

Answer ALL questions in the spaces provided.

1. (a) A sample of an element can be analysed using a mass spectrometer. State how the following are achieved in this instrument:

(i) ionisation

 (2)

(ii) deflection

 (1)

(b) The following data were obtained from the mass spectrum of a sample of gallium.

Peak at m/c	%
69.0	60.4
71.0	39.6

Calculate the relative atomic mass of this sample of gallium, to 3 significant figures.

(2)

(c) An atom contains five protons and five neutrons.

(i) Give the symbol for this atom, including the mass number.

${}_{11}^{20}\text{B}$
 (2)

(ii) Complete the electronic configuration of this atom.

1s²
 (1)

(iii) Give the formula of the compound formed between this element and chlorine.

.....
 (1)

(Total 9 marks)

Q1

2. Phosphorus(III) chloride, PCl_3 , can be formed by the reaction of phosphorus and chlorine.



- (a) (i) Calculate the maximum mass of phosphorus(III) chloride, PCl_3 , which could be obtained from 93.0 g of phosphorus.

(3)

- (ii) Calculate the minimum volume of chlorine required to react completely with 93.0 g of phosphorus.

[One mole of gas occupies a volume of 24.0 dm^3 under the conditions of the experiment].

(2)

- (iii) Identify the oxidising agent in the above reaction and explain your answer.

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.....

(2)

(b) (i) Draw a dot and cross diagram for a molecule of PCl_3 .

(2)

(ii) Draw the predicted shape of a PCl_3 molecule and mark on the diagram a value for the bond angle.

(2)

(c) Suggest the name for the shape of the PCl_4^+ ion.

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(1)

(Total 12 marks)

Q2

3. (a) State the type of bonding in the following substances and draw diagrams to illustrate their 3-dimensional structures.

(i) Diamond

Bonding

Diagram

(3)

(ii) Sodium chloride

Bonding

Diagram

(3)

(b) Explain why both diamond and sodium chloride have high melting temperatures.

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(3)

(c) Explain why sodium chloride conducts electricity when molten but not when solid.

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(2)

(Total 11 marks)

Q3

4. (a) (i) Define the term first ionisation energy.

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(3)

(ii) State and explain the general trend in the first ionisation energy across the period sodium to argon of the Periodic Table.

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(3)

(b) (i) Write an equation to illustrate the process occurring when the second electron affinity of nitrogen is measured.

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(2)

(ii) Explain why the second electron affinity of any element is endothermic.

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(2)

(Total 10 marks)

Q4

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5. (a) (i) Write the ionic half-equation to show the oxidation of calcium, Ca, to calcium ions, Ca^{2+} .

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(1)

(ii) Write the ionic half-equation to show the reduction of water to hydrogen, H_2 , and hydroxide ions, OH^- .

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(1)

(iii) Combine the two ionic half-equations above to produce an equation which shows the effect of adding calcium to water.

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(1)

(iv) State what you would expect to see when calcium is added to water.

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(2)

(b) State the trend in solubility of the hydroxides of the Group 2 elements as the atomic number increases.

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(1)

(c) Write an equation to show the reaction between sodium and chlorine, to produce sodium chloride.

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(2)

(Total 8 marks)

Q5

6. (a) Identify a halogen which, at room temperature, is:

a solid

a liquid

a gas

(3)

(b) Explain why the hydrogen halides, such as hydrogen chloride, HCl, are:

(i) water soluble

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(2)

(ii) acidic in aqueous solution

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(1)

(c) By consideration of intermolecular forces, explain why the boiling temperature of hydrogen fluoride, HF, is higher than that of hydrogen iodide, HI.

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(2)

(d) Deduce the oxidation number of chlorine in the following:

ClO^-

ClO_3^-

(2)

(Total 10 marks)

Q6

TOTAL FOR PAPER: 60 MARKS

END