Q1.

This question is about elements in Period 3 and their compounds.

(a) When a piece of sodium is added to 200 cm^3 of water in a large beaker a vigorous reaction occurs. The temperature of the water increases by 25 ^oC

Give an equation, including state symbols, for the reaction of sodium with water.

Suggest why it is dangerous to react a similar piece of sodium with 10 cm^3 of water in a boiling tube.

Equation

_____

Why it is dangerous _____

_____

_____

(2)

(b) Give an equation for the reaction of phosphorus(V) oxide with water.

Suggest a pH for the solution formed.

Equation

_____

pH _____

(2)

(c) Explain, in terms of crystal structure and bonding, why silicon(IV) oxide has a higher melting point than phosphorus(V) oxide.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(d) An element in Period 3 forms an oxide that is insoluble in water.
This oxide reacts with sulfuric acid and with aqueous potassium hydroxide.

Give the formula for this oxide.

Give an equation for the reaction of this oxide with sulfuric acid.

Formula _____

Equation

_____

(2)

(e) Give the formula of a hydroxide of an element in Period 3 used in medicine.

_____

(1)

(f) Identify the element in Period 3, from sodium to chlorine, that has the largest atomic radius.

_____

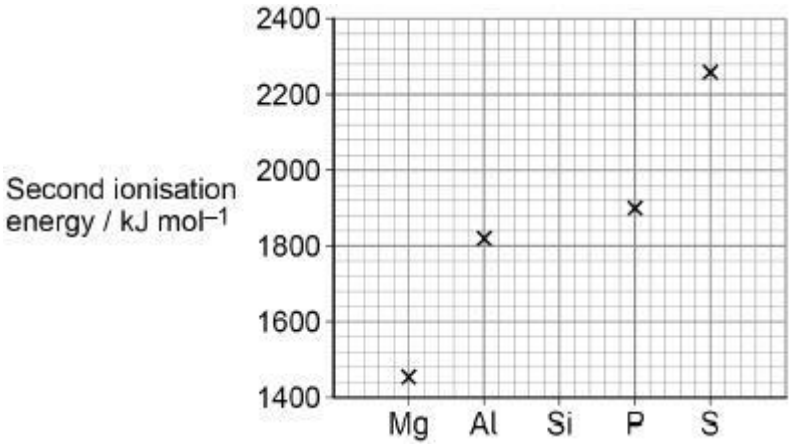
(1)

(Total 12 marks)

Q2.

This question is about Period 3 elements.

The graph shows the **second** ionisation energies of some elements in Period 3.



(a) Draw a cross (x) on the graph above to show the **second** ionisation energy of silicon.

(1)

(b) Identify the element in Period 3, from sodium to argon, that has the highest **second** ionisation energy.

Give an equation, including state symbols, to show the process that occurs when the **second** ionisation energy of this element is measured.

If you were unable to identify the element you may use the symbol **Q** in your equation.

Element

_____

Equation

_____

(2)

(c) Explain why the atomic radius decreases across Period 3, from sodium to chlorine.

_____

_____

_____

_____

(2)

(d) Identify the element in Period 3, from sodium to chlorine, that has the highest electronegativity.

_____

(1)

(e) Phosphorus burns in air to form phosphorus(V) oxide.
Give an equation for this reaction.

_____

(1)

(Total 7 marks)

Q3.

The elements sodium to sulfur in Period 3 all react with oxygen to form oxides.

(a) Give an equation and **two** observations made for the reaction that occurs when sodium is heated in oxygen.

Equation

_____

Observation 1

_____

Observation 2

_____

(2)

(b) Give an equation and **one** observation made for the reaction that occurs when phosphorus is heated in oxygen.

Equation

_____

Observation

_____

(2)

(c) The melting points of the highest oxides of the elements sodium to sulfur are shown in the table.

	Highest oxide of					
	sodium	magnesium	aluminium	silicon	phosphorus	sulfur
Melting point / K	1548	3125	2345	1883	573	290

Explain the increase in melting point from sodium oxide to magnesium oxide.

(2)

(d) Explain why the melting point of the oxide of silicon is much higher than that of the highest oxide of phosphorus.

(3)

(e) A sample of the highest oxide of phosphorus was prepared in a laboratory.

Describe a method for determining the melting point of the sample.
State how the result obtained could be used to evaluate its purity.

_____

_____

_____

(3)

(Total 12 marks)

Q4.

Which element forms an ionic oxide that reacts with strong alkalis?

A Aluminium ⬭

B Magnesium ⬭

C Sodium ⬭

D Sulfur ⬭

(Total 1 mark)

Q5.

This question is about some Period 3 elements and their oxides.

(a) Write an equation for the reaction of phosphorus with an excess of oxygen.

_____

(1)

(b) Describe a test you could carry out in a test tube to distinguish between sodium oxide and the product of the reaction in part (a)

_____

_____

_____

_____

_____

_____

(3)

(c) State the type of crystal structure shown in silicon dioxide and in sulfur trioxide.

Silicon dioxide

_____

Sulfur trioxide

_____

(2)

(d) Explain why silicon dioxide has a higher melting point than sulfur trioxide.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(e) Write an equation for the reaction of sulfur trioxide with potassium hydroxide solution.

_____

_____

(1)

(f) Write an equation for the reaction of an excess of magnesium oxide with phosphoric acid.

_____

_____

(1)

(g) Draw the displayed formula of the undissociated acid formed when sulfur dioxide reacts with water.

(1)

(Total 13 marks)

Q6.

Which is the formula of the main aluminium-containing species present when aluminium oxide is added to an excess of water?

A $[Al(H_2O)_6]^{3+}(aq)$ ○

B $Al(H_2O)_3(OH)_3(s)$ ○

C $[Al(H_2O)_2(OH)_4]^-(aq)$ ○

D $Al_2O_3(s)$ ○

(Total 1 mark)

Q7.

(a) Explain why the atomic radii of the elements decrease across Period 3 from sodium to chlorine.

_____

_____

_____

_____

_____

_____

(2)

(b) Explain why the melting point of sulfur (S_8) is greater than that of phosphorus (P_4).

(2)

(c) Explain why sodium oxide forms an alkaline solution when it reacts with water.

(2)

(d) Write an ionic equation for the reaction of phosphorus(V) oxide with an excess of sodium hydroxide solution.

(1)

(Total 7 marks)

Q8.

This question is about the elements in Period 3 from sodium to phosphorus (Na to P) and their oxides.

(a) Element **X** forms an oxide that has a low melting point. This oxide dissolves in water to form an acidic solution.

(i) Deduce the type of bonding in this oxide of **X**.

(1)

(ii) Identify element **X**.

(1)

(iii) Write an equation for the reaction between this oxide of **X** and water.

_____

(1)

(b) Element **Y** reacts vigorously with water. An oxide of **Y** dissolves in water to form a solution with a pH of 14.

(i) Deduce the type of bonding in this oxide of **Y**.

_____

(1)

(ii) Identify element **Y**.

_____

(1)

(iii) Write an equation for the reaction of element **Y** with water.

_____

(1)

(iv) Write an equation for the reaction of this oxide of **Y** with hydrochloric acid.

_____

(1)

(c) Element **Z** forms an amphoteric oxide that has a very high melting point.

(i) Deduce the type of bonding in this oxide of **Z**.

_____

(1)

(ii) Write the formula of this amphoteric oxide.

_____

(1)

(iii) State the meaning of the term amphoteric.

_____

(1)

(iv) Write two equations to show the amphoteric nature of the oxide of **Z**.

_____

_____

_____

(2)

(Total 12 marks)

Q9.

This question is about oxides.

(a) Sodium oxide forms a solution with a higher pH than magnesium oxide when equal amounts, in moles, of each oxide are added separately to equal volumes of water.

State why both oxides form alkaline solutions.

Suggest why sodium oxide forms a solution with a higher pH than the solution formed from magnesium oxide.

_____

_____

_____

_____

_____

(2)

(b) Give an equation for the reaction between phosphorus(V) oxide and water.

_____

(1)

(c) In the Contact process, sulfur(IV) oxide is converted into sulfur(VI) oxide using vanadium(V) oxide as a catalyst.

Give **two** equations to show how the vanadium(V) oxide acts as a catalyst in this process.

Equation 1

_____

Equation 2

_____

(2)

(Total 5 marks)