Displacement, Velocity and Acceleration Worksheet

1. Calculate the displacement for each of the following pairs of initial and final positions, respectively, along the x-axis.

   (a) +3 m, +5 m $\Delta d = 5 - 3 = 2\ m$

   (b) +3 m, -7 m $\Delta d = -7 - 3 = -10\ m$

   (c) +7 m, -3 m $\Delta d = -3 - 7 = -10\ m$

2. Are speed and velocity the same? Why or why not?

   No
   Speed is distance divided by time.
   Velocity is speed plus the direction of motion.

3. You drive your truck down a straight road for 5.2 km at 43 km/h, at which point you run out of fuel. You walk 1.2 km farther, to the nearest gas station, in 27 min (0.45 h). You carry the fuel back to the truck in 35 min (0.58 h).

   (a) What is your average velocity from the time you started your truck to the time you arrived at the gas station?

   $v = \frac{\Delta d}{\Delta t}$ $\quad 43\ km/h = \frac{5.2\ km}{\Delta t}$

   $\Delta t = .12\ h$

   $\vec{v}_{av} = \frac{\Delta d}{\Delta t} = \frac{(5.2\ km + 1.2\ km)}{(.12\ h + .45\ h)} = \frac{6.4}{.57} = 11.2\ km/h$

   (b) If the gas station is 1.5 km away, what is your average velocity for the full journey, from the start of driving to your arrival back at the truck with fuel?

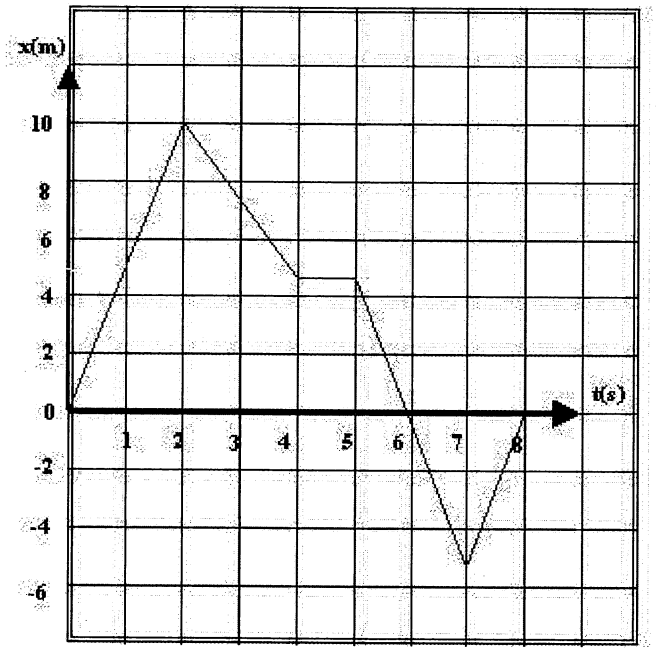
   displacement is $5.2\ km + 1.2\ km = 6.4\ km$ because it depends on final and initial positions.

   $\vec{v}_{av} = \frac{6.4}{(.12 + .45 + .58)} = \frac{6.4}{1.15} = 5.6\ km/h$

   (c) What is your average speed for the entire trip?

   $v_{av} = \frac{\Delta d}{\Delta t} = \frac{5.2 + 1.2 + 1.5}{.12 + .45 + .58} = \frac{7.9}{1.15} = 6.9\ km/h$

4. The position-time graph for a certain particle moving along the x axis is shown in the figure below.



(a) Describe the motion during each of the following time intervals.

(i) 0-2 s

moving forwards with constant velocity

(ii) 2-4 s

moving backwards with constant velocity.

(iii) 4-5 s

stationary

(iv) 5-7 s

moving backwards with constant velocity

(v) 7-8 s

moving forwards with constant velocity

(b) Calculate the average velocity during each of the following time intervals.

(i) 0-2 s

$$\vec{v}_{av} = \frac{10-0}{2-0} = 5 \text{ m/s}$$

(ii) 2-4 s

$$\vec{v}_{av} = \frac{5-10}{4-2} = -2.5 \text{ m/s}$$

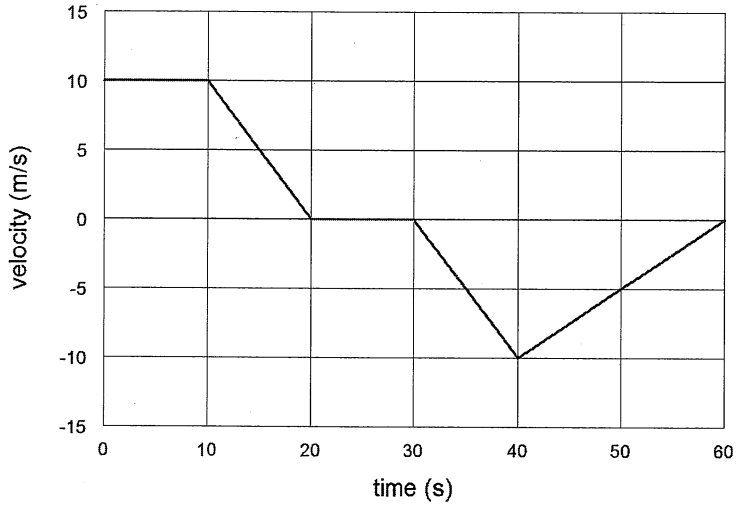
(iii) 5-7 s

$$\vec{v}_{av} = \frac{-5-5}{7-5} = -5 \text{ m/s}$$

(iv) 0-8 s

$$\vec{v}_{av} = \frac{0-0}{8-0} = 0 \text{ m/s}$$

5. The velocity of a car over a period of time is shown in the following velocity-time graph.



(a) Describe the motion during each of the following time intervals.

(i) 0-10 s

moving forwards with constant velocity.

(ii) 10-20 s

moving forwards, slowing down (to a stop)

(iii) 20-30 s

stationary

(iv) 30-40 s

moving backwards, speeding up

(v) 40-60 s

moving backwards, slowing down (to a stop)

(b) Calculate the acceleration during each of the following time intervals.

(i) 0-10 s

$a_{av} = \frac{10-10}{10} = 0 \text{ m/s}^2$

(ii) 10-20 s

$a_{av} = \frac{0-10}{20-10} = -1 \text{ m/s}^2$

(iii) 40-60 s

$a_{av} = \frac{0--10}{60-40} = 0.5 \text{ m/s}^2$

6. When Kitty 0'Neil set the dragster records for the greatest speed and least elapsed time, she reached 635.91km/h in 3.72 s. Calculate her average acceleration?

$3.72 \text{ s} \left(\frac{1}{3600}\right) = 0.001 \text{ hour}$

$a_{av} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t}$

$= \frac{635.91 - 0}{.001} = 635910 \text{ km/h}^2$