Q1. Some melting points of Period 3 oxides are given in this table.

	Na_2O	SiO_2	SO_2	SO_3
Melting point / K	1548	1883	200	290

(a) Explain, in terms of structure and bonding, why sodium oxide has a high melting point.

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(2)

(b) Explain, in terms of structure and bonding, why sulfur trioxide has a higher melting point than sulfur dioxide.

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(2)

(c) Some Period 3 oxides have basic properties.

State the type of bonding in these basic oxides.
Explain why this type of bonding causes these oxides to have basic properties.

Type of bonding .....

Explanation .....

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(3)

(d) Sulfur dioxide reacts with water to form a weakly acidic solution.

(i) Ions are formed when sulfur dioxide reacts with water.
Write an equation for this reaction.

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(1)

(ii) With reference to your equation from part (d)(i), suggest why sulfur dioxide forms a weakly acidic solution.

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(1)

(e) Suggest why silicon dioxide is described as an acidic oxide even though it is insoluble in water.

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(1)
(Total 10 marks)

Q2. The data in the table below show the melting points of oxides of some Period 3 elements.

	Na_2O	P_4O_{10}	SO_2
T_m/K	1548	573	200

(a) In terms of structure and bonding, explain why

(i) sodium oxide has a high melting point

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(Extra space) .....

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(2)

(ii) sulfur dioxide has a low melting point.

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(Extra space) .....

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(2)

(b) Explain why the melting point of P_4O_{10} is higher than the melting point of SO_2

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(Extra space) .....

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(2)

(c) Write equations for the reactions of Na_2O and P_4O_{10} with water. In each case give the approximate pH of the resulting solution.

Equation for Na_2O.....

pH .....

Equation for P_4O_{10}.....

pH .....

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(4)

(d) Write an equation for the acid–base reaction that occurs when Na_2O reacts with P_4O_{10} in the absence of water.

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(1)

(Total 11 marks)

Q3. Sodium, aluminium and silicon are solid elements with a silver colour. These elements react with oxygen to form oxides with high melting points. Aluminium is a reactive metal, but it resists corrosion in water because it has a surface coating of aluminium oxide.

(a) In terms of its structure and bonding, explain why silicon dioxide has a high melting point.

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(3)

(b) State the type of bonding in aluminium oxide.

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(1)

(c) Write an equation for the reaction of aluminium with oxygen.

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(1)

(d) Suggest **one** property of the aluminium oxide coating that causes aluminium to resist corrosion in water.

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(1)

(e) Sodium metal is **not** resistant to corrosion in water, despite having a surface coating of sodium oxide. Write an equation to show how sodium oxide reacts with water.

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(1)

(f) Aluminium oxide is amphoteric. It reacts with acids and alkalis.

(i) Write an equation for the reaction between aluminium oxide and hydrochloric acid.

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(1)

(ii) Write an equation for the reaction between aluminium oxide and an excess of aqueous sodium hydroxide.

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(1)

(g) Silicon dioxide does **not** react with hydrochloric acid but it does react with sodium hydroxide. State **one** property of silicon dioxide that can be deduced from this information and write an equation for its reaction with sodium hydroxide.

Property ….....

Equation .....

(2)

(Total 11 marks)

Q4. White phosphorus (P_4) is a hazardous form of the element. It is stored under water.

(a) Suggest why white phosphorus is stored under water.

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(1)

(b) Phosphorus(V) oxide is known as phosphorus pentoxide.
Suggest why it is usually represented by P_4O_{10} rather than by P_2O_5

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(1)

(c) Explain why phosphorus(V) oxide has a higher melting point than sulfur(VI) oxide.

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(2)

(d) Write an equation for the reaction of P_4O_{10} with water to form phosphoric(V) acid.
Give the approximate pH of the final solution.

Equation .....

pH .....

(2)

(e) A waste-water tank was contaminated by P_4O_{10}. The resulting phosphoric(V) acid solution was neutralised using an excess of magnesium oxide. The mixture produced was then disposed of in a lake.

(i) Write an equation for the reaction between phosphoric(V) acid and magnesium oxide.

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(1)

(ii) Explain why an excess of magnesium oxide can be used for this neutralisation.

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(1)

(iii) Explain why the use of an excess of sodium hydroxide to neutralise the phosphoric(V) acid solution might lead to environmental problems in the lake.

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(1)
(Total 9 marks)

Q5. This question is about the chemistry of the Period 3 elements and the trends in their properties.

(a) (i) Describe what you would observe when magnesium burns in oxygen. Write an equation for the reaction that occurs. State the type of bonding in the oxide formed.

Observations .....

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Equation .....

Type of bonding .....

(4)

(ii) Describe what you would observe when sulfur burns in oxygen. Write an equation for the reaction that occurs. State the type of bonding in the oxide formed.

Observations .....

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Equation .....

Type of bonding .....

(4)

(b) State the type of bonding in sodium oxide. Explain why sodium oxide reacts to form an alkaline solution when added to water.

Type of bonding .....

Explanation.....

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(3)

(c) Outline an experiment that could be used to show that aluminium oxide contains ions.

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(Extra space) ….....

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(2)

(d) Suggest one reason why a thin layer of aluminium oxide protects aluminium from corrosion in moist air.

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(1)

(e) Write an ionic equation in each case to show how aluminium oxide reacts with the following

(i) hydrochloric acid

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(1)

(ii) aqueous sodium hydroxide.

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(1)

(Total 16 marks)