GCE AS LEVEL CHEMISTRY

S21- B410

Assessment Resource C

Structure of Matter and Simple Reactions

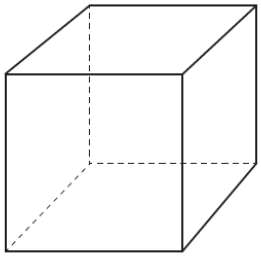
1. Complete the electronic structure for the Br^- ion. [1]

$1s^2 2s^2 2p^6 3s^2$ .....

2. An element absorbs green light with a wavelength of 500 nm. Another element absorbs red light. Suggest a value for the wavelength of this absorption. [1]

..... nm

3. Complete the diagram below to show the arrangement of ions in a sodium chloride lattice. [1]



4. A and B react according to the equation shown.

$$A(g) + 2B(g) \rightleftharpoons AB_2(g)$$

The equilibrium constant, K_c, for this reaction is 1.47 $dm^6 mol^{-2}$. At equilibrium the concentration of A was 0.2 mol dm^{-3}, and that of AB_2 was 0.4 mol dm^{-3}. Calculate the concentration of B. [2]

Concentration of B = ... mol dm^{-3}

5. Use ideas that you have studied in your Chemistry course to comment on and explain the following observations.

(a) When dilute sulfuric acid is added to aqueous magnesium chloride no visible change occurs but when it is added to aqueous barium chloride a white precipitate is observed.

Include an equation for any reaction that you describe. [3]

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(b) The bond angles in sulfur hexafluoride, SF_6, are 90°.

You should include a diagram in your explanation. [3]

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(c) Street lights containing sodium vapour emit yellow light. [4]

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6. *(a)* Both silicon oxide and silicon chloride are covalent compounds. Silicon has a valency of four in both compounds. At room temperature silicon chloride is a liquid whilst silicon oxide is a solid.

(i) Draw a dot and cross diagram to show the bonding in silicon chloride. Show outer electrons only. [2]

(ii) What is the bond angle in silicon chloride? [1]

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(iii) When silicon chloride is added to water, solid silicon oxide and a solution with a pH of less than 7 are formed.

Write the equation for this reaction. Include state symbols. [2]

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(iv) Suggest why silicon oxide is a solid with a very high melting temperature whereas silicon chloride is a liquid at room temperature. [4]

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(b) The acidity of solutions can be compared using the pH scale.

(i) Calculate the pH of 0.60 mol dm^{-3} nitric acid, HNO_3. [2]

pH = ...

(ii) A student was told that the pH of water is 7.0. The student tested a sample of hot water and found the pH to be 6.9.

Calculate, in mol dm^{-3}, the concentration of hydrogen ions present. [1]

Concentration = ... mol dm^{-3}

(iii) The equilibrium for the dissociation of water is shown.

$$H_2O \rightleftharpoons H^+ + OH^-$$

Use the fact that the pH of the hot water in part (ii) was 6.9 to deduce whether this reaction is exothermic or endothermic. Explain your reasoning. [3]

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(c) Magnesium reacts with hydrochloric acid.

$$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

A sample of magnesium of mass 5.00 g was reacted with excess hydrochloric acid. 4.31 dm^3 of hydrogen, measured at 273 K and 1 atm pressure, were produced.

Calculate the percentage purity of the sample of magnesium. [2]

Percentage purity = ... %

7. *(a)* Several different compounds containing sodium, chlorine and oxygen exist. One of these decomposes on heating as shown in the equation.

$$2NaClO_3(s) \longrightarrow 2NaCl(s) + 3O_2(g)$$

(i) What is the oxidation state of chlorine in $NaClO_3$? [1]

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(ii) Calculate the maximum volume of gas, measured at 600 K and 1 atm pressure, that can be made by heating 88.0 g of $NaClO_3$. Give your answer to an **appropriate** number of significant figures. [3]

Volume = ... dm^3

(b) The active component of bleach is sodium chlorate(I), NaClO. This is prepared by passing chlorine into aqueous sodium hydroxide.

$$2NaOH(aq) + Cl_2(g) \longrightarrow NaClO(aq) + NaCl(aq) + H_2O(l)$$

Calculate the atom economy of this process when used to prepare sodium chlorate(I). [2]

Atom economy = ... %

(c) Another compound containing sodium, chlorine and oxygen has the following composition by mass.

Na 18.8 % Cl 29.0 % O 52.2 %

Calculate its empirical formula.

[2]

Empirical formula .....