IB Chemistry 1.1, 1.2, 11.1, 11.2 Review Sheet

Name: Key
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-Matter: Mixtures, Stubstances, Phase Change (1.1)
-***Don't forget*** – naming compounds and writing formulas, balancing equations, assigning state symbols
-Dimensional analysis (unit conversions)
-Moles → Grams conversions (1.2)
-Using mole ratios from a balanced equation
-Finding empirical/molecular formula, percent/theoretical yield, limiting reactants
-Finding uncertainty and error

Topic 1: Stoichiometric relationship

1.1 Introduction to the particulate nature of matter and change

- atoms of different elements combine in fixed ratios to form compounds, which have different properties from their component elements (ex. pure sodium metal v. sodium chloride)
- mixtures contain more than one element and/or compound that are not chemically bonded together and so retain their individual properties (ex. Intro lab, separation of a mixture)
- mixtures are either homogeneous or heterogeneous
- deduction of chemical equations when reactants and products are specificed
- application of state symbols (s), (l), (g), and (aq) in equations
- explanation of observable changes in physical properties and temperature during changes of state

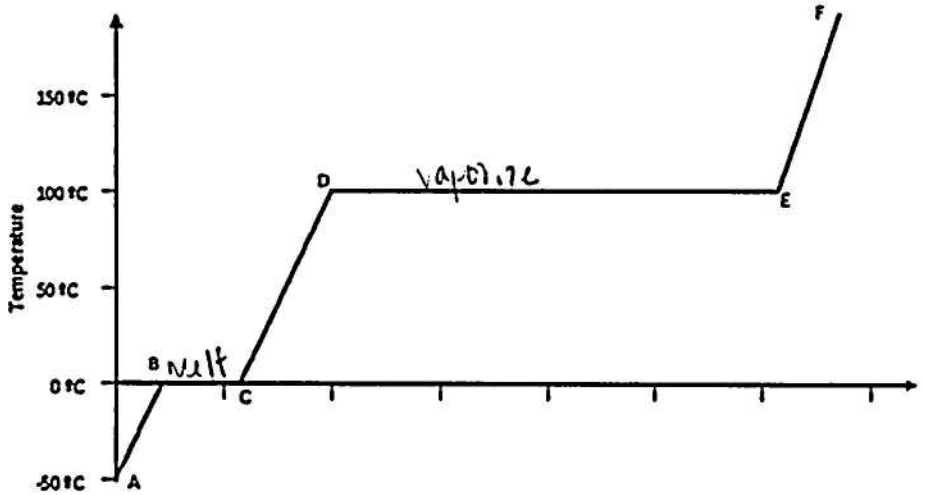
Example Questions:

1. What is the sum of the coefficients for the equation when balanced using the smallest possible whole numbers?

$$1N_2H_4(g) + 3O_2(g) \rightarrow 2NO_2(g) + 2H_2O(g)$$

↑ not necessary unless for questions like this =

A. 5
B. 6
C. 7
D. 8 D



Use the above graph to answer the following questions:

2. The graph most likely represents:
   A. super cooled nitrogen gas returning to room temperature
   B. ice water being heated at a constant rate until it boils B
   C. the combustion reaction of ethane and oxygen gas

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D. solid lauric acid being heated at a constant rate until it melts

3. The phase change occurring between point D and E on the graph could best be described as:
   i. Melting
   ii. Evaporation
   iii. Vaporization ←
   iv. Sublimation

4. It is observed that when two liquids are mixed, the color of the solution changes. It can then be inferred that:
   A. a physical change occurred
   B. a chemical change occurred
   C. both a chemical and physical change occurred
   D. neither a chemical nor physical change occurred

5. Match the following types of reactions:

D 1. Synthesis	A. $Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$
E 2. Combustion	B. $CuSO_4 + Fe \rightarrow FeSO_4 + Cu$
B 3. Single Replacement	C. $2H_2O \rightarrow 2H_2 + O_2$
A 4. Double Replacement	D. $8Fe + S_8 \rightarrow 8FeS$
C 5. Decomposition	E. $2C_4H_{10} + 13O_2 \rightarrow 10H_2O + 8CO_2$

6. What are the 7 elements that exist as diatomic gases under normal conditions?
(HOFBrINCl) $H_2\ O_2\ F_2\ Cl_2\ N_2$

7. Apply state symbols to the following reactions:

$2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$

$Fe_{(s)} + CuSO4_{(aq)} \rightarrow Cu_{(s)} + FeSO_{4(aq)}$

$2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$

8. Write balanced chemical equations ***with state symbols*** for the following reactions:
   A. Solid lithium metal and water react to form aqueous lithium hydroxide and hydrogen gas

$Li_{(s)} + 2H_2O_{(l)} \rightarrow 2LiOH_{(aq)} + H_{2(g)}$

   B. Lead (II) Nitrate reacts with sodium chloride in a double displacement reaction (all reactants and products are in aqueous solution)

$Pb(NO_3)_{2(aq)} + 2NaCl_{(aq)} \rightarrow PbCl_{2(s)} + 2NaNO_{3(aq)}$

   C. C_3H_6 gas reacts with oxygen gas in a combustion reaction

$C_3H_{6(g)} + O_{2(g)} \rightarrow H_2O_{(g)} + 3CO_{2(g)}$

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D. Potassium nitrate decomposes when heated into potassium nitrite and oxygen gas

$KNO_{3(s)} \rightarrow KNO_{2(s)} + O_{2(g)}$

E. Solid magnesium metal reacts with hydrochloric acid in a single replacement reaction

$Mg_{(s)} + HCl_{(aq)} \rightarrow H_{2(g)} + MgCl_{2(aq)}$

1.2 The mole concept

- the mole is a fixed number of particles and refers to the amount, n, of a substance
- masses of atoms are compared on a scale relative to ^{12}C and are expressed as relative atomic mass (A_r) and relative formula/molecular mass (M_r)
- molar mass (M) has the units g/mol or g mol^{-1}
- the empirical and molecular formula of a compound give the simplest ratio and the actual number of number of atoms present in a molecule respectively

Example Questions:

9. Which sample has the greatest mass?

A. 1 mol of SO_2 → 64.05
B. 2 mol of N_2O → 44 x 2 = 88
C. 2 mol of Ar → 40 x 2 = 80
D. 4 mol of NH_3 → 17 x 4 = 68

B

10. What is the total number of hydrogen atoms in 1.0 mol of benzamide, $C_6H_5CONH_2$?

A. 7
B. 6.0×10^{23}
C. 3.0×10^{24}
D. 4.2×10^{24}

7
7 x (6.02 x 10^{23})
D

11. Which is both an empirical and a molecular formula?

A. C_5H_{12} → cannot!
B. C_5H_{10} → can be reduced
C. C_4H_8 → can be reduced
D. C_4H_{10} → can be reduced!

A

12. The molar mass of a compound is approximately 56 g mol^{-1}. Which formula is possible for this compound?

A. $NaNO_3$ → 85
B. AgOH → 124
C. MgO → 40
D. KOH → 56

g/mol

13. Which sample has the greatest mass?

A. 6.0×10^{25} molecules of hydrogen, $6.02 \times 10^{23} = 99.67$ g
B. 5.0 mol of neon atoms x 20.17 = 100.9 g
C. 1.2×10^{24} atoms of silver / 6.02×10^{23} x 107 = 214 g
D. 1.7×10^2 g of iron
170 g

C

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g/mol

14. On analysis, a compound with molar mass 60 g mol^{-1} was found to contain 12 g of carbon, 2 g of hydrogen and 16 g of oxygen. What is the molecular formula of the compound?

A. CH_2O
B. CH_4O
C. C_2H_4O
D. $C_2H_4O_2$

C

12/12 = 1 2/1 = 2 16/16 = 1 (1:2:1 CH_2O emp)

60/30 = 2 × CH_2O

$C_2H_4O_2$

15. Equal masses of the metals Na, Mg, Ca and Ag are added to separate samples of excess HCl(aq). Which metal produces the greatest total volume of $H_2(g)$?

*

A. Na
B. Mg
C. Ca
D. Ag

We didn't address this yet

16. Which one of the following statements about SO_2 is/are correct?

i. One mole of SO_2 contains 1.8×10^{24} atoms
II. One mole of SO_2 has a mass of 64g

A. Both I and II
B. Neither I nor II
C. I only
D. II only

17. A pure compound contains 24g of carbon, 4 g of hydrogen, and 32 g of oxygen. No other elements are present. What is the empirical formula of the compound?

E. $C_2H_4O_2$
F. CH_2O
G. CH_4O
H. CHO

24/12 = 2 4/1 = 4 32/16 = 2

reduce 1 2 1

CH_2O

18. What is the empirical formula for the compound $C_6H_5(OH)_2$?

A. C_6H_6O
B. $C_6H_5O_2H_2$
C. C_6H_7O
D. $C_6H_7O_2$

D

$C_6H_7O_2$

can't reduce

19. Smog is common in cities throughout the world. One component of smog is PAN (peroxyacylnitrate) which consists of 20.2 % C, 11.4 % N, 65.9 % O and 2.50 % H by mass.
Determine the empirical formula of PAN, showing your work.

20.2/12 = 1.68 mol C/0.814 = 2.06
11.4/14 = 0.814 mol/0.814 = 1
65.9/16 = 4.11 mol O/0.814 = 5.04
2.50/1 = 2.50 mol H/0.814 = 3.07

$C_2NO_5H_3$

20. 0.600 mol of aluminium hydroxide is mixed with 0.600 mol of sulfuric acid, and the following reaction occurs:

$\_2\_ Al(OH)_3(s) + \_3\_ H_2SO_4(aq) \rightarrow \_1\_ Al_2(SO_4)_3(aq) + \_6\_ H_2O(l)$

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(a) Balance the equation
(b) Determine the limiting reactant.

$0.600\,mol\ Al(OH)_3 \left| \frac{3\,mol\ H_2SO_4}{2\,mol\ Al(OH)_3} \right. = 0.900\,mol\ H_2SO_4$ needed

H_2SO_4 is limiting reactant

(c) Calculate the mass of $Al_2(SO_4)_3$ produced.

$0.600\,mol\ H_2SO_4 \left| \frac{1\,mol\ Al_2(SO_4)_3}{3\,mol\ H_2SO_4} \right. \left| \frac{342.132\,g}{1\,mol} \right. = 68.4\,g\ Al_2(SO_4)_3$ produced

(d) Determine the amount (in g) of excess reactant that remains.

$0.600\,mol\ H_2SO_4 \left| \frac{2\,mol\ Al(OH)_3}{3\,mol\ H_2SO_4} \right. \left| \frac{77.979\,g}{1\,mol} \right. = 46.7874\,g$ have

$= 31.1916\,g$ reacted

$15.5958\,g = 15.6\,g$ leftover of excess

21. Aspirin, $C_9H_8O_4$, is made by reacting ethanoic anhydride, $C_4H_6O_3$ (Mr = 102.1), with 2-hydroxybenzoic acid (Mr = 138.1), according to the equation:

$$2C_7H_6O_3 + C_4H_6O_3 \rightarrow 2C_9H_8O_4 + H_2O$$

a. If 15.0g 2-hydroxybenzoic acid is reacted with 15.0g ethanoic anhydride, determine the limiting reagent in this reaction.

$15.0\,g\ C_4H_6O_3 \left| \frac{1\,mol}{102.1\,g} \right. \left| \frac{2\,mol\ C_7H_6O_3}{1\,mol\ C_4H_6O_3} \right. \left| \frac{138.1\,g}{1\,mol\ C_7H_6O_3} \right. = 40.6\,g$ needed $C_7H_6O_3$

$C_7H_6O_3$ limits

b. Calculate the maximum mass of aspirin that could be obtained in this reaction.

$15.0\,g\ C_7H_6O_3 \left| \frac{1\,mol\ C_7H_6O_3}{138.1\,g} \right. \left| \frac{2\,mol\ C_9H_8O_4}{2\,mol\ C_7H_6O_3} \right. \left| \frac{180.159\,g}{1\,mol} \right. = 19.6\,g$ aspirin theoretically obtained

c. If the mass obtained in this experiment was 13.7g, calculate the percentage yield of aspirin.

$$\%\ yield = \left(\frac{13.7\,g}{19.6\,g}\right) \times 100 = 69.9\%$$

22. Determine the empirical and molecular formulas of each of the following substances:

a. Styrene, a compound substance used to make Styrofoam cups and insulation, contains 92.3% C and 7.7% H by mass and has a molar mass of 104 g/mol.

CH = emp. f.

C	H
12	1
7.69	7.7
7.69	7.67
=1	=1

$\frac{104}{13} = 8 \times CH$

C_8H_8 = Molec. f.

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b. Caffeine, a stimulant found in coffee, contains 49.5% C, 5.15% H, 28.9% N, and 16.5% O by mass and has a molar mass of 195 g/mol.

emp

$C_4H_5N_2O$

12 1 14 16

11 11 11 = 1.03/1.03

4.125 5.15 2.06/1.03 = 1

1.03 = 5 = 2

molecular

$\frac{195}{97} = 2 \times (C_4H_5N_2O) = C_8H_{10}N_4O_2$ 1.03 = 4

c. Monosodium glutamate (MSG), a flavor enhancer in certain foods, contains 35.51% C, 4.77% H, 37.85% O, 8.29% N, and 13.60% Na, and has a molar mass of 169 g/mol.

35.51/12 = 2.959 /0.59 = 5

4.77/1 = 4.77 /0.59 = 8

37.85/16 = 2.365/0.59 = 4

8.29/14 = 0.59/0.59 = 1

13.6/23 = 0.59/0.59 = 1

emp form = $C_5H_8O_4NNa$

$\frac{169}{169} = 1$

Molecular formula is the same

d. Ibuprofen, a headache remedy, contains 75.69% C, 8.80% H, and 15.51% O by mass, and has a molar mass of 206 g/mol.

12 1 16

C 6.3075/0.969 = 6.5 x 2 = 13

H 8.80/0.969 = 9 x 2 = 18

O 0.969375/0.969 = 1 x 2 = 2

$C_{13}H_{18}O_2$

$\frac{206}{206} = 1$ Molecular formula is the same

e. Cadaverine, a foul-smelling substance produced by the action of bacteria on meat, contains 58.55% C, 13.81% H, and 27.40% N by mass; its molar mass is 102.2 g/mol.

12 1 14

C 4.879/1.95 = 2.5 x 2 = 5

H 13.81/1.95 = 7 x 2 = 14

N 1.95/1.95 = 1 x 2 = 2

$C_5H_{14}N_2$

$\frac{102.2}{102} = 1$

Molecular formula the same

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Exercises

24 Give the empirical formulas of the following compounds:

(a) ethyne: C_2H_2 — a) CH
(b) glucose: $C_6H_{12}O_6$ — b) CH_2O
(c) sucrose: $C_{12}H_{22}O_{11}$ — c) $C_{12}H_{22}O_{11}$
(d) octane: C_8H_{18} — d) C_4H_9
(e) oct-1-yne: C_8H_{14} — e) C_4H_7
(f) ethanoic acid: CH_3COOH — f) CH_2O

25 A sample of a compound contains only the elements sodium, sulfur, and oxygen. It is found by analysis to contain 0.979 g Na, 1.365 g S, and 1.021 g O. Determine its empirical formula.

$\frac{23}{} \quad \frac{32}{} \quad \frac{16}{}$

$0.0425 \quad 0.04265 \quad 0.06381$

$0.0425 = 1 \times 2 \quad 0.0425 = 1 \times 2 \quad 0.0425 = 1.5 \times 2$

$Na_2S_2O_3$

26 A sample of a hydrated compound was analysed and found to contain 2.10 g Co, 1.14 g S, 2.28 g O, and 4.50 g H_2O. Determine its empirical formula.

$\frac{58.93}{} \quad \frac{32}{} \quad \frac{16}{} = 0.1425/0.03565 = 4$

$0.03565 \quad 0.035625/0.03565 = 1 \quad 0.1425/0.03565 = 4$

$18 = .25/0.03565 = 7$

$CoSO_4 \cdot 7H_2O$

hydrate!!

27 A street drug has the following composition: 83.89% C, 10.35% H, 5.76% N. Determine its empirical formula.

$\frac{}{12} \quad \frac{}{1} \quad \frac{}{14}$

C $6.9908/0.4114 = 17$
H $10.35/0.4114 = 25$
N $0.4114/0.4114 = 1$

$C_{17}H_{25}N$

28 The following compounds are used in the production of fertilizers. Determine which has the highest percentage by mass of nitrogen: NH_3, $CO(NH_2)_2$, $(NH_4)_2SO_4$.

$\frac{14}{17} = 82\% \quad \frac{28}{60} = 46\% \quad \frac{28}{132} = 21\%$

29 A compound has a formula M_3N where M is a metal element and N is nitrogen. It contains 0.673 g of N per gram of the metal M. Determine the relative atomic mass of M and so its identity.

$0.673 + 1g = 1.673g$

$\frac{0.673}{1.673} = 40\%$

60%

$40.2g/14 = 2.87$

M_3N

$60g/x = 3(2.87) = 8.62$

$x = 6.96$
Lithium
7

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30 Compounds of cadmium are used in the construction of photocells. Deduce which of the following has the highest percentage by mass of cadmium: CdS, CdSe, CdTe.

$\frac{112.41}{144.41} = 77\%$ $\frac{112.41}{191.37} = 58\%$ $\frac{112.41}{240.01} = 46\%$

31 Benzene is a hydrocarbon, a compound of carbon and hydrogen only. It is found to contain 7.74% H by mass. Its molar mass is 78.10 g mol^{-1}. Determine its empirical and molecular formulas.

$7.74/1 = 7.74 \text{ mol H}/7.68 = 1$ (CH) $\frac{78.1}{13} = 6$

$92.26/12 = 7.68/76\ell = 1$ C_6H_6

32 A weak acid has a molar mass of 162 g mol^{-1}. Analysis of a 0.8821 g sample showed the composition by mass is 0.0220 g H; 0.3374 g P, and the remainder was O. Determine its empirical and molecular formulas.

$2.49\text{gH} \left| \frac{1\text{mol}}{1\text{gH}} \right. = 2.49\text{mol H}/1.23 = 2$

$38.24\text{gP} \left| \frac{1\text{mol}}{30.97\text{gP}} \right. = 1.23 \text{ mol P}/1.23 = 1$

$59.27\text{gO} \left| \frac{1\text{mol}}{15.99\text{gO}} \right. = 3.7\pi \text{ mol O}/1.23 = 3$

H_2PO_3 $\frac{162}{81} = 2 \times H_2PO_3$ $H_4P_2O_6$

33 ATP is an important molecule in living cells. A sample with a mass of 0.8138 g was analysed and found to contain 0.1927 g C, 0.02590 g H, 0.1124 g N, and 0.1491 g P. The remainder was O. Determine the empirical formula of ATP. Its formula mass was found to be 507 g mol^{-1}. Determine its molecular formula.

$(0.1927/.8138) \times 100\% = 23.67/12 = 1.9725/.5929 = 3.33 \times 3$

$(.02590/.8138) \times 100\% = 3.182/1 = 3.182/.5929 = 5.33 \times 3$

$(.1124/.8138) \times 100\% = 13.81/14 = 0.9865/.5929 = 1.66 \times 3$

$(.1491/.8138) \times 100\% = 18.32/31 = 0.5929/.5929 = 1 \times 3$

$= 41.01/16 = 2.5635/.5929 = 4.33 \times 3$

$C_{10}H_{16}N_5P_3O_{13}$ ugh

34 A 0.30 g sample of a compound that contains only carbon, hydrogen, and oxygen was burned in excess oxygen. The products were 0.66 g of carbon dioxide and 0.36 g of water. Determine the empirical formula of the compound.

$C_xH_yO_z + O_2 \rightarrow \frac{4}{\pi} H_2O_{(g)} + \frac{3}{\pi} CO_{2(g)}$

0.30g 0.36g/18 0.66g/44

$C_3H_8O + 4O_2 \rightarrow$ $0.02/.015 = 1.33$ $0.015/.015 = 1$

4 : 3

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35 You are asked to write your name on a suitable surface, using a piece of chalk that is pure calcium carbonate, $CaCO_3$. How could you calculate the number of carbon atoms in your signature?

mass of chalk used x $\frac{1 \text{ mol}}{?\ g\ CaCO_3}$ = x mol $CaCO_3 \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol C}}$

Topic 11: Measurement and data processing analysis

11.1 Uncertainties and errors in measurements and results

- qualitive data include all non-numerical information obtained from observations not from measurement
- quantitative data are obtained from measurements, and are always associated with random errors/uncertainties, determined by the apparatus, and by how human limitations such as reaction times
- propagation of random errors in data processing shows the impact of the uncertainties on the final result
- experimental design and procedure usually lead to systematic errors in measurement, which cause a deviation in a particular direction
- repeat trials and measurements will reduce random errors but not systematic errors

Solve the following mathematical problems such that the answers have the correct number of significant figures:

36) 334.54 grams + 198 grams = 533 g
37) 34.1 grams / 1.1 mL = 31 mL
38) 2.11×10^3 joules / 34 seconds = 62 J/s
39) 0.0010 meters – 0.11 meters = −0.11 m
40) 349 cm + 1.10 cm + 100 cm = 450 cm
41) 450 meters / 114 seconds = 3.9 m/s
42) 298.01 kilograms + 34.112 kilograms = 325.12 kg
43) 84 m/s x 31.221 s = 2600 m

IB Chemistry Error Notes and Worksheet

Uncertainty Rules for performing calculations:

x = value dx = absolute uncertainty of the value	$x \pm dx$

from here down

We didn't get to CO this stuff .. We will... not on this test

Averaging values (i.e. multiple trials, up to 8): to find $x_{avg} \pm dx_{avg}$

Uncertainty of average = $\frac{\text{(range of trials)}}{\text{(\# of trials)}}$

$x_{avg} = \frac{x_1 + x_2 + x_3 + x_4 + \ldots}{N}$ and, $\delta x_{avg} = \frac{x_{max} - x_{min}}{N}$

44. Practice problem: Julie times how long it takes for a 1.0g of sodium metal to completely react in 200 cm^3 of water. The data is stated in the table below. What average value should be stated for this experiment?

Trial Number	1	2	3	4

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Time ± 2 sec	23	25	22	21

$x = \frac{23+25+22+21}{4} = 23$ $\quad c\,x = \frac{25^{max} - 21^{min}}{4} = 1$

(now do #12 in the chapter 11 problems) 23 ± 1 sec.)

Adding or Subtracting values w/ uncertainty: to find $c \pm \bar{d}c$

Absolute Uncertainty on final value = sum of absolute uncertainties

Ex: If $(a \pm dc) + (b \pm db) = c \pm dc$

Then, $a + b = c$ and, $\delta c = \delta a + \delta b$

45. Practice problem: Noa is frustrated by how quickly her coffee is cooling. She takes an initial temperature reading of 80±0.5°C and another reading after 2 minutes when the temperature is 70±0.5°C. What is the change in temperature?

$80 - 70 = 10\,^\circ C$ $\quad (10 \pm 1\,^\circ C)$

$0.5 + 0.5 = 1\,^\circ C$

(now do #13 and 14 in the chapter 11 problems)

Multiplying or Dividing values w/ uncertainty: to find $z \pm dz$

Percent Uncertainty on final value = sum of percent uncertainties

Ex: If $(x \pm dx)(y \pm dy) = (z \pm dz)$

Then, $x \cdot y = z$ and, $\frac{\delta z}{z} = \left(\frac{\delta x}{x}\right) + \left(\frac{\delta y}{y}\right)$

And the absolute uncertainty, $\delta z = \left[\left(\frac{\delta x}{x}\right) + \left(\frac{\delta y}{y}\right)\right] \cdot z$

46. Practice problem: You cut a piece of paper to be a square so that you can make an origami crane.  You measure a square 20±0.1cm by 20±0.1cm. What is the area of this square?

1. Find the error using the absolute uncertainty formula above.

$20 \times 20 = 400\,cm^2$

$\frac{0.1}{20} = 0.5\% + 0.5\% = 1\%$ $\quad 400cm^2 \pm 4cm^2$

$\text{absolute} = \frac{1\%}{100} \times 400cm^2 = 4$

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2. Find the error by finding the percent uncertainty and then adding them together.

oops — See above :)

47. Practice problem: (from notes) The lengths of the sides of a wooden block are measured to be 40.0±0.5cm and 20.0±0.5cm. What would the absolute uncertainty of the block be?

$\left(\frac{0.5}{20.0}+\frac{0.5}{40}\right) \times 800^{cm^2} = 30cm$ $800cm^2 \pm 30$

Raising a value to a power:

Percent uncertainty on final value = multiply percent uncertainty by the power

Ex. If $y \pm dy = (x \pm dx)^n$ then, $y = x^n$

And the absolute uncertainty, $\delta y = \left[n \cdot \left(\frac{\delta x}{x}\right)\right] \cdot y$

48. Practice problem: You are measuring the volume of an origami cube that you just built. You measure each side to be 5±0.5cm, what would its volume be? $5 \times 5 \times 5 = 125\ cm^3$

Multiplying/Dividing by a number without uncertainty:

Keep the same percent uncertainty on final value

$(.30) \times 125 = 37.5$

$125\ cm^3 \pm 37.5 cm^3$

$\frac{0.5}{5} = 10\%$

$+10\%$

$+10\%$

30%

Ex. If $(x \pm dx)(constant)$ then, $(constant)(x) \pm (constant)(dx)$

So that $\frac{\delta x}{x} = \frac{(constant) \cdot \delta x}{(constant) \cdot x}$

49. Practice problem: Elizabeth is running over Imogene Pass. The pass is 13,114±2 ft at the top, how many meters is this? (1 foot = 0.3048m)

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Practice problems:

50. You are measuring the temperature of your Mitchell's ice cream as it melts over the course of 2 minutes. 

Time (minutes)	0	0.5	1.0	1.5	2.0
Temp (±0.1°C)	-10	-8	-8	-7	-6

What is the average temperature over the course of the 2 minutes?

Do you think there was error on the time?

51. You are measuring the area of the top of your desk. You estimate it to be 37±0.5cm by 22±0.5cm, what is the area of the top of your desk?

a. When trees "sneeze," the branches are estimated to move 0.5±0.1m, if a tree sneezes 3 times, how far would one branch move?