SMART EXAM RESOURCES

9701 CAMBRIDGE AS CHEMISTRY
TOPIC QUESTIONS AND MARK SCHEMES
TOPIC :ATOMIC STRUCTURE
TOPIC:TREND IN IONISATION ENERGY
SET-1-QP-MS

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1 Explain the general increase in the first ionisation energies of the Period 3 elements.

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..... [2]

MARK SCHEME:

M1: increasing proton number but similar shielding **M2:** greater attraction of nucleus (for outer / valence electrons)	**2**

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2 Fig. 1.1 shows how **first** ionisation energies vary across Period 2.

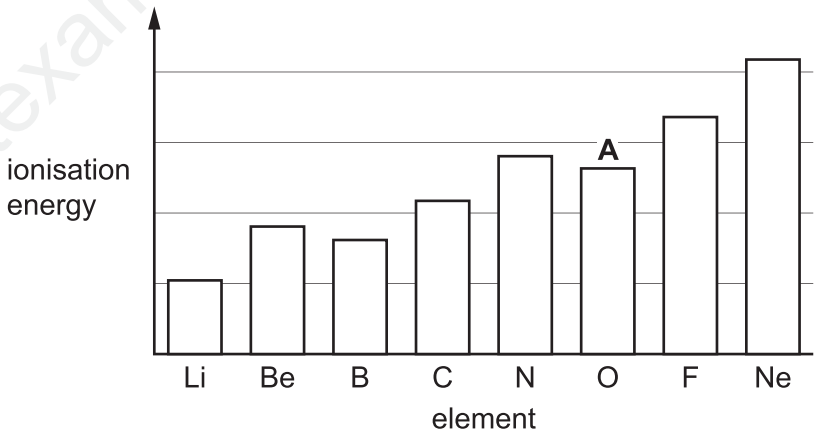

Fig. 1.1

(b) (i) State and explain the general trend in first ionisation energies across Period 2.

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(ii) Explain why ionisation energy **A** in Fig. 1.1 does **not** follow the general trend in first ionisation energies across Period 2.

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MARK SCHEME:

(i)	increase across period **AND** increased nuclear attraction **for** (valence / outer) **electrons** [1] increase in (positive) nuclear charge / number of protons (in the nucleus) [1] similar shielding (of outer electrons) [1]	**3**
(ii)	spin-pair repulsion (of electrons) in (2)p orbital [1] outweighs increased nuclear charge [1]	**2**

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3 **(a)** Group 2 elements share common chemical properties.

(i) Calcium reacts in cold water more quickly than magnesium because more energy is required to remove the outer electrons in magnesium. This occurs even though calcium atoms have a greater nuclear charge.

Explain why more energy is required to remove the outer electrons in magnesium than in calcium.

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MARK SCHEME:

(i)	**M1** (one) fewer (inner) shell of electrons / less shielding (effect) *ORA*	**1**
	M2 smaller distance of the **outer** electrons (from the nucleus) / stronger nuclear attraction to the (outer) electrons *ORA*	**1**

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4 Complete the table which describes a gaseous atom of gallium.

isotope	nucleon number	total number of electrons in **lowest** energy level	type of orbital which contains the electron in the **highest** energy level
^{71}Ga			

[3]

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MARK SCHEME:

isotope	nucleon number	total number of electrons in **lowest** energy level	type of orbital contains the electron in the **highest** energy level
^{71}Ga	**M1** 71	**M2** 2	**M3** p (-orbital)

3

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5 (a) Across Period 3 there is a general trend for first ionisation energies to increase due to the increase in attraction between the nucleus and the outer electron.

Explain why the first ionisation energy of sulfur is less than the first ionisation energy of phosphorus.

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(b) In an Al^{2+} ion the nuclear attraction for the outer electron is stronger than in an atom of Na.

Compare the electronic structures of Al^{2+} and an atom of Na and explain why the third ionisation energy of aluminium is greater than the first ionisation energy of sodium.

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MARK SCHEME:

(c)	**M1** reference to spin pair repulsion in (3)p orbital (in S) **OR** due to repulsion of two electrons in a (3)p orbital (in S) **M2** outweighs increased nuclear charge (in S)	**2**
(d)	**M1** *similarity in electronic structure / shielding of Al^{2+} and Na* both remove electron from (3)s^1 / single electron in (3)s (sub-level / orbital) **OR** Al^{2+} and Na have same electronic configuration **OR** shielding (of outer electron) is the same **M2** *greater nuclear charge / number of protons* $Al^{(2+)}$ has greater nuclear charge **OR** 13p compared to 11p	**2**

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