IB Chemistry SL Unit 0 Practice

Significant Digits

1) The measurement, 206 cm, has how many significant (measured) digits?
2) The measurement, 206.0 °C, has how many significant digits?
3) The measurement, 0.00206 g, has how many significant digits?
4) The measurement, 0.0020600 mole, has how many significant digits?
5) The measurement, 2.060×10^{-3} coulombs, has how many significant digits?
6) The measurement, 20600 molecules, has how many significant digits?
7) Add the following three numbers and report your answer using significant figures:

   2.5 cm + 0.50 cm + 0.055 cm = ?
8) Subtract the following numbers and report your answer using significant figures:

   416 g – 210. g = ?
9) Multiply the following three numbers and report your answer to the correct number of significant figures:

   0.020 cm x 50. cm x 11.1 cm = ?
10) Divide the following three numbers and report your answer to the correct number of significant figures:

    0.530 g / 0.1010 mL = ?

Propagation of Uncertainties

Adding and subtracting values: *Rule: Add uncertainties!*

1) 1.00 ± 0.05 g of Copper is added to 10.00 g ± 0.05 g of Iron. What is the mass of the two, together?

2) The starting volume on a buret is 40.00 ± 0.02 mL. The final volume on the buret is 32.60 ± 0.02 mL. What volume of liquid was removed from the buret?

3) The weighing boat weighs 2.45 ± 0.01 g. The total weight, after adding Calcium Carbonate to the weighing boat is 4.62 ± 0.01 g. What is the mass of the calcium carbonate?

Multiplying and dividing by a constant value (constant value means the value has no uncertainty). *Rule: Multiply or Divide the uncertainty by the constant value (in other words, do the same thing to the uncertainty that you did to the value!)*

1) Unit conversion
   a) How many milligrams is 0.000120 ± 0.000005 g?
   b) How many milligrams is $1.20 \times 10^{-4} \pm 5 \times 10^{-6}$ g?
   c) How many milligrams is $(1.20 \pm 0.05) \times 10^{-4}$ g?
   d) All of the above are the same problem, which is the best way to write the question?

2) Mole conversions
   a) How many moles in 12.01 ± 0.02 g of Aluminum?

   b) How many atoms in 1.45 ± 0.04 moles of Aluminum?

   c) How many atoms in 3.24 ± 0.01 g of Aluminum?

Multiplying and dividing when both values have uncertainty *Rule: 1) Find the fractional uncertainty for each value given in the problem, 2) Add the fractional uncertainties together 3) Find the absolute uncertainty of the desired quantity by multiplying the result of step 2) times the desired quantity.*

1) Molarity: Calculate the molarity when 2.0 ± 0.1 moles of NaCl is dissolved in 100. ± 1 mL of water.

2) Density: Calculate the density of an object with mass 25.0 ± 0.2 g and volume 50.0 ± 0.5 mL

3) Density: Calculate the density of a rectangular object with mass of 32.0 ± 0.2 g, length of 1.25 ± 0.05 cm, width of 2.25 ± 0.05 cm and height of 3.35 ± 0.05 cm.

Standard Deviation and Error Analysis

1) In 1894 Lord Rayleigh prepared "nitrogen" by two independent methods: (*1*) by chemically removing the oxygen, water vapour and carbon dioxide from air, and (*2*) by reducing NO over hot iron. He then measured the mass (in g) of a given volume of the nitrogen which yielded the following results.

From air	2.31017	2.30986	2.31010	2.31001
From NO	2.30143	2.29890	2.29816	2.30182

a) Estimate the mean and standard deviation of the mass measured by each method.

b) In your opinion is there a systematic difference between the two sets of results? Can you think of a possible reason for *any* difference you find?

2) When HI is heated it dissociates reversibly: $HI \rightleftharpoons \frac{1}{2} H_2 + \frac{1}{2} I_2$ The following values have been measured for the degree of dissociation of HI at 629 K.

0.1953, 0.1968, 0.1956, 0.1937, 0.1949, 0.1948, 0.1954

a) Calculate the mean and standard deviation of these measurements.

b) The literature value for the dissociation of HI is 0.1989. Are the measurements precise, accurate, both, or neither? Explain your choice.

3) Identify each of the following as an error due to either random or systematic errors. Then, suggest a way to overcome these errors.

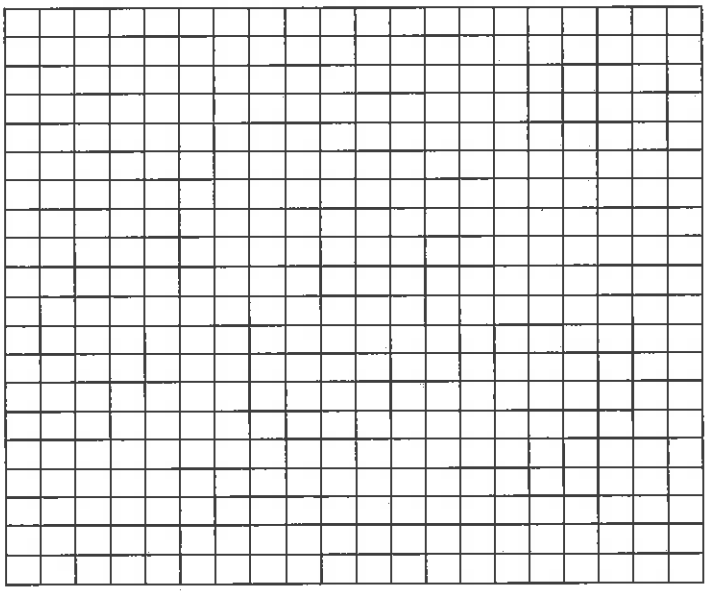
a) You measure the mass of an individual object three times and obtain masses of 17.44g, 17.46g, and 17.41g.

b) A meterstick is used to measure the length of your classroom. However, the meterstick had been previously dropped on its end repeatedly, crushing the end of the meterstick.

Graphing

1) Plot the data appropriately. Draw an appropriate line of best fit.

# of Days	# of Bacteria
1	4
2	16
3	40
4	80
5	100
6	200



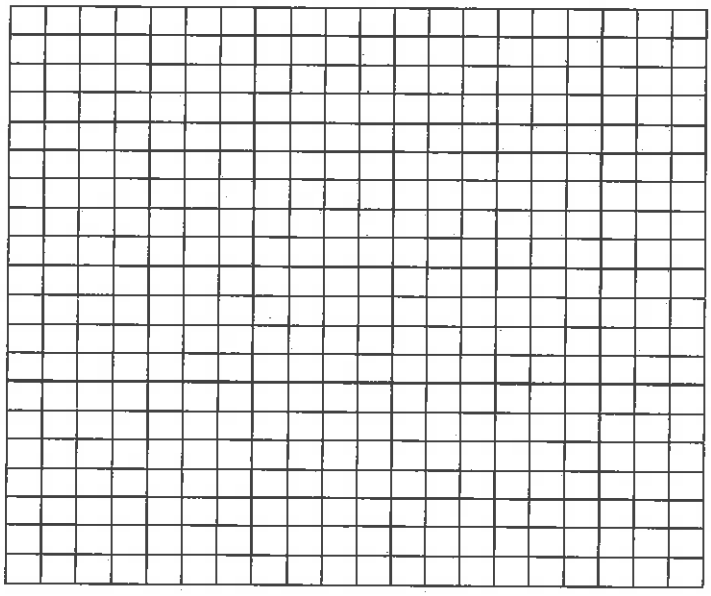
a) What is the independent variable? _____

b) What is the dependent variable? _____

c) Graphically determine the growth rate (bacteria per day) between days 3 and 5. _____

2) *Plot the data appropriately. Draw and determine the slope of a line of best fit.*

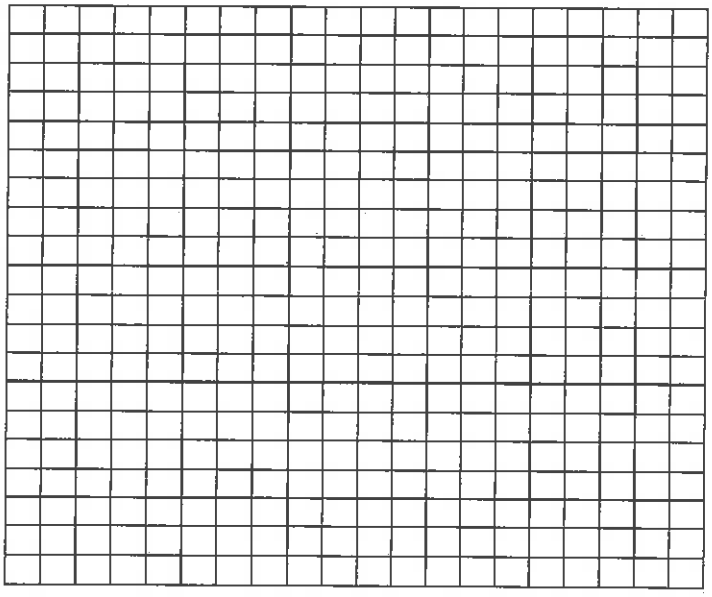
# of Hours of Study	Grade
0	20
2	60
4	70
6	80
8	90
10	100



a) What is the independent variable? _____
b) What is the dependent variable? _____
c) What was the average grade earned? _____

3) *Plot the data appropriately. Draw an appropriate line of best fit.*

Temperature	Enzyme Activity
0	0
20	10
30	15
40	20
50	8
60	5
70	0



a) What is the independent variable? _____
b) What is the dependent variable? _____