

Periodicity

Period 3 oxides summary

Complete the diagram showing the formulae of the period 3 oxides, their pH in water, the nature of the oxide and the species present in the solution.

Oxide	pH in water	Nature of oxide	Species present in water
Na ₂ O	14	Basic	
MgO			
Al ₂ O ₃			-
SiO ₂		Acidic	-
P ₄ O ₁₀			
SO ₂			
SO ₃	0		H ₂ SO ₄

Reactions of Period 3 oxides

Write balanced equations for the following reactions illustrating the reactions of period 3 oxides with water, acids and bases.

1. Phosphorus oxide with water
2. Sulfur dioxide with water
3. Sulfur trioxide with water
4. Sodium oxide with hydrochloric acid
5. Magnesium oxide with sulphuric acid
6. Aluminium oxide with sulphuric acid
7. Aluminium oxide with sodium hydroxide
8. Silicon dioxide with sodium hydroxide
9. Phosphorus oxide with sodium hydroxide
10. Sulfur dioxide with sodium carbonate

Structure and bonding in Period 3 oxides

1. Complete the table to show the bonding present in the period 3 oxides.

Oxide	Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	P ₄ O ₁₀	SO ₂	SO ₃
Bonding							

(4 marks)

1. Explain why Al₂O₃ displays amphoteric properties with reference to the ions present.
(2 marks)
2. In water, SiO₂ maintains a pH of 7. With reference to the structure and bonding in SiO₂ explain this observation.
(1 mark)
3. Na₂O reacts with water to give a solution with a pH of 14 whereas MgO reacts with water to give a solution with a pH of 10. Write equations for both reactions and explain the observed differences in pH.
(3 marks)

Periodicity – Answers

Oxide	pH in water	Nature of oxide	Species present in water
Na ₂ O	14	Basic	NaOH
MgO	10		Mg(OH)₂
Al ₂ O ₃	7	Amphoteric	-
SiO ₂	7	Acidic	-
P ₄ O ₁₀	0		H₃PO₄
SO ₂	3		H₂SO₃
SO ₃	0		H ₂ SO ₄

- $P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$
- $SO_2 + H_2O \longrightarrow H_2SO_3$
- $SO_3 + H_2O \longrightarrow H_2SO_4$
- $Na_2O + 2HCl \longrightarrow 2NaCl + H_2O$
- $MgO + H_2SO_4 \longrightarrow MgSO_4 + H_2O$
- $Al_2O_3 + 3H_2SO_4 \longrightarrow Al(SO_4)_3 + 3H_2O$
- $Al_2O_3 + 2NaOH + 3H_2O \longrightarrow 2NaAl(OH)_4$
- $SiO_2 + 2NaOH \longrightarrow Na_2SiO_3 + H_2O$
- $P_4O_{10} + 12NaOH \longrightarrow 4Na_3PO_4 + 6H_2O$
- $SO_2 + Na_2CO_3 \longrightarrow Na_2SO_3 + CO_2$

Oxide	Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	P ₄ O ₁₀	SO ₂	SO ₃
Bonding	<i>(Giant) ionic</i>		<i>(Giant) ionic with covalent character</i>	<i>(Giant) covalent macromolecular</i>	<i>(Simple) covalent molecular</i>		

(a) Al³⁺ ion is small and highly charged (1 mark) and polarises the oxide ion (1 mark)

(b) SiO₂ has a covalent macromolecular structure so is insoluble in water (1 mark)

(c) Na₂O + H₂O → 2NaOH (1 mark) MgO + H₂O → Mg(OH)₂ (1 mark) MgO is only sparingly soluble/is less soluble (1 mark)