Second Year HL Chemistry

Final Review: Stoichiometry

1. M03 None!
2. Nov 02/5

5. An element X reacts with oxygen to form the oxide X_2O_3.

(a) Write a balanced equation for the reaction. *[1]*

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(b) If 2.199 g of the oxide was obtained from 1.239 g of X, calculate the relative atomic mass of X and identify the element. *[5]*

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(c) Nitrogen also forms an oxide on reaction with oxygen. This oxide contains 25.9 % of nitrogen and 74.1 % of oxygen by mass. Calculate the empirical formula of this second oxide. *[3]*

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3. M02/2. The existence of isotopes in magnesium can beshown usinga mass spectrometer. The operation of a mass spectrometer can be described in terms of five main stages. The first is evaporation and the last is detection.

   (a) After evaporation, the magnesium is then ionised. Outline how it is ionised. [2]

   (b) State the names, in the correct order, of the other two stages, and in each case state the technique used. [4]

(c) The relative abundances of the three isotopes of magnesium are as follows:
24Mg = 78.6%, 25Mg = 10.1%, 26Mg = 11.3%

Calculate the relative atomic mass ofmagnesium using these values, giving your answer to three decimal places. [2]

(d) Write the electronic configuration of magnesium using the spdf notation. [1]

4. M02/3. A student is asked to prepare some copper(II) nitrate by reacting nitric acid with copper(II) oxide.

(a) Write a balanced equation for this reaction. [1]

(b) The student carries out this reaction byadding 0.0345 mol of copper(II) oxide to 36.0 cm3 of 1.15 moldm-3 nitric acid solution. Calculate the amount (in mol) of nitric acid. [1]

(c) Use the information in (a) and (b) to identify the limitingreagent and determine the amount (in mol) of copper(II) nitrate formed. [2]

(d) The product of this reaction is isolated as copper(II) nitrate trihydrate. Calculate the molar mass of copper(II) nitrate trihydrate and the mass of product obtained. [2]

5. M02 CPS/1. (a) Research has now determined that nicotine is an addictive component of tobacco used in cigarettes. Chemical analysis showed that nicotine contained 74.07 % carbon, 8.64 % hydrogen and 17.28 % nitrogen. The molecular mass of nicotine is 162.

(i) Determine the empirical formula of nicotine. [3]

(ii) Calculate the molecular formula of nicotine. [3]

(iii) Predict whether nicotine would be a polar or non-polar molecule. [1]

(b) Bromine exists in nature as isotopes Br-79 and Br-81. Given that the relative atomic mass of bromine is 79.9, what percentage of each isotope is present in nature? [3]

(c) In an experiment, copper was converted into a series of different compounds. Write balanced chemical equations for the following reactions.

(i) Copper is reacted with 8 M nitric acid to produce a solution of copper(II) nitrate and a brown pungent gas. No copper metal remains. [2]

(ii) The copper nitrate is reacted with 2 M sodium hydroxide to form a light blue precipitate of copper hydroxide. [2]

(iii)100 dm3 of water is added to the precipitate, and the solution is heated to form a black copper(II) oxide precipitate due to a decomposition reaction occurring. [2]

(iv) The copper (II) oxide precipitate is decanted from the solution and washed with water to remove any excess reactants. The precipitate is added to 50 dm3 of 2 M sulfuric acid. An aqua-blue solution is formed. [2]

(v) Some pieces of zinc are added to the aqua-blue solution. [2]

6. N01/2. Indigo is a blue dye which contains only carbon, nitrogen, hydrogen and oxygen.

(a) 2.036 gof indigowas completelyoxidised to produce 5.470 gof carbon dioxide and 0.697 g of water. Calculate:

(i) the percentage by mass of carbon in indigo; [2]

(ii) the percentage by mass of hydrogen in indigo. [2]

(b) If the percentage by mass of nitrogen in the indigo sample is 10.75 %, determine the empirical formula of indigo. [3]

(c) If the molar mass is approximately 260 1, determine the molecular formula of indigo.gmol- [2]

7. M01/2. (a) An anti-cancer drug called Cisplatin has the following percentage composition by mass:
   %,Pt= 65.01 Cl= 23.63 %, N= 9.340 %, H= 2.020 %.

   Calculate the empirical formula of Cisplatin.

   (Relative Atomic Masses are Pt = 195.09, Cl= 35.45, N = 14.01, H =1.01 [3]

   (b) The molecular and empirical formulas of Cisplatin are the same. Analysisof the molecule shows platinum to be the central atom, being bonded to four separate atoms; the hydrogen is bonded to nitrogen. Draw a representation of the molecule. [1]

   (c) 16.20 x 10−3 dm3 of 0.1020 mol dm-3 aqueous AgNO3 is added to 14.80 x 10−3 dm3 of 0.1250 mol dm-3 aqueous NaCl. Calculate the maximum mass (g) of AgCl which could be obtained from this reaction. (Relative Atomic Masses are Ag = 107.87, Cl = 35.45.) [4]

8. N00. No stoimetry question.