SMART EXAM RESOURCES
9701 CAMBRIDGE AS CHEMISTRY
TOPIC QUESTIONS AND MARK SCHEMES
TOPIC :ATOMIC STRUCTURE
SUB-TOPIC: IONISATION ENERGY
SET-2-QP-MS

Neon is a noble gas.

1 **(a)** Complete the full electronic configuration of neon.

$1s^2$ ..... [1]

(b) **(i)** Explain what is meant by the term *first ionisation energy*.

.....

.....

..... [3]

(ii) Explain why the first ionisation energy of neon is greater than that of fluorine.

.....

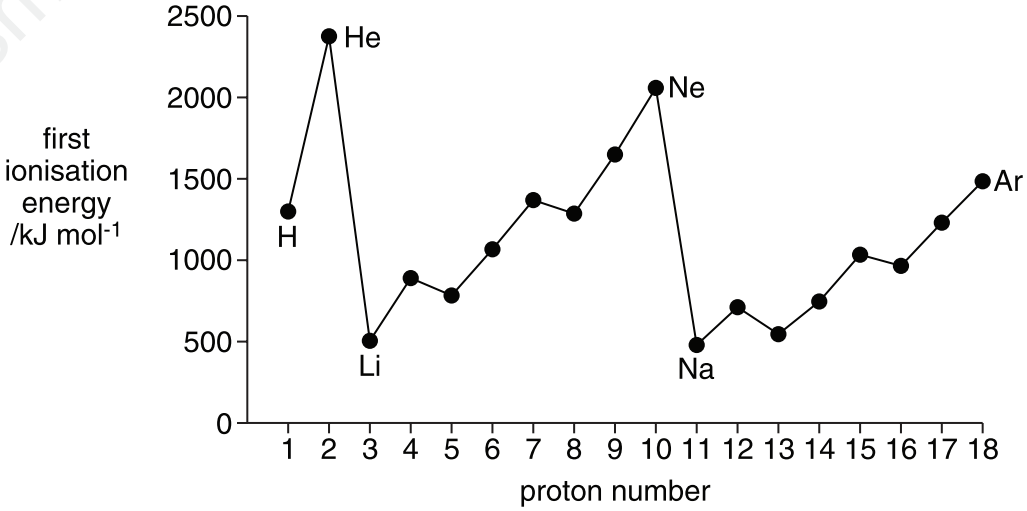
..... [2]

MARK SCHEME:

(a)	$(1s^2)2s^22p^6$	[1]	[1]
(b) (i)	The amount of energy required/energy change when one electron is removed	[1]	
	from each atom in one mol	[1]	
	of gaseous atoms	[1]	[3]
(ii)	Greater nuclear charge/number of protons	[1]	
	Same shielding/number of shells/energy level	[1]	[2]

2 The Periodic Table we currently use is derived directly from that proposed by Mendeleev in 1869 after he had noticed patterns in the 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 as we know it today.



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

.....[2]

(b) Explain why there is a general increase in first ionisation energies from sodium to argon.

.....

.....

.....

.....[3]

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

.....

.....

.....

(ii) Explain why the first ionisation energy of sulphur is less than that of phosphorus.

.....

.....

.....
[4]

The table below refers to the elements sodium to sulphur and is incomplete.

element	Na	Mg	A*l*	Si	P	S
melting point		high				
conductivity		high				

(d) **(i)** Complete the 'melting point' row by using **only** the words 'high' **or** 'low'.

(ii) Complete the 'conductivity' row by using **only** the words 'high', 'moderate' **or** 'low'.
[5]

(e) When Mendeleev published his Periodic Table, the elements helium, neon and argon were not included.

Suggest a reason for this.

.....

.....[1]

[Total: 15]

MARK SCHEME:

(a) $F(g) \rightarrow F^{+}(g) + e^{-}$

correct equation (1)

correct state symbols (1) [2]

(b) from Na to Ar, electrons

are added to the same shell/have same shielding (1)

are subject to increasing nuclear charge/proton number (1)

are closer to the nucleus **or** atom gets smaller (1) [3]

(c) (i) A*l* and Mg

in A*l* outermost electron is in 3p rather than 3s (1)

3p electron is at higher energy
or is further away/is more shielded from nucleus (1)

(ii) P and S

for P 3p sub-shell is singly filled
and for S one 3p orbital has paired electrons (1)

paired electrons repel (1) [4]

(d) (i) and **(ii)**

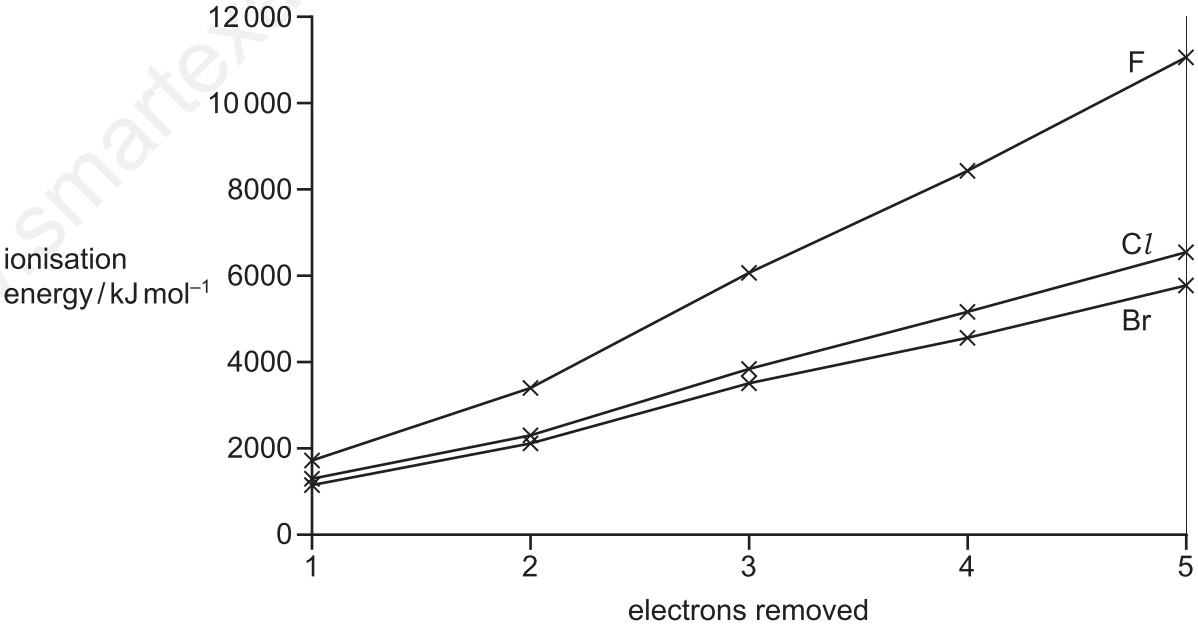
element	Na	Mg	A*l*	Si	P	S
melting point	low	------	high	high	low	low
conductivity	high	------	high	moderate	low	low
	(1)		(1)	(1)	(1)	(1)

one mark for each correct column [5]

(e) because they had not been discovered (1) [1]

[Total: 15]

3 **(a)** Successive ionisation energies for the elements fluorine, F, to bromine, Br, are shown on the graph.



(i) Explain why the first ionisation energies decrease down the group.

.....

.....

.....

..... [3]

(ii) Explain why there is an increase in the successive ionisation energies of fluorine.

.....

.....

..... [2]

MARK SCHEME:

(a) (i)	increasing **distance** of (outer/highest energy) electron(s) from nucleus OR increasing distance of outer/valence shell from nucleus	1	
	increased **shielding** / screening (from inner shells)	1	
	reduces **attraction**	1	[3]
(ii)	increasing cation charge / effective nuclear charge OR decreasing number of electrons compared with protons	1	
	increase in attraction	1	[2]

4 The elements in the third period show a general increase in their first ionisation energies from left to right.

Identify **two** pairs of successive elements in the third period that do **not** agree with this statement.
For each pair, explain why the change in ionisation energy does **not** agree with this statement.

Use of the Data Booklet may help you to answer this question.

pair 1 .....

explanation .....

.....

.....

.....

.....

pair 2 .....

explanation .....

.....

.....

.....

.....

[4]

MARK SCHEME:

	M1 process of 'first ionisation energy' involves the loss/removal of an electron [1]		**4**
	M2 Mg and Al **AND** S and P (in either order) [1]		
	M3 For Al **3p** (orbital / sub-level / sub-shell) is higher in energy / further from the nucleus / more shielded (than Mg) [1]	*ora*	
	M4 For S the pair of electrons in the (3)**p-orbital** repel [1]	*ora*	