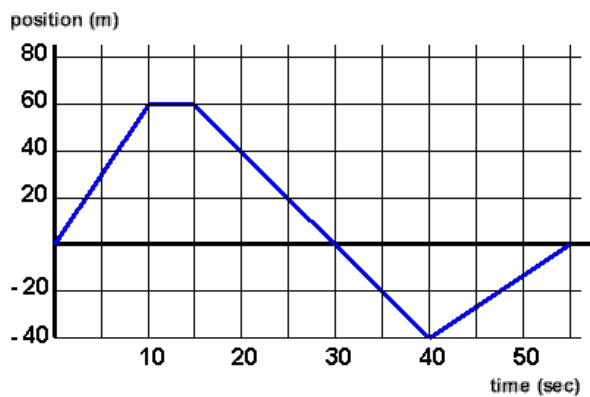
Goal:

    - to be able to read position-time graphs

    - to be able to calculate speed and velocity from a d-t graph

position (m)

1) What is the displacement of the object from 0 s to 10 s?

$$\vec{\Delta d} = 60m - 0m = +60m$$

2) What is the distance covered from 0 s to 10 s?

$$\Delta d = 60 m$$
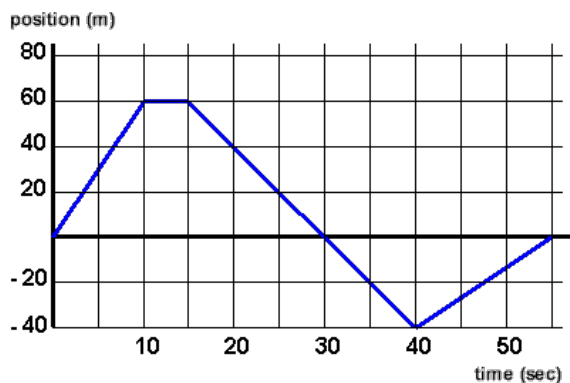
3) What is the displacement from 0 s to 40 s?

$$\vec{\Delta d} = \vec{d}_f - \vec{d}_i$$

$$= -40m - 0m$$

$$= -40m$$

4) What is the distance covered from 0 s to 40 s?

$$\Delta d = \overset{0-10s}{|60-0|m} + \overset{15-40s}{|-40-60|m}$$

$$= |60|m + |-100|m$$

$$= 60m + 100m$$

position (m)

time (sec)

3) What is the velocity of the object at 5 seconds?

$$\vec{V}_{av} = \frac{\vec{\Delta d}}{\Delta t} = \vec{V}_{inst} \quad \text{since velocity is}$$

constant from

0 to 10s

$$= \frac{60 - 0 \, m}{10 - 0 \, s} = 6 \, m/s$$

4) What is the velocity of the object at 20 s?

$$\vec{V}_{inst} = \vec{V}_{av} \quad \text{from 15s to 40s}$$

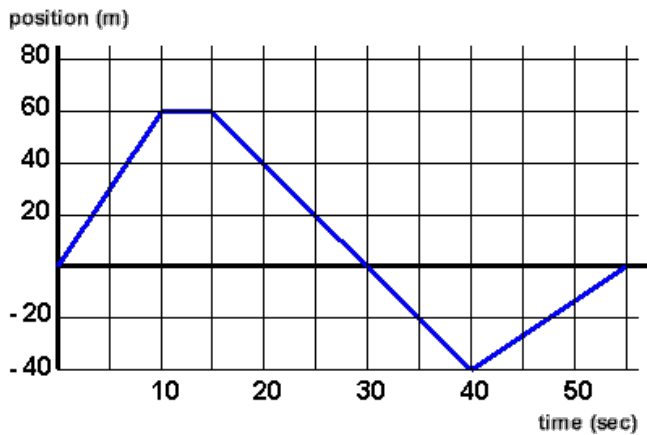$$= \frac{\vec{\Delta d}}{\Delta t} = \frac{-40 - 60 \, m}{40 - 15 \, s} = \frac{-100 \, m}{25 \, s} = -4 \, m/s$$

5) What is the average velocity of the object from 0 to 40 s?

$$\vec{V}_{av} = \frac{\vec{\Delta d}}{\Delta t} = \frac{\Delta y}{\Delta x} = \frac{-40 - 0 \, m}{40 - 0 \, s} = \frac{-40 \, m}{40 \, s} = -1 \, m/s$$

6) What is the average velocity of the trip?

$$\vec{V}_{av} = 0$$

position (m)

[Position-time graph: a line rising from origin to 60 m at t=10-15 s, staying flat until 15 s, then decreasing to -40 m at t=40 s, then rising back to 0 at t=55 s. Time axis marked 10, 20, 30, 40, 50. Position axis marked 80, 60, 40, 20, -20, -40.]

time (sec)

6) What is the speed of the object at 5 seconds?

$$V = \frac{\Delta d}{\Delta t} = \frac{60m}{10s} = 6 \, m/s$$

7) What is the speed of the object at 20 s?

$$V = \frac{\Delta d}{\Delta t} = \frac{|40-60|m}{20s-15s} = \frac{20m}{5s} = 4 \, m/s$$

8) What is the average speed of the object from 0 to 40 s?

$$V = \frac{\Delta d}{\Delta t} = \frac{160m}{40s} = 4 \, m/s$$

9) What is the average speed of the trip?

$$V = \frac{\Delta d}{\Delta t} = \frac{200m}{55s} = 3.64 \, m/s$$

Position-time graphs show the position of an object over time.

Other useful information that can be determined include:

1. displacement

$$\vec{\Delta d} = \vec{d_f} - \vec{d_i} = \Delta y$$

2. distance

$$\Delta d = |\Delta y_A| + |\Delta y_B| + \ldots$$

   separate displacement for every
   change in direction

3. velocity

$$\vec{V} = \text{slope of } d\text{-}t \text{ graph}$$

Since $\quad \text{slope} = \dfrac{\Delta y}{\Delta x} = \dfrac{\vec{\Delta d}}{\Delta t}$

4. speed

$$V = \dfrac{\text{distance}}{\text{time}}$$