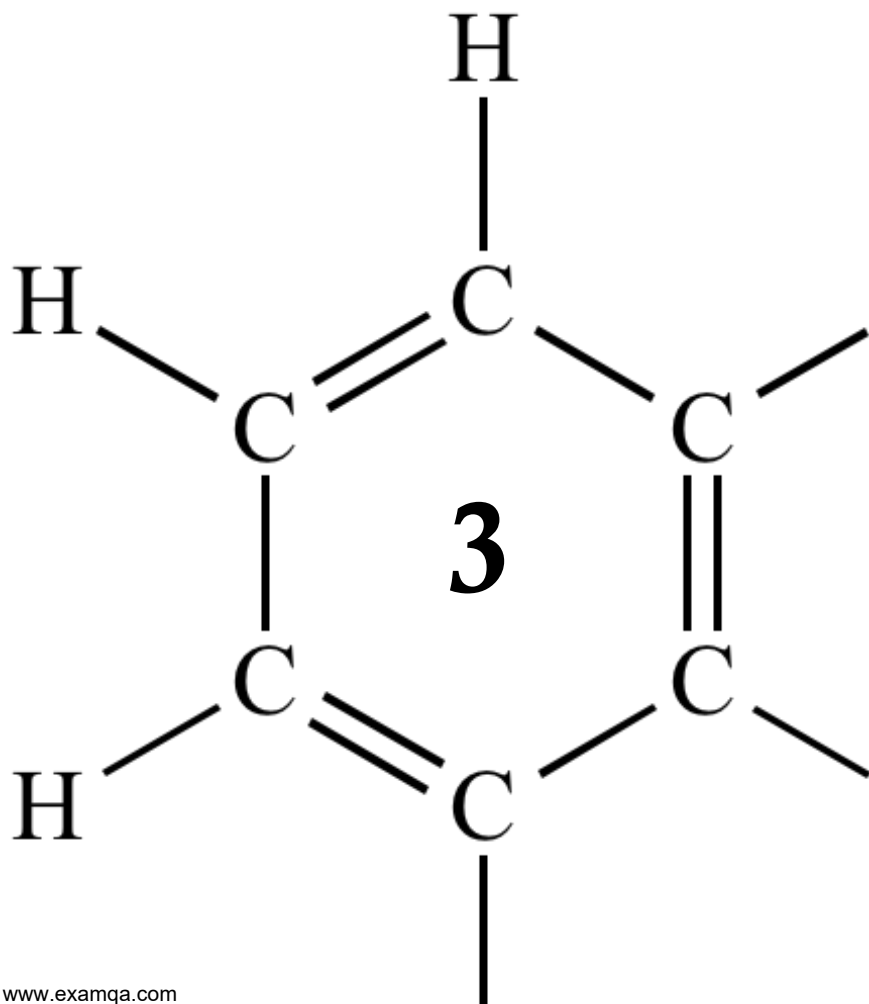


AQA A2 CHEMISTRY
PERIOD 3 OXIDES



1

There is a link between the properties of the oxides of the Period 3 elements and their structure and bonding. The table below shows the melting points of the oxides of some Period 3 elements.

	Na ₂ O	SiO ₂	P ₄ O ₁₀
T _m /K	1548	1883	573

- (a) In terms of crystal structure and bonding, explain in each case why the melting points of sodium oxide and silicon dioxide are high.

Na₂O

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SiO₂

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(4)

- (b) Predict whether the melting point of lithium oxide is higher than, the same as, or lower than the melting point of sodium oxide and explain your prediction.

Prediction

Explanation

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(3)

- (c) Phosphorus(V) oxide has a lower melting point than sodium oxide.

(i) State the structure of and bonding in phosphorus(V) oxide.

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(2)

(ii) Explain why the melting point of phosphorus(V) oxide is low.

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(1)

- (d) Separate samples of phosphorus(V) oxide and sodium oxide were reacted with water. In each case, predict the pH of the solution formed and write an equation for the reaction.

pH with P_4O_{10}

Equation

pH with Na_2O

Equation

(4)

- (e) Write an equation for the reaction between Na_2O and P_4O_{10}
State the general type of reaction illustrated by this example.

Equation

Reaction type

(2)

(Total 16 marks)

2

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)

3

(a) State and explain the trend in electronegativities across Period 3 from sodium to sulfur.

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(4)

(b) Explain why the oxides of the Period 3 elements sodium and phosphorus have different melting points. In your answer you should discuss the structure of and bonding in these oxides, and the link between electronegativity and the type of bonding.

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(6)

- (c) A chemical company has a waste tank of volume 25 000 dm³. The tank is full of phosphoric acid (H₃PO₄) solution formed by adding some unwanted phosphorus(V) oxide to water in the tank.

A 25.0 cm³ sample of this solution required 21.2 cm³ of 0.500 mol dm⁻³ sodium hydroxide solution for complete reaction.

Calculate the mass, in kg, of phosphorus(V) oxide that must have been added to the water in the waste tank.

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(5)
(Total 15 marks)

4

(a) The melting points of some of the oxides formed by Period 3 elements are given in a random order below.

Oxide	A	B	C	D	E
$T_m/^\circ\text{C}$	2852	-73	1610	1275	300

(i) Using the letters **A** to **E**, give **two** oxides which have simple molecular structures.

Explain your answer.

Oxide 1

Oxide 2

Explanation

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(ii) Give a simple chemical test which could be used to show which of the oxides in the table is sodium oxide. State the observation you would make.

Chemical test

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Observation

(6)

(b) The base calcium oxide can be used to remove sulfur dioxide from flue-gases produced when fossil fuels are burnt in coal-fired power stations. Calcium oxide is produced when calcium carbonate, is decomposed by heat.

(i) Write an equation for the action of heat on calcium carbonate.

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(ii) Identify the product formed when sulfur dioxide reacts with calcium oxide.

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(iii) Despite the additional cost, operators of power stations are encouraged to remove the sulfur dioxide from flue-gases. Explain why this may not be environmentally beneficial.

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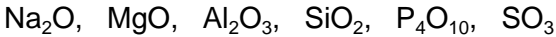
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(4)

(Total 10 marks)

5

Consider the following oxides.



(a) Identify one of the oxides from the above which

(i) can form a solution with a pH less than 3

(ii) can form a solution with a pH greater than 12

(2)

(b) Write an equation for the reaction between

(i) MgO and HNO_3

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(ii) SiO_2 and NaOH

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(iii) Na_2O and H_3PO_4

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(3)

(c) Explain, in terms of their type of structure and bonding, why P_4O_{10} can be vaporised by gentle heat but SiO_2 cannot.

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(4)

(Total 9 marks)