## Q1.

This question is about the elements in Group 2.

(a) Explain why the third ionisation energy of beryllium is **much** higher than the second ionisation energy of beryllium.

_____

_____

_____

_____

_____

_____

**(3)**

(b) Magnesium reacts slowly with cold water but rapidly with steam.

Compare these reactions, in terms of the products formed.
You should identify one similarity in, and one difference between, these reactions.

Similarity _____

_____

Difference _____

_____

**(2)**

(c) The reaction of calcium with water is a redox reaction.

Explain, in terms of oxidation states, why this reaction involves both oxidation and reduction.

_____

_____

_____

_____

**(2)**

**(Total 7 marks)**

## Q2.

This question is about redox reactions.

(a) State, in terms of electrons, the meaning of the term oxidising agent.

_____

_____

**(1)**

(b) Give a half-equation to show the oxidation of copper to copper(II) ions.

_____

**(1)**

(c) Give a half-equation to show the reduction of $NO_3^-$ ions in acidic solution to $NO_2$

_____

**(1)**

(d) Use your answers to part (b) and part (c) to deduce an overall equation for the reduction of $NO_3^-$ ions by copper.

_____

**(1)**

**(Total 4 marks)**

## Q3.

This question is about chlorine.

(a) Give an equation to show how chlorine forms an acidic solution in water.

_____

**(1)**

(b) Give an equation for the reaction between chlorine and cold, dilute aqueous sodium hydroxide.

_____

**(1)**

(c) In acidic conditions, $ClO_3^-$ ions oxidise $Cl^-$ ions to form $Cl_2$

Deduce a half-equation for the oxidation of $Cl^-$ to $Cl_2$

Deduce a half-equation for the reduction of $ClO_3^-$ to $Cl_2$

Deduce the overall equation for this reaction.

Half-equation for the oxidation of $Cl^-$ to $Cl_2$

_____

Half-equation for the reduction of $ClO_3^-$ to $Cl_2$

_____

Overall equation

_____

**(3)**

(d) Give the equation for the reaction of solid sodium chloride with concentrated sulfuric acid.

State the role of the chloride ions in this reaction.

Equation

_____

Role _____

**(2)**

(e) Draw the shape of the $Cl_3^-$ ion.
Include any lone pairs of electrons that influence the shape.

**(1)**

(f) Chlorine forms an ion with the Group 3 element thallium (Tl).

State and explain the bond angle in $TlCl_2^+$

Bond angle _____

Explanation _____

_____

_____

_____

**(2)**

**(Total 10 marks)**

## Q4.

Iodide ions can be oxidised to iodine using oxidising agents such as iodate(V) ions ($IO_3^-$) and concentrated sulfuric acid.

(a) State, in terms of electrons, the meaning of the term oxidising agent.

_____

_____

**(1)**

In acidic solution, $IO_3^-$ ions oxidise iodide ions to iodine.

$$IO_3^- + 5\ I^- + 6\ H^+ \rightarrow 3\ I_2 + 3\ H_2O$$

(b) Give a half-equation for the oxidation of iodide ions to iodine.

Deduce the half-equation to show the reduction process in this reaction.

Oxidation half-equation

_____

Reduction half-equation

_____

**(2)**

(c) When iodide ions are oxidised using concentrated sulfuric acid, sulfur dioxide, a yellow solid and a foul-smelling gas are all formed.

Give an equation to show the reaction between iodide ions and concentrated sulfuric acid to form the yellow solid.

Identify the foul-smelling gas.

Equation

_____

Identity of foul-smelling gas _____

**(2)**

**(Total 5 marks)**