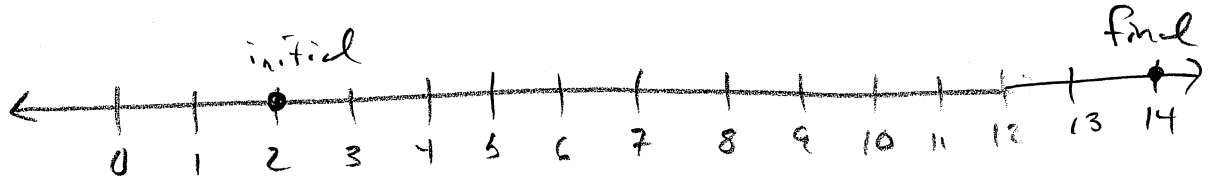
Basics of Motion

1. distance is how far something moves, not including direction.

displacement is the difference between final position and initial position (includes direction)

2. Car

(a)

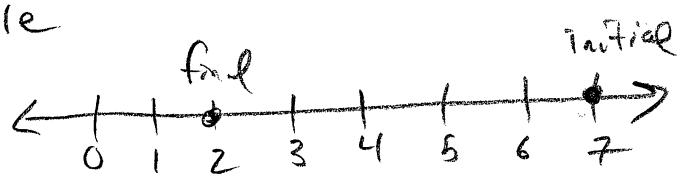


(b) distance = 12 m

(c) displacement = 12 m to the right

bicycle

(a)

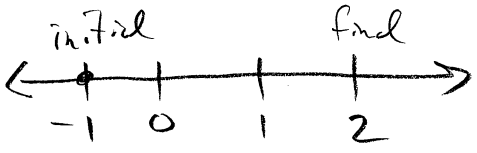


(b) distance = 5 m

(c) displacement = 5 m to the left

pedestrian

(a)

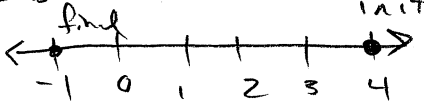


(b) distance = 3 m

(c) displacement = 3 m to the right

skateboarder

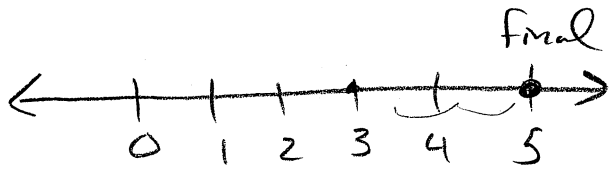
(a)



(b) distance = 5 m

(c) displacement = 5 m to the left

(3)



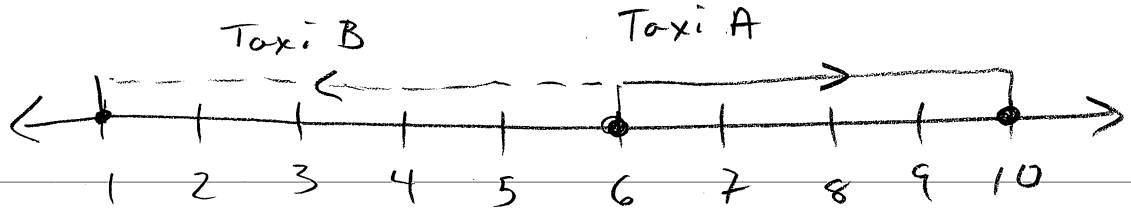
initial position = 3

$\Delta d = d_{final} - d_{initial}$

$2 = 5 - d_{initial}$

$d_{initial} = 3$

(4) (a)



(b) Taxi A

$\vec{\Delta d} = d_{final} - d_{initial}$

$= 10 - 6$

$= 4$ km right

Taxi B

$\vec{\Delta d} = d_{final} - d_{initial}$

$= 1 - 6$

$= -5$ km

$= 5$ km left

(c) Taxi B travels further in the same amount of time. Therefore, it must be moving faster.

(5) speed is just how fast something is traveling. velocity includes the direction of travel.

(6) $v_{av} = \frac{\Delta d}{\Delta t} = \frac{300.0 \text{ miles}}{5.5 \text{ hours}} = 54.5 \text{ miles/hour}$

(7) $v_{av} = \frac{\Delta d}{\Delta t}$

$330 \text{ m/s} = \frac{1500 \text{ m}}{\Delta t}$

$\Delta t = \frac{1500 \text{ m}}{330 \text{ m/s}} = 4.5 \text{ s}$

(8) $v_{av} = \frac{\Delta d}{\Delta t} = \frac{3260 \text{ km}}{4 \text{ hours}} = 815 \text{ km/h}$

(9) (a) $v_{av} = \frac{\Delta d}{\Delta t}$

$10 \text{ km/h} = \frac{\Delta d}{3.5 \text{ h}}$

$\Delta d = 35 \text{ km downstream}$

(b) $v_{av} = \frac{\Delta d}{\Delta t}$

$4 \text{ km/h} = \frac{35 \text{ km}}{\Delta t}$

$\Delta t = \frac{35 \text{ km}}{4 \text{ km/h}} = 8.75 \text{ hours}$

(10) (a) $\vec{v}_{av} = \frac{\vec{\Delta d}}{\Delta t} = \frac{36\ km}{1.2\ h} = 30\ km/h\ north$

(b) $\vec{v}_{av} = \frac{\vec{\Delta d}}{\Delta t} = \frac{17\ m}{2\ s} = 8.5\ m/s\ east$

(c) $\vec{v}_{av} = \frac{\vec{\Delta d}}{\Delta t} = \frac{2\ cm - 26\ cm}{0.5\ s} = -48\ cm/s$

(11) $\vec{v}_{av} = \frac{\vec{\Delta d}}{\Delta t}$

$2\ m/s = \frac{\vec{\Delta d}}{3.5\ s}$

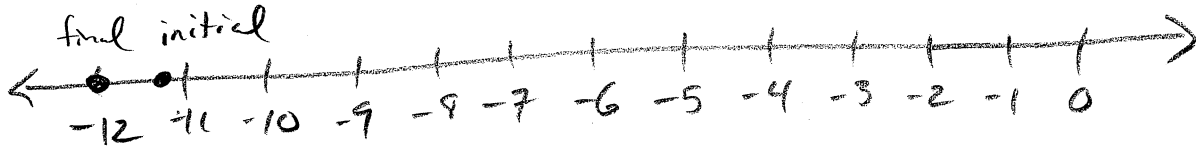
$\vec{\Delta d} = 7\ m$

(12) (a) the track is 12 m long.

(b) $\vec{v}_{av} = \frac{\vec{\Delta d}}{\Delta t}$

$1.5\ m/s = \frac{\vec{\Delta d}}{.5\ s}$

$\vec{\Delta d} = 0.75\ m$



(13) acceleration is the change in velocity divided by time.

(14) $\vec{a}_{av} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t} = \frac{0 - 72\ m/s}{12\ s} = -6\ m/s^2$

(15) $\vec{a}_{av} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t} = \frac{5.6\ m/s - 1.4\ m/s}{10\ s} = 0.42\ m/s^2$

(16) $\vec{a}_{av} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t} = \frac{0 - 24\ m/s}{.25} = -120\ m/s^2$

(17) $\vec{a}_{av} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t} = \frac{30\ m/s - 0}{4\ s} = 7.5\ m/s^2$

(18) $\vec{a}_{av} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t} = \frac{32\ m/s - 80\ m/s}{2\ s} = -24\ m/s^2$

(19) $100\ \frac{km}{h}\left(\frac{1000}{3600}\right) = 27.8\ m/s$

(20) $50\ \frac{km}{h}\left(\frac{1000}{3600}\right) = 13.9\ m/s$

$60\ \frac{km}{h}\left(\frac{1000}{3600}\right) = 16.7\ m/s$

$\vec{a}_{av} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t} = \frac{16.7\ m/s - 13.9\ m/s}{6\ s} = 0.47\ m/s^2$