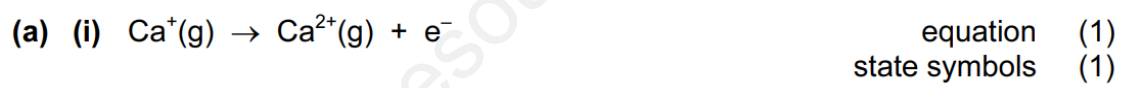


SMART EXAM RESOURCES
9701 CAMBRIDGE AS CHEMISTRY
TOPIC QUESTIONS AND MARK SCHEMES
TOPIC :ATOMIC STRUCTURE
SUB-TOPIC: IONISATION ENERGY
SET-1-QP-MS

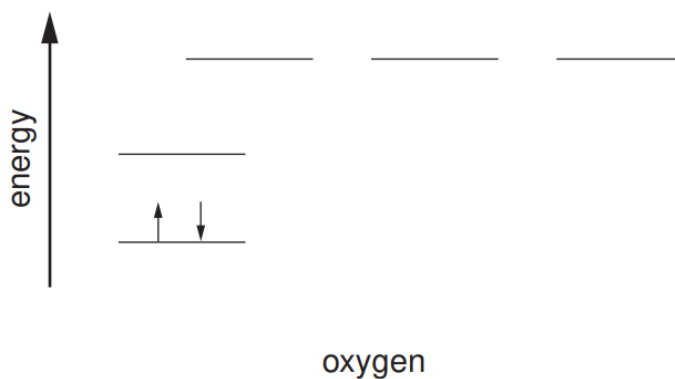
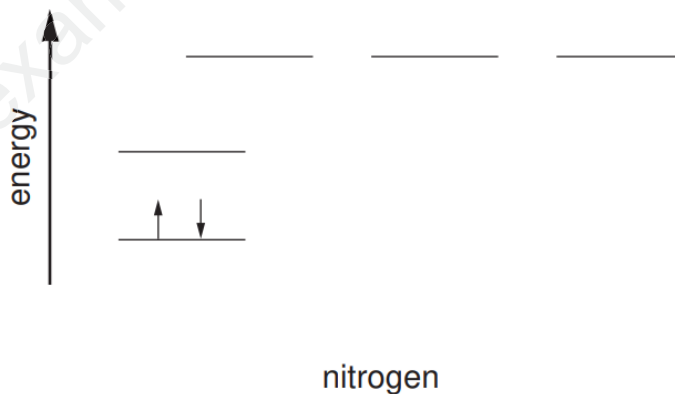
1 Phosphorus is a very reactive non-metallic element which readily forms ionic compounds with metals such as calcium and covalent compounds with non-metals such as chlorine and oxygen.

(a) (i) Write an equation, with state symbols, for the **second** ionisation energy of calcium.

.....

MARK SCHEME:

- 2 (a)** Complete the electronic configurations of nitrogen atoms and oxygen atoms on the energy level diagrams below. Use arrows to represent electrons.



[6]

- (b) (i)** Use the *Data Booklet* to state the value of the first ionisation energy of nitrogen and of oxygen.

N kJ mol⁻¹

O kJ mol⁻¹

- (ii)** Explain, with reference to your answer to **(a)(iii)**, the relative values of these two ionisation energies.

.....

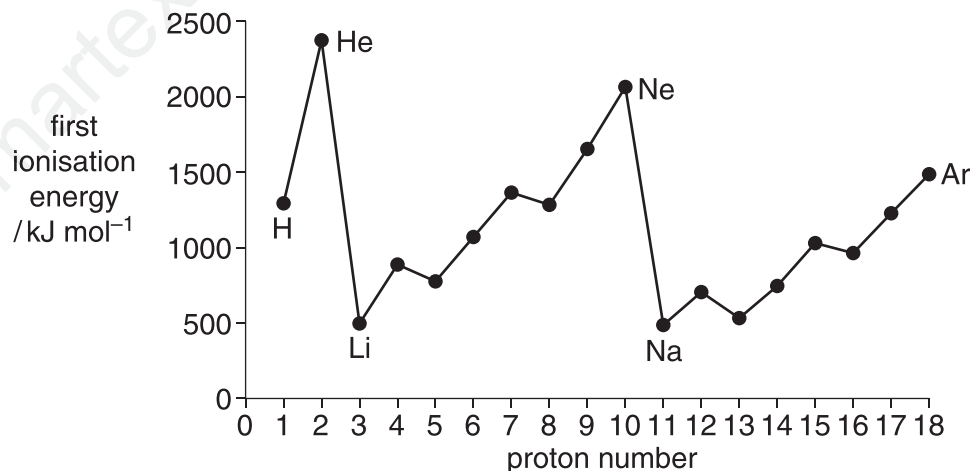
.....

.....

[3]

- 3 The Periodic Table we currently use is derived directly from that proposed in 1869 by Mendeleev who had noticed patterns in the physical and chemical properties of the elements he had studied.

The diagram below shows the first ionisation energies of the first 18 elements of the Periodic Table.



- (a) Give the equation, including state symbols, for the first ionisation energy of sulfur.

..... [2]

- (b) Explain why there is a **general** increase in first ionisation energies across the Period from sodium to argon.

.....

 [3]

- (c) (i) Explain why the first ionisation energy of magnesium is greater than that of aluminium.

.....

- (ii) Explain why the first ionisation energy of phosphorus is greater than that of sulfur.

.....

 [4]

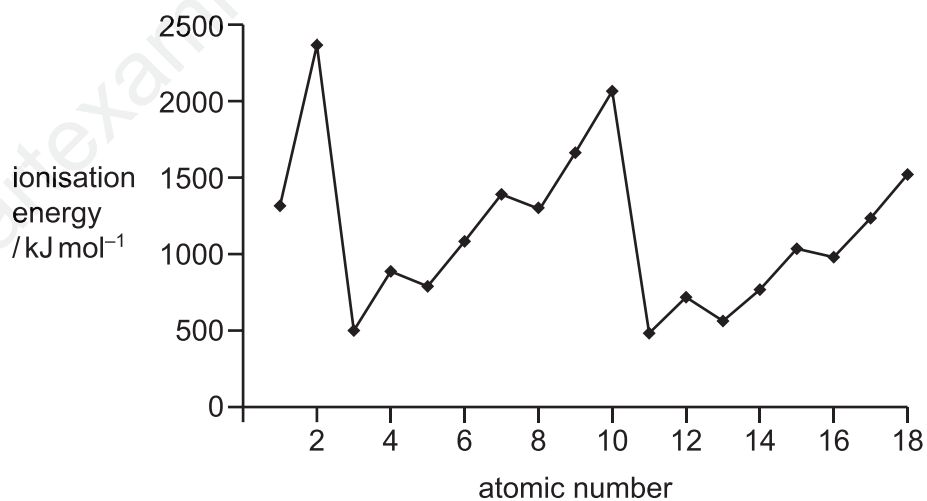
MARK SCHEME:

- (a) $S(g) \rightarrow S^+(g) + e^-$
correct equation (1)
correct state symbols (1) [2]
- (b) **from Na to Ar,**
electrons are added to the same shell/have same shielding (1)
electrons are subject to increasing nuclear charge/proton number (1)
electrons are closer to the nucleus **or** atom gets smaller (1) [3]
- (c) (i) **Mg and Al**
in Mg outermost electron is in 3s **and**
in Al outermost electron is in 3p (1)

3p electron is at higher energy **or**
is further away from the nucleus **or**
is more shielded from the nucleus (1)
- (ii) **S and P**
for S one 3p orbital has paired electrons **and**
for P 3p sub-shell is singly filled (1)

paired electrons repel (1) [4]

- 4** The Periodic Table is arranged such that the properties of the elements show a number of trends.
 (a) A plot of the first ionisation energies for the first 18 elements is shown.



- (i) Explain why the values show a general increase from atomic number 11 to 18.

.....

 [2]

- (ii) Explain the decreases in first ionisation energies between

- atomic numbers 12 and 13,

.....

- atomic numbers 15 and 16.

.....

 [4]

- (iii) Suggest an explanation for the trend in the first ionisation energies of the elements with atomic numbers 2, 10 and 18.

.....

 [2]

MARK SCHEME:

		8
(a)(i)	Increasing nuclear attraction	1
	Increasing nuclear charge / number of protons AND constant / similar shielding / same shell	1
(a)(ii)	From 12 / Mg to 13 / Al:	
	(Outer) electron in '13' / Al in (3)p (whereas outer electron in '12' / Mg in (3)s)	1
	(3p =) higher energy level / more shielded	1
	From 15 / P to 16 / S	
electron repulsion	1	
('16' / S has a) pair of electrons in a (3)p orbital / a (3)p orbital is full OR A	1	
(a)(iii)	(decreasing IE down Group 0) due to decreasing nuclear attraction	1
	increasing shielding / increasing number of shells / energy levels / increasing distance of (outer) electrons (from nucleus)	1

5 (a) Explain what is meant by the term *ionisation energy*.

.....
.....
..... [3]

(b) The first seven ionisation energies of an element, **A**, in kJ mol^{-1} , are

1012 1903 2912 4957 6274 21269 25398.

(i) State the group of the Periodic Table to which **A** is most likely to belong. Explain your answer.

.....
.....
.....
..... [2]

(ii) Complete the electronic configuration of the element in Period 2 that is in the same group as **A**.

$1s^2$ [1]

MARK SCHEME:

(a)	The amount of energy required/energy change/enthalpy change when one electron is removed from each atom/(cat)ion in one mol of gaseous atoms/(cat)ions OR energy change when 1 mole of electrons is removed from one mole of gaseous atoms/ions $X(g) \rightarrow X^+(g) + e^-$ gains 2 marks	1 1 1	3
(b) (i)	Group V / 5 / 15 Big difference between fifth and sixth ionisation energies	1 1	2
(ii)	$1s^2 2s^2 2p^3$ ecf from (b)(i) if period 2	1	1