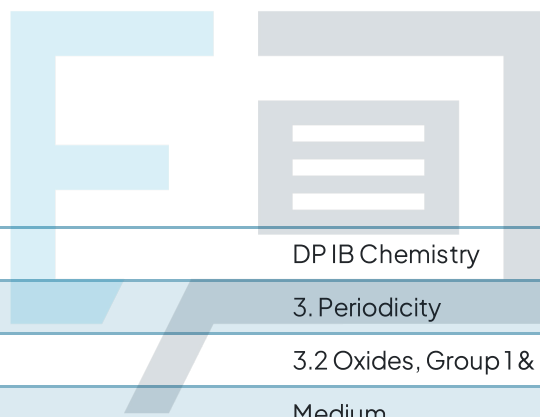




3.2 Oxides, Group 1 & Group 17

Mark Schemes



Course	DP IB Chemistry
Section	3. Periodicity
Topic	3.2 Oxides, Group 1 & Group 17
Difficulty	Medium

Exam Papers Practice

To be used by all students preparing for DP IB Chemistry HL
Students of other boards may also find this useful

1

The correct answer is **A** because:

- The metallic radius of an element is half the distance between two adjacent metallic nuclei
- An **electron shell** is added to each element moving down group I
- This increases the radius of the atoms as we move down the group

B, C & D are incorrect as

statements 1 and 2 are correct. Statement 3 is incorrect as the nuclear forces do increase but are outweighed by the addition of an extra electron shell

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2

The correct answer is **C** because:

- In period 3 the following oxides produce an **acidic solution** when added to water:
- phosphorus oxide:

$$\text{P}_4\text{O}_6 + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_3 \quad \text{or} \quad \text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_4$$
- sulfur dioxide:

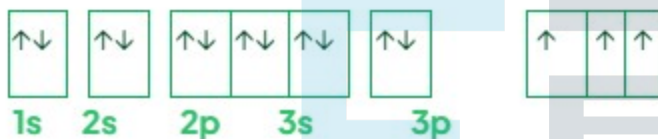
$$\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$$
- H_3PO_3 , H_3PO_4 and H_2SO_4 are all acids because they **dissociate** in water, **releasing H^+ ions**
- Therefore, **arsenic and selenium oxides** will also produce an **acidic solution**

<p>A is incorrect as</p>	<p>aluminium (and therefore Ga) oxide does not react simply with water because despite containing oxide ions, they are held too strongly in the solid lattice to react with the water</p> <p>silicon (and therefore Ge) oxide does not react with water because it has a giant covalent structure</p>
<p>B is incorrect as</p>	<p>silicon (and therefore Ge) oxide does not react with water because it has a giant covalent structure</p>
<p>D is incorrect as</p>	<p>phosphorous (and therefore As) oxides also react with water to produce an acidic solution</p>

3

The correct answer is **D** because:

- Sulfur trioxide reacts with water to produce a **strong** acidic solution in water:
- $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$
- A 'strong' acid is one that **fully dissociates** into its ions when in aqueous solution producing a high concentration of **H⁺ ions** and therefore has a very low pH (1)
- The electronic configuration of phosphorus is $1s^2 2s^2 2p^6 3s^2 3p^3$



- Following **Hund's rule**, the 3 electrons in the 3p orbital are found separated across different orbitals

A is incorrect as	phosphorus oxides only produce weak acids (H_3PO_3 and H_3PO_4) that do not fully dissociate in solution
B & C are incorrect as	the electronic configuration for sulfur is $1s^2 2s^2 2p^6 3s^2 3p^4$ and therefore has one electron pair in the 3p orbital
	phosphorus oxides only produce weak acids (H_3PO_3 and H_3PO_4) that do not fully dissociate in solution



4

The correct answer is **A** because:

- There are only weak van der Waals' forces between the diatomic molecules, caused by instantaneous dipole-induced dipole forces
- These forces increase as you go down Group 17 as the number of electrons in the molecules increase
- The greater the number of electrons the greater the chance of instantaneous dipoles arising within molecules inducing dipoles in neighbouring molecules
- The larger the molecules, the stronger the van der Waals' forces
- Therefore, iodine has a stronger force than fluorine

B is incorrect as	the bond length increases in Group 17 as you go down the group
C is incorrect as	the bond energy decreases as you go down Group 17
D is incorrect as	the boiling point of Group 17 increases as you go down the group

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5

The correct answer is **B** because:

- **As you go down group 1, the atomic radius increases**
 - There are more filled shells to shield the outer electrons from the attraction of the nucleus
 - More filled shells means that the radius of the atom increases
 - This causes the force of attraction between the nucleus and outer electrons to be reduced
 - So, the distance between the nucleus and the outer electrons increases
 - Therefore, less energy is needed to remove an outer electron.

A is incorrect as	as you go down group 1, the first ionisation energy decreases
C is incorrect as	as you go down group 1, the melting point decreases. This is because as the ions get larger the distance between the bonding electrons and the positive nucleus gets larger and reduces the overall attraction between the two
D is incorrect as	as you go down group 1, the reactions of the elements with water become more vigorous

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6

The correct answer is **B** because:

- The group 1 metals become increasingly reactive with water as you move down the group
 - Rubidium is below potassium on the Periodic Table, so it should react **more** violently



<p>A is incorrect as</p>	<p>caesium does have a lower first ionisation energy than rubidium.</p> <p>This is because caesium has the same equivalent nuclear charge of +1 but experiences more shielding. This leads to a weaker force of attraction between the nucleus and outer electron and, therefore, a lower first ionisation energy</p>
<p>C is incorrect as</p>	<p>potassium does have a greater atomic radius than sodium.</p> <p>Potassium has more electron shells to shield the outer electron from the nucleus, therefore, there is a weaker grip on the outer electron</p>
<p>D is incorrect as</p>	<p>sodium melts at a higher temperature than caesium.</p> <p>The melting point decreases as you move down group 1</p>

Careful: The question asked which statement was **NOT** correct



7

The correct answer is **A** because:

- Calcium is a metal so will form an alkaline oxide
 - This will result in an alkaline solution turning litmus paper blue
- Tellurium is a non-metal so will form an acidic oxide
 - This will result in an acidic solution turning litmus paper red

B, C & D are incorrect as	they give the wrong colour changes for litmus paper for oxides of calcium and tellurium in water
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8

The correct answer is **A** because:

- Strontium is a metal so forms a basic oxide giving a pH greater than 7
- Lithium is a metal so forms a basic oxide
- A basic oxide would turn universal indicator blue

B, C & D are incorrect as	they contain statement III which is incorrect
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9

The correct answer is **B** because:

- Reactivity decreases down group 17
- Fluorine is above chlorine in group 17
 - Fluorine is more reactive than chlorine
 - Fluorine will displace the chloride forming potassium fluoride and chlorine
- Bromine is above iodine in group 17
 - Bromine is more reactive than iodine
 - Bromine will displace the iodide forming potassium bromide and iodine

A, C & D are incorrect as	they all contain statement II which is false. Iodine is below chlorine in group 17 hence iodine is less reactive. Therefore iodine will not displace the chloride ions.
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10

The correct answer is **A** because:

- Sodium is a metal so forms a basic oxide
 - When dissolved in water this will form an alkaline solution turning litmus paper blue

B is incorrect as	acidic oxides would dissolve in water to form acidic solutions turning litmus paper red
C is incorrect as	acidic oxides would dissolve in water to form acidic solutions giving a solution with a pH of less than 7
D is incorrect as	sodium oxide does not react with magnesium metal