AQA Chemistry A-level

Topic 2.4 - Properties of Period 3 Elements and their Oxides

Flashcards

Appearance and physical properties of sodium?

Appearance and physical properties of sodium?

Metallic, shiny, conducts electricity (worst conductor out of the metals)

Reaction of sodium with acid?

Reaction of sodium with acid?

$$Na + acid \rightarrow H_2 + salt$$

Reaction of sodium with cold water - equation and observations?

Reaction of sodium with cold water - equation and observations?

Vigorous reaction, floats on water, fizzes, melts

due to -ΔH of the reaction. NaOH is pH 13-14.

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

Reaction of sodium with oxygen (equation and observations)?

Reaction of sodium with oxygen (equation and observations)?

Bright yellow flame, forms white powder of Na_2O

$2Na + ½ O_2 \rightarrow Na_2O$

Appearance and physical properties of magnesium?

Appearance and physical properties of magnesium?

Metallic, shiny, conducts electricity (between Na and Al in terms of how well it does).

Reaction of Mg with cold water (observations and equation)?

Reaction of Mg with cold water (observations and equation)?

Very slow reaction. pH = 10 as $Mg(OH)_2$ is sparingly soluble

$$Mg + 2H_2O \rightarrow H_2 + Mg(OH)_2$$

Reaction of Mg with steam (observations and equation)?

Reaction of Mg with steam (observations and equation)?

Much faster.

$$Mg + H_2O \rightarrow MgO + H_2$$

Reaction of Mg with oxygen (observations and equation)?

Reaction of Mg with oxygen (observations and equation)?

Bright white flame, forms white powder of MgO

$2Mg + O_2 \rightarrow 2MgO$

Appearance and physical properties of aluminium?

Appearance and physical properties of aluminium?

Metallic, shiny, best conductor of electricity in period 3

Reaction of Al with cold water?

Reaction of Al with cold water?

No reaction

Reaction of Al with oxygen (equation and observations)?

Reaction of Al with oxygen (equation and observations)?

Heat and lower into jar of O_2 → bright flame,

forms white powder.

$4Al + 3O_2 \rightarrow 2Al_2O_3$

Why is aluminium considered unreactive even though the metal itself is reactive?

Why is aluminium considered unreactive even though the metal itself is reactive?

Covered by Al_2O_3 from where oxygen has oxidised the surface of the Al. Al_2O_3 is unreactive. Makes it useful for saucepans, window frames etc.

If Al_2O_3 is scratched off, Al reacts rapidly with air to form a new coat.

Appearance and physical properties of silicon?

Appearance and physical properties of silicon?

Semimetal (metalloid), semiconductor (conducts electricity to an extent and in certain conditions)

Reaction of silicon with oxygen (observations and equation)?

Reaction of silicon with oxygen (observations and equation)?

Heat strongly

$Si + O_2 \rightarrow SiO_2$ (white powder)

Appearance and physical properties of phosphorus?

Appearance and physical properties of phosphorus?

Non-metal, low m.p. And b.p., does not conduct electricity.

Red Phosphorus as a crystal structure

White Phosphorus as P_4

Reaction of phosphorous in excess oxygen (observations and equation)?

Reaction of phosphorous in excess oxygen (observations and equation)?

Red P needs to be heated significantly first, white P ignites spontaneously in air

Phosphorus pentoxide (white crystalline solid) formed

$$4P + 5O_2 \rightarrow P_4O_{10}$$

Reaction of phosphorous in

limited oxygen

(observations and

equation)?

Reaction of phosphorous in limited oxygen (observations and equation)?

Incomplete combustion: colourless liquid phosphorus trioxide is formed.

$$4P + 3O_2 \rightarrow P_4O_6$$

Appearance and physical properties of sulfur?

Appearance and physical properties of sulfur?

Non-metal, low mp and bp, does not conduct electricity.

Reaction of sulfur with oxygen (observations and equation)?

Reaction of sulfur with oxygen (observations and equation)?

Need to heat and lower into a jar of oxygen.

Colourless gas sulfur dioxide formed. Some SO_3 also formed.

$S + O_2 \rightarrow SO_2$

What are the different types of structure and bonding displayed by the period 3 oxides?

What are the different types of structure and bonding displayed by the period 3 oxides?

Na ionic lattice

Mg ionic lattice

Al ionic lattice with covalent character; Al_3^+ distorts O_2^- electron cloud

Si giant covalent

P simple molecular covalent

S simple molecular covalent

What is the trend in melting points for period 3 oxides (state highest and lowest and why and draw graph)?

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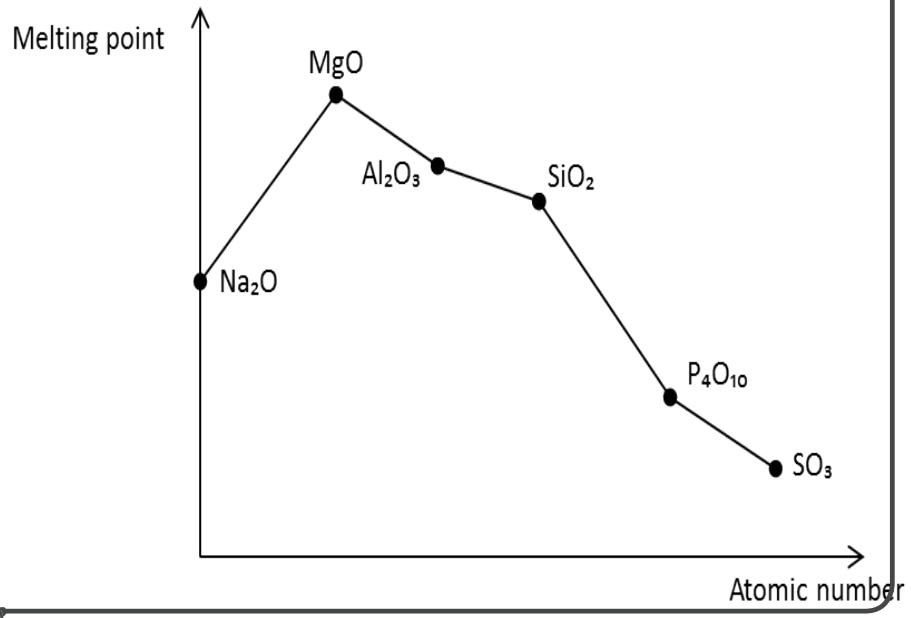
Highest is MgO, lowest is SO_2; increases along group for metals for Na_2O and MgO due to stronger ionic bonding, but Al_2O_3 is lower due to the covalent character of the bonding. Decreases with size for simple molecular molecules.



Which period 3 oxides are basic?

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Na_2O and MgO

Reaction of Na oxide with water? pH?

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$Na_2O + H_2O \rightarrow 2Na^+ + 2OH^-$; pH = 14

Reaction of Mg oxide with water? pH?

Reaction of Mg oxide with water? pH?

$MgO + H_2O \rightarrow Mg^{2+} + 2OH^- \rightleftharpoons Mg(OH)_2$

pH = 9-10 as $Mg(OH)_2$ is sparingly soluble

What are the products if Na_2O and MgO are reacted with acid?

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Salt and water only

Is aluminium oxide acidic or basic?

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It is amphoteric; can act as either an acid or a base

Is aluminium oxide soluble?

Is aluminium oxide soluble?

Not in water

Reaction of aluminium oxide with HCl?

Reaction of aluminium oxide with HCl?

$$Al_2O_3 + 6HCl \rightarrow 3H_2O + 2AlCl_3$$

Reaction of aluminium oxide with NaOH?

Reaction of aluminium oxide with NaOH?

$Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2NaAl(OH)_4$; sodium aluminate is formed

Is silicon dioxide soluble in water?

Is silicon dioxide soluble in water?

No

In what conditions will silicon dioxide act as an acid?

In what conditions will silicon dioxide act as an acid?

Reacts as a weak acid with a strong base (e.g. hot, conc NaOH)

Reaction of silicon dioxide with hot, conc NaOH?

Reaction of silicon dioxide with hot, conc NaOH?

$SiO_2 + 2NaOH \rightarrow H_2O + Na_2SiO_3$ - sodium silicate

How is silicon dioxide used in the production of Fe?

How is silicon dioxide used in the production of Fe?

$SiO_2 + CaO \rightarrow CaSiO_3$ - calcium silicate

Reaction of Phosphorus pentoxide with water? pH?

Reaction of Phosphorus pentoxide with water? pH?

$$P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4 \text{ ; pH = 1-2}$$

Dissociation of the acid formed (H_3PO_4)?

Dissociation of the acid formed (H_3PO_4)?

$$H_3PO_4 \rightarrow H^+ + H_2PO_4^-$$

Reaction of P_4O_{10} with NaOH?

Reaction of P_4O_{10} with NaOH?

$$3NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3H_2O$$

Reaction of SO_2 with water? pH?

Reaction of SO_2 with water? pH?

$SO_2 + H_2O \rightarrow H_2SO_3$; weak acid $\rightarrow$ pH = 2-3

Reaction of SO_3 with water? pH?

Reaction of SO_3 with water? pH?

$$SO_3 + H_2O \rightarrow H_2SO_4$$

strong acid $\rightarrow$ pH = 0-1

Reaction of SO_2 with NaOH? (2 stages)

Reaction of SO_2 with NaOH? (2 stages)

$$SO_2 + NaOH \rightarrow NaHSO_3$$

$$NaHSO_3 + NaOH \rightarrow Na_2SO_3 + H_2O$$

How can flue gases be removed by CaO?

How can flue gases be removed by CaO?

$$CaO + SO_2 \rightarrow CaSO_3 \text{ (calcium sulfite)}$$

Draw the structure of H_3PO_4?

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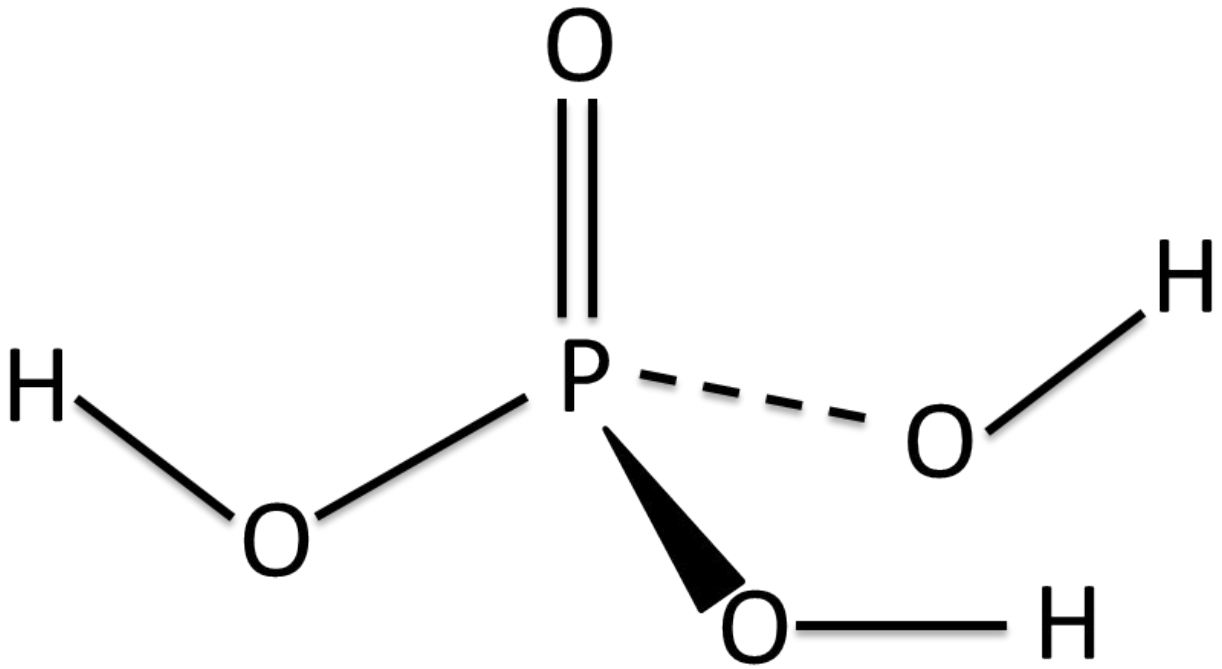

How many electrons does P have in its outer shell in H_3PO_4?

How many electrons does P have in its outer shell in H_3PO_4?

10

What is the shape and bonding in PO_4^{3-}?

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Electrons delocalise to give tetrahedral structure with 109.5º bond angle. Each P-O bond is the same length

Draw the structure and bonding of H_2SO_4?

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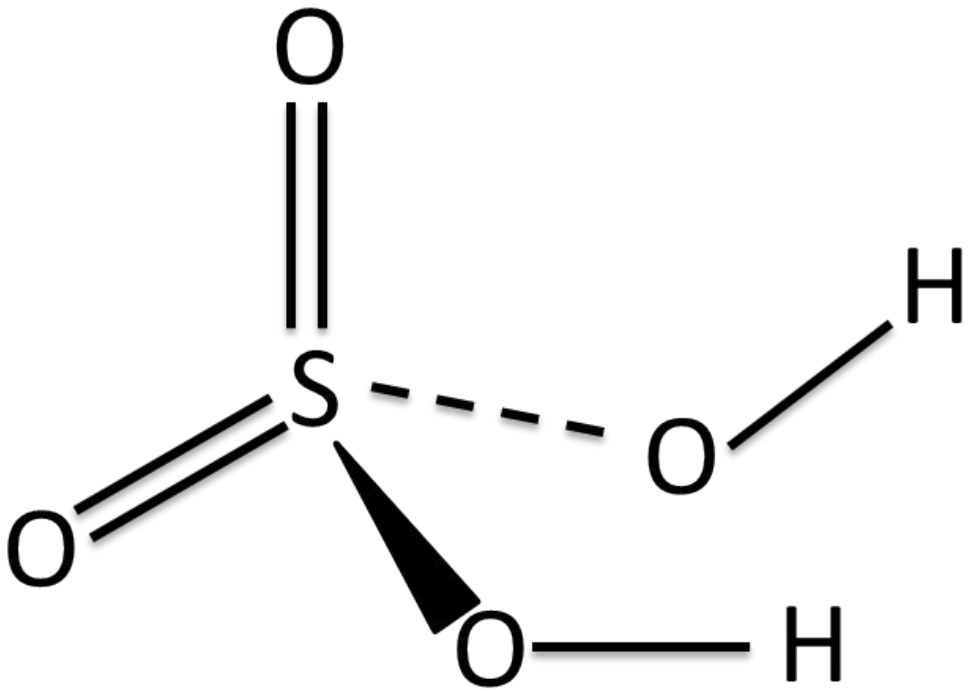

What is the structure, bonding and shape of SO_4^{2-}?

What is the structure, bonding and shape of SO_4^{2-}?

Electrons delocalise → tetrahedral with 109.5° bond angle. Each S-O bond is the same

What is the structure, bonding and shape of SO_3^{2-}?

What is the structure, bonding and shape of SO_3^{2-}?

Bond angle = 106º (trigonal pyramid shape), each S-O bond is the same, S has one lone pair of electrons.

Uses of MgO?

Uses of MgO?

Additive for cattle feed

How useful is Al_2O_3?

How useful is Al_2O_3?

Oxide layer on Aluminium makes it very useful as it is unreactive and returns quickly if it is scratched off

Uses of SO_2?

Uses of SO_2?

Reactant in contact process (making H_2SO_4)

Would Lithium oxide or sodium oxide have a higher melting point? Why?

Would Lithium oxide or sodium oxide have a higher melting point? Why?

Li_2O has a higher m.p., since Li^+ is a smaller ion than Na^+, so the O^{2-} and Li^+ charge centres are closer together and there is a greater electrostatic force of attraction between the oppositely charged ions.