Chapter 1, Sections 1.4-1.5

1.4 - A Sense of Scale: Significant Figures, Scientific Notation, and Units

(1.) Calculate the following quantities following the rules for significant figures given in the text.

(a) The average velocity of a car that goes $75.0\,m$ in $2.367\,s$.

3sig Fs   4sig Fis

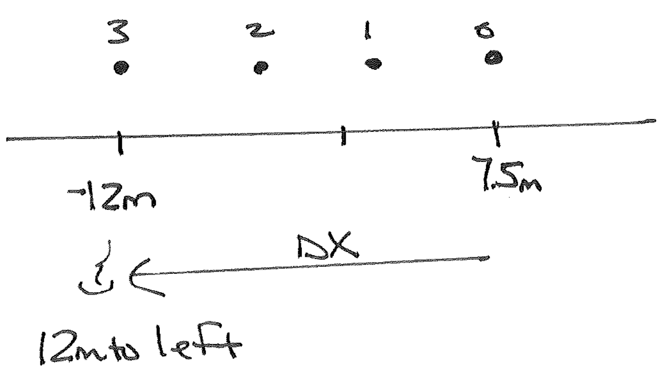
$$V = \frac{\Delta x}{\Delta t}$$

$$\Delta X = 75.0\,m, \quad \Delta t = 2.367\,s$$

$$V = \frac{75.0\,m}{2.367\,s} = 31.7\,m/s$$ ← 3 sig Fig

(b) The displacement of a bicyclist who starts $7.3\,m$ to the right of the origin and ends $12\,m$ to the left of the origin. Please include a motion diagram and coordinate system for this problem.

→ Assume Constant Speed



$$X_i = 7.5\,m$$

$$X_f = -12\,m$$

$$\Delta X = X_f - X_i = -12\,m - 7.5\,m = -19.5\,m = -20\,m$$

No places past decimal   1 place past decimal   Rounded to No places past decimal

2sig figs

(c) The distance traveled by an airplane in 7200 s if its average velocity is 242 m/s.

↳ 3sig figs

$V = \frac{\Delta X}{\Delta t}$ $\quad V = 242 m/s, \quad \Delta t = 7200s, \quad \Delta X = ?$

$\Delta X = V\Delta t \Rightarrow \Delta X = (242 m/s)(7200s) = 1,700,000m = 1.7\times10^{6}m$

↑ 2sig fig

(2.) Rank the following list of time intervals from longest to shortest by converting them all to the same unit. Table 1. 2 from the textbook may be helpful.

$$1500\,s, 16.5\,ns, 3.6\,ks, 700\,ms, 5\,Ms, 29\,\mu s$$

Convert to seconds: $1500s$, $\quad 16.5ns = 16.5(1\times10^{-9}s) = 1.65\times10^{-8}s$

$3.6Ks = 3.6(1000s) = 3600s$

$700ms = 700(1\times10^{-3}s) = .7s, \quad 5Ms = 5(1\times10^{6}s) = 5\times10^{6}s = 5,000,000s$

$29\mu s = 29(1\times10^{-6}s) = 2.9\times10^{-5}s$

THEREFORE: 5Ms, 3.6Ks, 1500s, 700ms, 29μs, 16.5ns

(3.) Using table 1. 3 from the textbook, determine whether each of the following statements are *reasonable*. Each question must have a correct unit conversion for full credit.

(a) Betty is 13400 μm tall.

$$13400\mu m = 13400\,(1\times10^{-6} m) = 0.0134 m \times \frac{39.37 in}{1 m} = 0.527 in$$

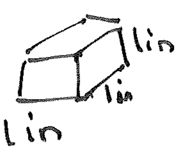
Unless Betty is a zygote.
Not reasonable.

(b) Usain Bolt can run 30 m/s.

$$30 m/s \times \frac{1 mph}{.447 m/s} = 67.1 mph$$ ← Not reasonable (even for him)

(c) I drank 37 in^3 of iced tea with lunch. (Here you may want to use the conversion that 1.0 ft^3 = 120 *cups*, and be careful with this one.)

in^3 is a volume



So to convert to ft^3, we have to convert each side.

$$12 in = 1 ft \Rightarrow 1 in^3 = (1 in)(1 in)(1 in) \hat{=} \left(\frac{1 ft}{12 in}\right)\left(\frac{1 ft}{12 in}\right)\left(\frac{1 ft}{12 in}\right) = \frac{1 ft^3}{12^3} = \frac{1 ft^3}{1728}$$

So $1 ft^3 = 1728 in^3$

$$37 in^3 \times \frac{1 ft^3}{1728 in^3} \times \frac{120 cups}{1 ft^3} = 2.6 cups$$ ← A lot but reasonable

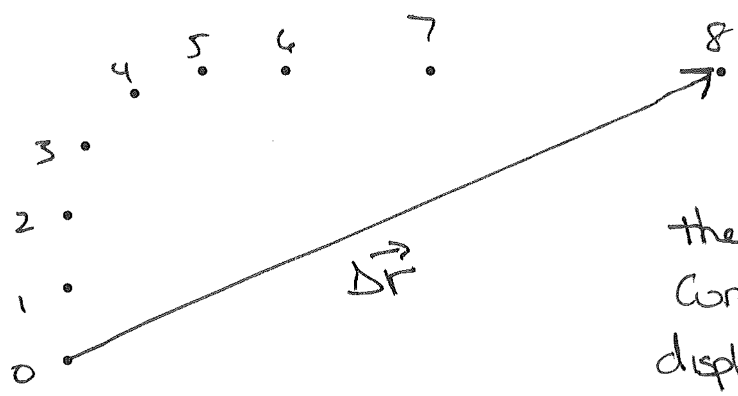
1.5 - Vectors and Motion: A First Look

(1.) For the following motion diagram:

(a) Label the dots as shown in figure 1. 4 of the textbook.

(b) Draw an arrow to indicate the displacement vector between the initial and final positions.

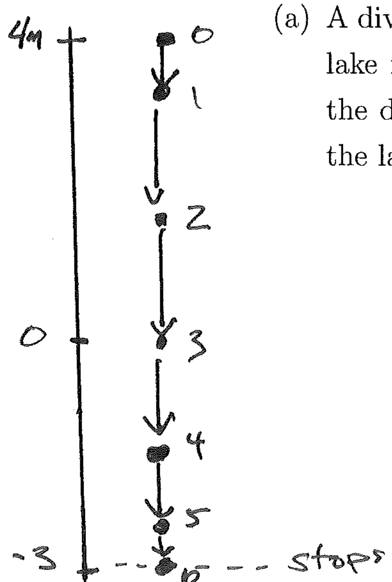
(c) Explain how and why the magnitude of the displacement vector is different from the distance the object travels.



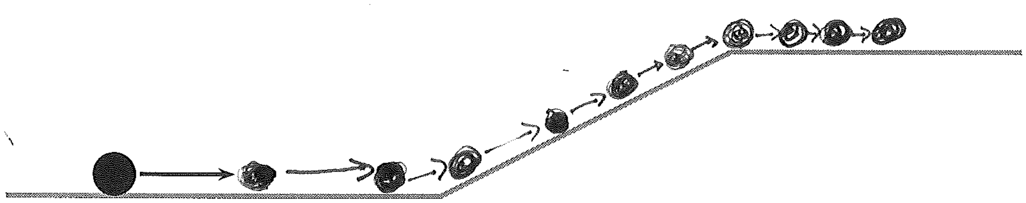
the object goes Along the Curved path from 0 to 8. displacement is straight-line. So distance is longer than magnitude of $\vec{\Delta r}$

(2.) Draw motion diagrams, like those shown in Figure 1. 26 of the textbook, for each motion described below. Use the particle model and include the velocity vectors.

(a) A diver jumps off a cliff that is $4\,m$ above the surface of a lake. The lake is $3\,m$ deep. After speeding up while falling through the air, the diver enters the water, slows, and stops just at the bottom of the lake.



(b) A bowling ball starts off rolling on a smooth horizontal surface. It then rolls up a ramp and goes onto another level surface at very low speed. Assume that the bowling ball rolls with constant speed on both horizontal surfaces.



Constant speed ⇒ EQUAL SPACING.

SLOWS DOWN going uphill ⇒ decreasing SPACE

ON top, constant slower speed ⇒ EQUAL SPACING

but CLOSER THAN AT BEGINING