Motion in One Dimension

1. How is distance different from displacement?

distance is the length of the path traveled

displacement is the difference between starting and ending position

2. The following data represent the initial and final positions of a car, bicycle, pedestrian, and skateboarder.

	Initial Position (m)	Final Position (m)
Car	+2	+14
Bicycle	+7	+2
Pedestrian	-1	+2
Skateboarder	+4	-1

Calculate the distance traveled and the displacement of each object

	Car	Bicycle	Pedestrian	Skateboarder
Distance	$14 - 2$ $12\,m$	$7 - 2$ $5\,m$	$2 - -1$ $3\,m$	$4 - -1$ $5\,m$
Displacement	$14 - 2$ $+12\,m$	$2 - 7$ $-5\,m$	$2 - -1$ $+3\,m$	$-1 - 4$ $-5\,m$

3. A taxi travels 25 km South then 14 km North.

(a) Calculate the distance traveled.

$25 + 14 = 29\,km$

(b) Calculate the displacement of the taxi.

$-25 + 14 = -11\,km$ 11 km South

4. A delivery truck is 5 km East of its destination after traveling for 2 km West. What was the initial position of the truck?

$\Delta\vec{d} = d_1 + d_2$

$5 = -2 + d_1$

$d_1 = 7$

7 km East

10. A toy car moves along a track from a position of 26 cm to a position of 2 cm in 0.5 seconds. What is the average velocity of the car?

$$\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{(2 - 26)}{.5} = -48 \text{ cm/s} \text{ or } -.48 \text{ m/s}$$

11. A car rolls off a ramp with a constant velocity of 1.5 m/s onto a horizontal track. The end of the ramp is at position -12 m. The car reaches the end of the track in 0.5 seconds. Calculate the length of the track.

$$\vec{v} = \frac{\Delta \vec{d}}{\Delta t}$$

$$\Delta \vec{d} = \vec{v} \Delta t$$

$$= 1.5(.5)$$

$$= 0.75 \text{ m}$$

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

$$.75 = d_f - (-12)$$

$$d_f = -11.25 \text{ m}$$

5. What is the difference between speed and velocity?

- speed is distance divided by time
- velocity is speed plus direction

6. What is the average speed of a car that traveled 300.0 km in 5.5 hours?

$$v = \frac{d}{t} = \frac{300 \text{ km}}{5.5 \text{ h}} = 54.5 \text{ km/h}$$

7. How much time would it take for the sound of thunder to travel 1,500 meters if sound travels at a speed of 330 m/s?

$$v = \frac{d}{t} \qquad t = \frac{d}{v} = \frac{1500 \text{ m}}{330 \text{ m/s}} = 4.5 \text{ s}$$

8. An airplane travels 3260 km West in 4 hours. What is the airplane's average velocity?

$$\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{3260 \text{ km}}{4 \text{ h}} = 815 \text{ km/h West}$$

9. A person in a kayak paddles down river with an average velocity of 5.0 m/s.

(a) How far has she traveled after 3.5 hours?

$3.5 \text{ hours} \times 60(60) = 12600 \text{ s}$

$$\vec{v} = \frac{\Delta \vec{d}}{\Delta t} \qquad \Delta \vec{d} = \vec{v} \Delta t$$

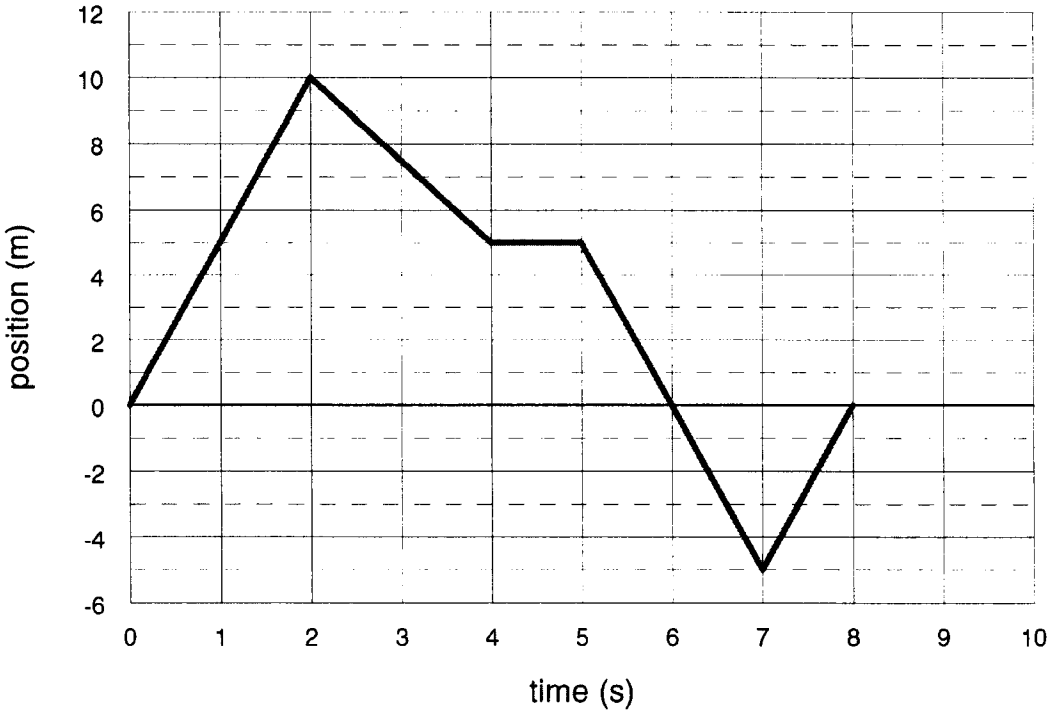
$$= (5)(12600) = 63000 \text{ m}$$

(b) The same person paddles upstream with an average velocity of 3.0 m/s. How long would it take her to get back to her starting point?

$$\vec{v} = \frac{\Delta \vec{d}}{\Delta t}$$

$$\Delta t = \frac{\Delta \vec{d}}{\Delta \vec{v}} = \frac{63000}{3} = 21000 \text{ s} \text{ or } 5.8 \text{ hours}$$

12. 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 forward, constant velocity

(ii) 2-4 s moving backward, constant velocity

(iii) 4-5 s stationary

(iv) 5-7 s moving backward, constant velocity

(v) 7-8 s moving forward, constant velocity

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

(i) 0-2 s $\vec{v} = \frac{10 - 0}{2 - 0} = 5 \text{ m/s}$

(ii) 5-7 s $\vec{v} = \frac{-4 - 5}{7 - 5} = -4.5 \text{ m/s}$

13. Define acceleration.

The change in velocity divided by time

14. A jet lands on a runway with an initial velocity of 72 m/s. 12 seconds later it comes to a stop. Calculate the acceleration of the jet?

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{0 - 72}{12} = -6 \text{ m/s}^2$

15. A car traveling with a velocity of 1.4 m/s accelerates to 5.6 m/s in 10s. Calculate the acceleration?

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{(5.6 - 1.4)}{10} = 0.42 \text{ m/s}^2$