SOLUTIONS
Worksheet 1: Math review and 1D motion

1 Sig Figs and Scientific Notation

1.1 How many significant figures does each of the following numbers have?

a. 6.21 3
b. 62.1 3
c. 6210 3
d. 6210.0 5

e. 0.062 2
f. 0.620 3
g. 0.62 2
h. 62 2

i. 1.062 4
j. 6.21 \times 10^3 3
k. 6.21 \times 10^{-3} 3
l. 62.1 \times 10^3 3

1.2 Compute the following numbers with the correct number of sig figs:

a. 33.3 \times 25.4 = \underline{846}
d. 2.345 \times 3.321 = \underline{7.788}

b. 33.3 - 25.4 = \underline{7.9}
e. (4.32 \times 1.23) - 5.1 = \underline{0.2}

1.3 Express the following numbers and computed results in scientific notation

a. 9.827 \underline{9.827 \times 10^3}
d. 32,041 \times 47 = \underline{1.5 \times 10^6}

b. 0.0000000550 \underline{5.50 \times 10^{-8}}
e. 0.059 \div 2,304 = \underline{2.6 \times 10^{-5}}

c. 3,200,000 \underline{3.2 \times 10^6}
f. 320 \times 0.050 = \underline{1.6 \times 10^1}

2 Algebra Review:

2.1 Simplify or solve each:

a. \frac{10^2}{(10^4)^2} = \underline{10^{-4}}
b. \frac{(10^2)^5}{(10^4)^6} = \underline{10^{-2}}
c. \frac{(10^2)^{10}}{10^{10}} = \underline{1}
d. \frac{10^9}{(10^4)^2} = \underline{10}
e. Solve for a: \[ a = \frac{2}{t^2} (y - v_0 t) \]
f. Solve for g: \[ g = \frac{4\pi^2 L}{T^2} \]
g. Solve for \[ \mu = \frac{v^2 r}{\mu g} \]

2.2 Solving systems of equations

A) \[ h = h_0 + v_0 t - \frac{1}{2} gt^2 \]
B) \[ v^2 = v_0^2 - 2gh \]
C) \[ v = v_0 - gt \]

1) You are given \( v_0 \), \( h_0 \), and \( g \) and the equations above. Do you have enough equations to solve for \( v \)? Can you do it with two equations? With one? Solve for \( v \):

Yes you can solve for \( v \). You have to use all three.

\[
v^2 = v_0^2 - 2g \left[ h_0 + v_0 \left( \frac{v_0 - v}{g} \right) - \frac{1}{2} g \left( \frac{v_0 - v}{g} \right)^2 \right]
\]

2) You are given \( v \), \( t \), and \( g \). Do you have enough equations to solve for \( h \)? Can you do it with two equations? With one? Solve for \( h \):

You can solve for \( h \) with Equations B and C.

\[
v_0 = v - gt \quad \Rightarrow \quad v^2 = (v - gt)^2 - 2gh
\]

Arrange (C) plug into (B)

\[
 h = \frac{(v - gt)^2 - v^2}{2g}
\]

3 SI Units and Dimensional analysis:

3.1 Convert the following to SI units. Work across the line and show all steps in the conversion. Use scientific notation and apply the proper use of significant figures.

a. \[ 9.12 \mu s \times \frac{1 s}{10^6 \mu s} = 9.12 \times 10^{-6} s \]

b. \[ 3.42 \text{ km} \times \frac{10^3 \text{ m}}{1 \text{ km}} = 3.42 \times 10^3 \text{ m} \]

c. \[ 44 \text{ cm/s} \times \frac{10^3 \text{ m}}{1 \text{ cm}} \times \frac{1 \text{ m}}{10^2 \text{ cm}} = 440 \text{ m/s} \]

d. \[ 80 \text{ km/hr} \times \frac{10^3 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ hr}}{3600 \text{ s}} = 22 \text{ m/s} \]

e. \[ 8 \text{ in} \times \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{1 \text{ m}}{10^2 \text{ cm}} = 0.2 \text{ m} \]

f. \[ 13 \text{ in}^2 \times \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right)^2 \times \left( \frac{1 \text{ m}}{10^2 \text{ cm}} \right)^2 = 8.3 \times 10^{-3} \text{ m}^2 \]

g. \[ 250 \text{ cm}^3 \times \left( \frac{1}{10^2 \text{ cm}} \right)^3 = 2.5 \times 10^{-4} \text{ m} \]
3.2 Determine which of the following statements are reasonable:

a. Joe is 180 cm tall. \[1.80 \text{ m} \approx 6 \text{ ft tall, which is reasonable}\]

b. I rode my bike to campus at a speed of 50 m/s \[\approx 120 \text{ mph, not reasonable}\]

c. A skier reaches the bottom of the hill going 25 m/s \[\approx 60 \text{ mph, reasonable}\]

d. I can throw a ball a distance of 2 km \[\text{not reasonable}\]

e. I can throw a ball at a speed of 50 km/hr \[\approx 30 \text{ mph, reasonable}\]

3.3 Use the following dimensions for variables to determine which equations are valid:

\[ [x] = [L], \quad [m] = [M], \quad [v] = [L]/[T], \quad [t] = [T], \quad [a] = [L]/[T]^2, \quad [A] = [L]^2, \quad [E] = [M][L]^2/[T]^2, \quad [F] = [M][L]/[T]^2, \quad [p] = [M][L]/[T], \quad [P] = [M][L]^3/[T]^2 \]

\[ x = vt \quad [L] = \frac{[L]}{[T]} \cdot [T] = [L], \quad \text{which is valid} \]

\[ x = \frac{1}{2}at^2 \quad [L] = \frac{[L]}{[T]^2} \cdot [T] = [L], \quad \text{Valid} \]

\[ v^2 = x + at \quad \left(\frac{[L]}{[T]^2}\right)^2 \not= [L] + \frac{[L]}{[T]^2}[L], \quad \text{not valid} \]

\[ v = at \quad \left(\frac{[L]}{[T]^2}\right) = \frac{[L]}{[T]^2} [T], \quad \text{Valid} \]

\[ F = ma \quad \frac{[M][L]^2}{[T]^2} = \frac{[M]}{[T]^2} [L], \quad \text{Valid} \]

\[ E = Fx \quad \frac{[M][L]^2}{[T]^2} \not= \frac{[M][L]^2}{[T]^2} [L], \quad \text{not valid} \]

\[ E = \frac{1}{2}p^2 \not= \frac{[M][L]^2}{[T]^2} \quad \not= \frac{[M][L]^2}{[T]^2} [L], \quad \text{not valid} \]
4. **Reading graphs**

![Graph of position vs. time](image)

1. During what time interval is there acceleration? **0 - 5 min**

2. During what time interval is there zero velocity? **5 - 6 min**

3. At what instant is velocity zero but acceleration nonzero? **t = 2.25 min**

4. During what time interval is there the highest speed? **4 - 5 min**

5. During what time interval is there slow down? **0 min - 2.25 min**

6. During what time interval is there speeding up? **2.25 min - 5 min**

7. Do your best to sketch graphs for velocity and acceleration

![Graph of velocity vs. time](image)  ![Graph of acceleration vs. time](image)
3. Vectors

Vectors shown:
- Components of the x and y
- Numerical values of determine
- Draw and

\[ \vec{A} + \vec{B} = \vec{C} \]

\[ \vec{A} - \vec{B} = \vec{C} \]

\[ \vec{A} + 2\vec{C} - \vec{B} = \vec{D} \]

\[ \vec{D} - \vec{B} = 2\vec{A} \]
Determine $A_x$ and $A_y$ in each coordinate system.

Define vector $A$ with magnitude=5, 30$^\circ$ above the horizontal.

- Find the magnitude and direction of the vector.

- Label the angle $\theta$ to describe the direction of the vector.

- Draw the vector on the axes provided.