A-level Chemistry Transition Task

At A-level there are several calculations that you need to be able to complete. These are from the AQA Separate Chemistry and/or the AQA Combined Science Trilogy courses. To help you know which calculations are for the AQA Separate Chemistry (8642), AQA Combined Science Trilogy (8646) or, if some are new calculations for which you will not have studied before and so will need to carry-out so research, the following codes are used:

-B=both
-S=just covered in separate chemistry
-N=new for A-level study

(B) Relative Formula Mass, Mr (Spec. Refs. Combined Science 5.3.1.2, Chemistry 4.3.1.2)

1. Calculate the Relative Formula Mass (Mr) for:

CH_3COOH H_2SO_4 $Ca(OH)_2$ $CuSO_4$ $Al_2(SO_4)_3$

(B) Moles Spec. Refs. Combined Science 5.3.2.1, Chemistry 4.3.2.1)

2. How many moles are there in:

    a. 1g of Hydrogen atoms
    b. 1g of Hydrogen molecules, H_2
    c. 24.3g of Mg
    d. 16.0g of Oxygen
    e. A student knows they have 1 mole of Oxygen. If the mass is 16.0g, is the formula O or O_2?

3. a) How many moles in 14.6g of Ethanoic Acid (Vinegar) CH_3COOH
   b) How many grams in 0.01 moles of Hydrogen Sulfate H_2SO_4
   c) Calculate the mass of 2 moles of $Ca(OH)_2$

(S) Percentage Yield Calculations (Separate Chemistry AQA spec. ref. 4.3.3.1)

4. A reaction that could produce a theoretical mass of 200g of product produces only 140g. What is the percentage yield?

5. The theoretical yield for a reaction was 175g and the actual yield was 173.2g, what was the % yield?

6. From the equation $CaCO_3 \rightarrow CaO + CO_2$

    - What is the theoretical mass of CaO? In a reaction, 40.0g of CaO was made, calculate the % yield of CaO

    - What is the theoretical mass of CO_2? In a reaction, 38.7g of CO_2 were made calculate the % yield of CO_2

(B) Reacting Masses Calculations using the idea of the mole. Spec. Refs. Combined Science 5.3.2.2, Chemistry 4.3.2.2)

7. Iron (III) chloride can be produced by the reaction shown in the equation:

    $$2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$$

    Calculate the maximum mass of iron (III) chloride ($FeCl_3$) that can be produced from 14.70 g of iron.

    Relative atomic masses (Ar): Cl = 35.5; Fe = 55.8

8. From the reaction: $2Mg + O_2 \rightarrow 2MgO$

    Calculate the mass of magnesium needed to make 75 g of magnesium oxide.

    Relative atomic masses (Ar): Mg = 24.3; O = 16.0

9. From the reaction: $2Cu + O_2 \rightarrow 2CuO$

   Calculate the mass of copper that would be needed to make 66.0 g of copper oxide.

   Relative atomic masses (Ar): Cu = 63.5; O = 16.0

(N) Empirical Formula Calculations Using the Mole

10. An unknown Organic compound was found to contain 0.12g of carbon and 0.02g of Hydrogen. Calculate its empirical formula.

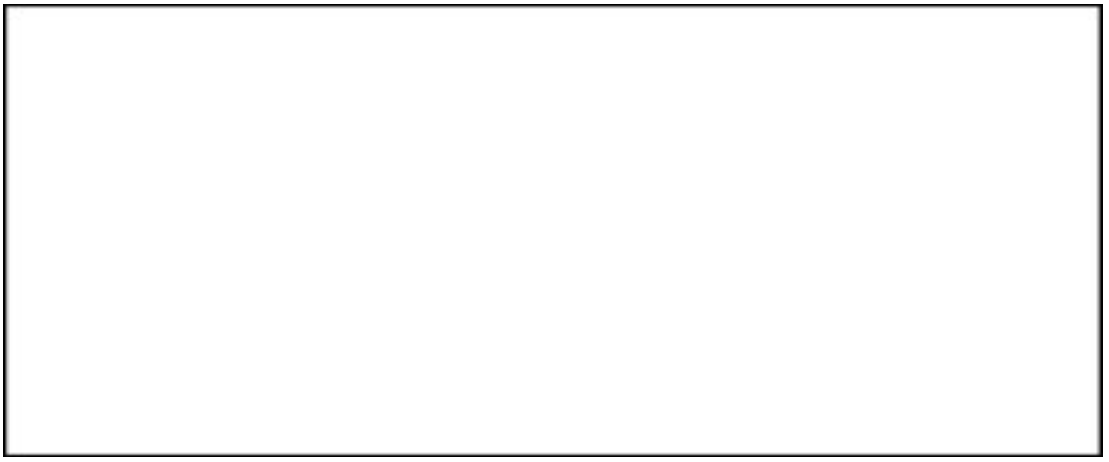
11. Calculate the empirical formula of an organic compound containing 92.3% Carbon and 7.7% Hydrogen by mass.

12. Calculate the empirical formulae of the following compounds with the following compositions:

    a) 20.0g Mg 26.6g S 53.3g O

    b) 35.5% N 5.0% H 60.0% O

(S) Titration calculations (Separate Chemistry AQA Spec. Ref. 4.3.4)
We can use the results from a titration between an acid and a base to identify an unknown concentration of one of these compounds. To carry-out these calculations we use the formula:



13. A student added 27.25cm^3 of hydrochloric acid from a burette to completely neutralise 25.00cm^3 of sodium hydroxide of concentration 0.10 mol dm^{-3}. Calculate the concentration of the hydrochloric acid **in mol dm^{-3} and g dm^{-3}.**

14. A student found that it takes 15.0cm^3 of 0.50 moldm^{-3} hydrochloric acid to neutralise 10.0cm^3 of potassium hydroxide solution.
What is the concentration of the potassium hydroxide solution **in mol dm^{-3} and g dm^{-3}.**

15. 75.0cm^3 of 0.50mol dm^{-3} hydrochloric acid required 21.6cm^3 of sodium hydroxide for complete reaction. Calculate the concentration of the sodium hydroxide solution in **mol dm^{-3} and g dm^{-3}**.

(B) Working Scientifically-Key Vocabulary

Look at the tables below and answer the questions that follow

True value = 24.6 kJ/mol

Energy Released/ kJ/mol Run 1	Energy Released/ kJ/mol Run 2	Energy Released/ kJ/mol Run 3	Mean Energy Released/ kJ/mol
23.8	25.2	24.1	24.4

Energy Released/ kJ/mol Run 1	Energy Released/ kJ/mol Run 2	Energy Released/ kJ/mol Run 3	Mean Energy Released/ kJ/mol
14.2	14.4	14.5	14.4

Energy Released/ kJ/mol Run 1	Energy Released/ kJ/mol Run 2	Energy Released/ kJ/mol Run 3	Mean Energy Released/ kJ/mol
16.132	7.478	1.917	8.509

Which set of results is:

a) The most precise.
b) The most accurate.
c) Shows the highest resolution.
d) The least precise.

(S) Working Scientifically - Applying this to required practical techniques

16. In question 14, what is the % uncertainty in the volume delivered from the burette? (At A-level, to calculate % uncertainty you use the following equation)

A burette has an error value of =/- 0.1 cm^3

16.1.
In question 14, the Potassium Hydroxide was delivered using a 10cm^3 pipette. (the pipette has an error value of +/- 0.06 cm^3). What is the % uncertainty in the volume delivered by the pipette?

16.2.
If the experiment were repeated, what could be done to reduce the size of the % uncertainty when measuring out the quantity of both the hydrochloric acid and the potassium hydroxide?