SPH4U GRADE 12 PHYSICS

Data Analysis Practice

1. Give the number of **significant digits** in each of the following measurements.

a) 12.04 m ____ b) 156.00 kg ____ c) 0.065 cm ____ d) 0.00320 ms ____

e) 129 g ____ f) 2.5×10^5 s ____ g) 6.300×10^5 km ____ h) 1070 kg ____

2. a) *State the "weakest link rule" for determining the number of significant digits in the resultant when **multiplying or dividing** measured values:*

*State the "weakest link rule" for determining the precision of the resultant when **adding or subtracting** measured values:*

b) Perform the following calculations, rounding off the answers to the appropriate number of significant digits. Include the correct units in your answer.

i) 136.06 g + 2.1 g =

ii) 1560.35 kg + 242 kg =

iii) 8.5 m + 2.194 m – 3.45 m =

iv) 2.55 m ÷ 0.38 s =

v) 4.550 N × 1.2 m =

vi) 3.2 m × 1.455 m x 0.55m =

vii) 13.25 cm + 42.985 cm + 26.4 cm – 695 mm =

viii) 467.28 g ÷ (10.6 cm x 3.7 cm x 2.75 cm) =

3. Give the **units** that would result from each of the following calculations.

a) 15 m/s ÷ 5.0 s

b) 4 kgm ÷ 6 m/s

c) 5 m/s^2 × 4 s^2

d) 5 kgm/s^2 ÷ 3 s

e) 3 N ÷ 2 m^2

f) 16 kg/m^2 ÷ 4 m

4. Make the following unit conversions, using the "multiply by one" method. Keep the same number of significant digits after the conversion. Express the result in scientific notation if necessary! Show your work.

a) 3360 pm = ? nm

b) 678.2 kg = ? Mg

c) 0.00785 mm = ? µm

d) 1.5 year = ? seconds

e) 79 km/h = ? m/s

f) 6.3 m/s^2 = ? km/h^2

g) 494 Mg = ? Gg

h) 0.000056 m^3 = ? cm^3

5. a) *State the formula for finding* ***percent uncertainty*** *in a measurement given the* ***absolute uncertainty:***

b) Convert the following measurement uncertainties between absolute and percent uncertainty as indicated:

Quantity with absolute uncertainty	Quantity with percent uncertainty
24.0 ± 0.5 kg	= 24.0 kg ± 2 %
23.65 ± 0.05 s	
8.135 m ± 0.005m	
0.128 ± 0.005 g	
4.8 ± 0.5 km	

Quantity with percent uncertainty	Quantity with absolute uncertainty
37.5 kg ± 2 %	37.5 ± 0.8 kg
156 m ± 1 %	
6.3 s ± 5 %	
23.6cm ± 0.5 %	
18 g ± 3 %	

6.a) State the following rules for combining measurement uncertainties:

When adding or subtracting measured values we __________ the __________________ uncertainties.

When multiplying or dividing measured values we __________ the __________________ uncertainties.

b) Find the resultant for each calculation below and **determine the absolute uncertainty.**
In cases involving multiplication or division, you may need to convert to relative or percent uncertainties first.

i) $L_{total} = L_1 + L_2$, $L_1 = 5.35\ m \pm 0.02\ m$, $9.87\ m \pm 0.02\ m$

ii) $m_{total} = m_1 + m_2 + m_3$, $m_1 = 14.3 \pm 0.2\ kg$, $m_2 = 2.6 \pm 0.1\ kg$, $m_3 = 7.4 \pm 0.1\ kg$

iii) $\Delta t = t_2 - t_1$, $t_1 = 18.6 \pm 0.1\ s$, $t_2 = 39.5 \pm 0.1\ s$

iv) $A = L \times W$, $L = 1.64 \pm 0.05\ m$, $W = 0.65 \pm 0.05\ m$

v) $D = m / V$, $m = 67.4\ g \pm 1\%$, $V = 18.2\ cm^3 \pm 2\%$

vi) $v = \Delta d / \Delta t$, $\Delta d = 25.8 \pm 0.2\ m$, $\Delta t = 6.3\ s \pm 0.2\ s$

Graphical Analysis of Relationships

Determine the relationship between the variables in each data set below using the method below:

1) Draw a graph of the dependent variable (y) versus the independent variable (x).
2) Identify the possible relationship between the two variables. Create a second table in which the independent variable has been modified to attempt to linearize the graph. Re-plot the graph.
3) If the second graph is now linear, find the slope of your graph to determine the constant of proportionality. If the second graph is not linear, repeat step 2.

1. A cart was attached to a suspended mass by a string hanging over a pulley. The cart accelerated when the mass was released. The acceleration of the cart was measured as the total mass of the system was varied by adding mass to the top of the cart. The relationship between the measured acceleration (a) and the total mass (m) of the system is shown below:

[mass-independent (x), acceleration-dependent (y)]

Total Mass , m (kg)	Acceleration , a (m/s^2)
1.00	2.46
1.20	2.08
1.40	1.76
1.60	1.56
1.80	1.39
2.00	1.22
2.20	1.13
2.40	1.05
2.60	0.94
2.80	0.89

2. The light intensity (power per square meter) produced by a light bulb was measured as a function of distance from the bulb using a device called a photometer. The relationship between measured light intensity (I) and distance from the bulb (d) is shown below:

[distance-independent (x), intensity-dependent (y)]

Distance from bulb (d) (m)	Light Intensity (I) (W/m^2)
1.0	25.0
1.5	11.1
2.0	6.3
2.5	4.0
3.0	2.8
3.5	2.0
4.0	1.6
4.5	1.2
5.0	1.0

3. The period (time for one full cycle) of a simple pendulum (T) was measured as a function of pendulum length (L).. The relationship between Period (T) and pendulum length (L) is shown below:

[length-independent (x), period-dependent (y)]

Length , L (cm)	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	50.0	60.0	70.0	80.0
Period, T (s)	0.0	0.45	0.63	0.78	0.89	1.02	1.10	1.18	1.25	1.43	1.55	1.68	1.80