Sponne School

Science Faculty

CHEMISTRY DEPARTMENT

Introduction to Salters

Advanced Level Chemistry

Induction Tasks

1. Calculations in Chemistry

2. Presentation Task

Name: .....

Induction Task 1 – Calculations in Chemistry

1. Calculation of the Relative Molecular Mass of compounds

Calculate the Relative Molecular Mass of the following. You will need access to a periodic table.

a. H_2O …… **b.** CO_2 …… **c.** NH_3 ……

d. SO_2 …… **e.** C_2H_4 …… **f.** C_2H_5OH ……

g. SO_3 …… **h.** HBr …… **i.** H_2SO_4 ……

2. The Mole...

When chemists measure how much of a particular chemical reacts they measure the amount in grams; or they measure the volume of a gas. However, chemists find it convenient to use a unit called a ***mole***. The **mole** is the amount of substance, which contains the same number of particles (atoms, ions, molecules, formulae or electrons) as there are carbon atoms in 12 g of C^{12}. In other words, 12g of carbon contains 1 mole of atoms. This gives the following calculation:

$$\text{Moles} = \frac{\text{Mass of substance}}{\text{Relative molecular mass of substance}}$$

In this set of calculations all the examples chosen are from the list of compounds whose relative molecular mass you calculated in question 1. In each case calculate the number of moles of the material in the mass stated.

a. 9.00 g of H_2O

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b. 88.0 g of CO_2

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c. 1.70 g of NH_3

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d. 230 g of C_2H_5OH

e. 560 g of C_2H_4

f. 0.640 g of SO_2

g. 80.0 g of SO_3

h. 18.0 g of HBr

i. 0.0960 g of H_2SO_4

j. 3.15 g of HNO_3

3. Calculation of the mass of material in a given number of moles of the material

In each case calculate the mass in grams of the material in the number of moles stated.

a. 2 moles of H_2O

b. 3 moles of CO_2

c. 2.8 moles of NH_3

d. 0.50 moles of C_2H_5OH

e. 1.2 moles of C_2H_4

f. 0.64 moles of SO_2

g. 3 moles of SO_3

h. 1 mole of HBr

4. Calculation of a formula from experimental data

Calculate the empirical formula of the compound from the data given. This may be as percentage composition or as the masses of materials found in an experiment (hint: work out the number of moles of each element, and then work out the ratio of moles).

a. Pb 92.8%; O 7.20%

b. Pb 90.66g; O 9.34g

c. C 75%; H 25%

d. C 81.81%; H 18.18%

e. H 5.88g; O 94.12g

f. 22.3 g of an oxide of lead produced 20.7 g of metallic lead on reduction with hydrogen. Calculate the empirical formula of the oxide concerned.

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5. Balancing equations

Balance the following equations. In one or two difficult examples some of the numbers have been added. You will not need to change these. Also remember all the molecular formulae are correct!

a. $H_2 + O_2 \rightarrow H_2O$

b. $BaCl_2 + NaOH \rightarrow Ba(OH)_2 + NaCl$

c. $H_2SO_4 + KOH \rightarrow K_2SO_4 + H_2O$

d. $K_2CO_3 + HCl \rightarrow KCl + H_2O + CO_2$

e. $CaCO_3 + HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$

f. $Ca + H_2O \rightarrow Ca(OH)_2 + H_2$

g. $Pb(NO_3)_2 + NaI \rightarrow PbI_2 + NaNO_3$

h. $Al_2(SO_4)_3 + NaOH \rightarrow Al(OH)_3 + Na_2SO_4$

i. $Al(OH)_3 + NaOH \rightarrow NaAlO_2 + H_2O$

j. $Pb(NO_3)_2 \rightarrow PbO + NO_2 + O_2$

6. What's wrong here?

The following equations have one or more mistakes. These may be in a formula, in the balancing, in the state symbols or even in the chemistry. Your job is to identify the error and then write a correct equation.

1 $Na_{(s)} + H_2O_{(l)} \rightarrow NaOH_{(aq)} + H_{(g)}$

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2 $PbNO_{3(aq)} + NaCl_{(aq)} \rightarrow PbCl_{(s)} + NaNO_{3(aq)}$

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3 $CaOH_{2(aq)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + 2H_2O_{(l)}$

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4 $C_2H_{4(g)} + 2O_{2(g)} \rightarrow 2CO_{2(g)} + 2H_{2(g)}$

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5 $MgSO_{4(aq)} + 2NaOH \rightarrow Ca(OH)_{2(s)} + Na_2SO_{4(aq)}$

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6 $Cu(NO_3)_{2(s)} + CuO_{(s)} \rightarrow 2NO_{(g)} + O_{3(g)}$

7. Calculations of reacting masses

Use the information in each question to work out the mass of the reactant or product involved in the reaction stated (hint: work out the moles of the substance that you know the mass for. Then, work out the number of moles of the requested substance, using the balanced equation. Finally, work out the mass of this substance by rearranging the equation given at the start of question 2).

a. In the following reactions calculate the mass of metal hydroxide formed from 20 g of the metal sulfate in each case.

(i) $ZnSO_{4(aq)} + 2NaOH \rightarrow Zn(OH)_{2(s)} + Na_2SO_{4(aq)}$

(ii) $Al_2(SO_4)_{3(aq)} + 6NaOH \rightarrow 2\ Al(OH)_{3(s)} + 3Na_2SO_{4(aq)}$

(iii) $MgSO_{4(aq)} + 2NaOH \rightarrow Mg(OH)_{2(s)} + Na_2SO_{4(aq)}$

b. What mass of barium sulphate would be produced from 10 g of barium chloride in the following reaction? ($BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$)

c. What mass of potassium chloride would be produced from 20 g of potassium carbonate? (Use the equation that you balanced in 5d).

Induction Task 2 – Presentation Task

How do we know about atoms?

Introduction

No one yet has been able to look inside atoms to see what they are really like. The typical picture of an atom we have in our minds is neither 'the truth' nor 'the right answer' – it is a good working *model* which helps to explain many phenomena.

Much evidence has been gathered to support the current model of an atom. The model may change as more evidence comes to light, and it is very likely to become more detailed.

We can sometimes explain things using only a simplified model of the atom. Thinking of atoms as tiny spheres is sufficient to explain the states of matter (the properties of solids, liquids and gases) – but this model is not detailed enough to explain why metals tend to react with non-metals. Models can be simple or elaborate, depending on the job they need to do. Keep this in mind as your ideas and understanding of chemistry develop.

What you do

How has the current model of the atom developed? Many scientists contributed to the sequence of gathering knowledge about the atom, but some made particularly important discoveries – they were:

- Joseph J. Thomson (key discovery 1897–1899)
- Hans Geiger, Ernest Marsden and Ernest Rutherford (key discovery 1909)
- Henry Moseley (key discovery 1913)
- James Chadwick (key discovery 1932).

Prepare a ***presentation*** on each of the scientists given above. Cover the following points:

- who they are
- when they did the work
- what they already knew about the atom
- what they did
- what they found out
- what conclusions were drawn from their results.

Use suitable textbooks, magazine articles or the Internet to help you to find the information you need (ask a chemistry teacher if you are stuck).

You could start by searching the Salters Advanced Chemistry website.

You will need to decide what information and images to include and what to leave out.

You will be asked to present to the class in September so ensure that you know your presentation well.