A' Level Chemistry

Year 1

Unit 1: Atomic Structure & Periodicity

Summer Examination Revision Pack

The questions in this pack should be attempted **AFTER** completing all other revision.

Grade Accelerator
Recall Definitions
Drawing Diagrams
Using Equations
Drawing Graphs

Quizlet

Quizlet Classes
Flashcard Based
Games
Tests & Quizzes
Keyword Spell Checker

Condensed Notes
Keywords & Definitions
Key Concepts
Application
Key Skills

Online Forms
Take Time to Answer
Use Paper & Calculator
Work It Out
Review Missed Marks

Use the 3 Wave Process when completing these revision packs.

1. Complete the questions without assistance
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

1. Having gaps after step 1 is normal, that's why we are doing revision!
2. If your notes don't help during step 2, they are not good enough!
(Change your note taking method and try to understand the problem)
3. If you don't understand why the mark scheme answer is correct, **see Andy.**

If you struggle with the questions in the pack, **STOP!** and complete some more revision.

If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

Section A

Answer **all** questions in this section.

1 This question is about electron configuration.

0 1 . 1 Give the full electron configuration of an Al atom and of a Cr^{3+} ion.

[2 marks]

Al atom _____

Cr^{3+} ion _____

0 1 . 2 Deduce the formula of the ion that has a charge of 2+ with the same electron configuration as krypton.

[1 mark]

_____

0 1 . 3 Deduce the formula of the compound that contains 2+ ions and 3− ions that both have the same electron configuration as argon.

[1 mark]

_____

2 This question is about Period 3 of the Periodic Table.

0 2 . 1 Deduce which of Na^+ and Mg^{2+} is the smaller ion.
Explain your answer.

[2 marks]

Smaller ion _____

Explanation _____

_____

_____

_____

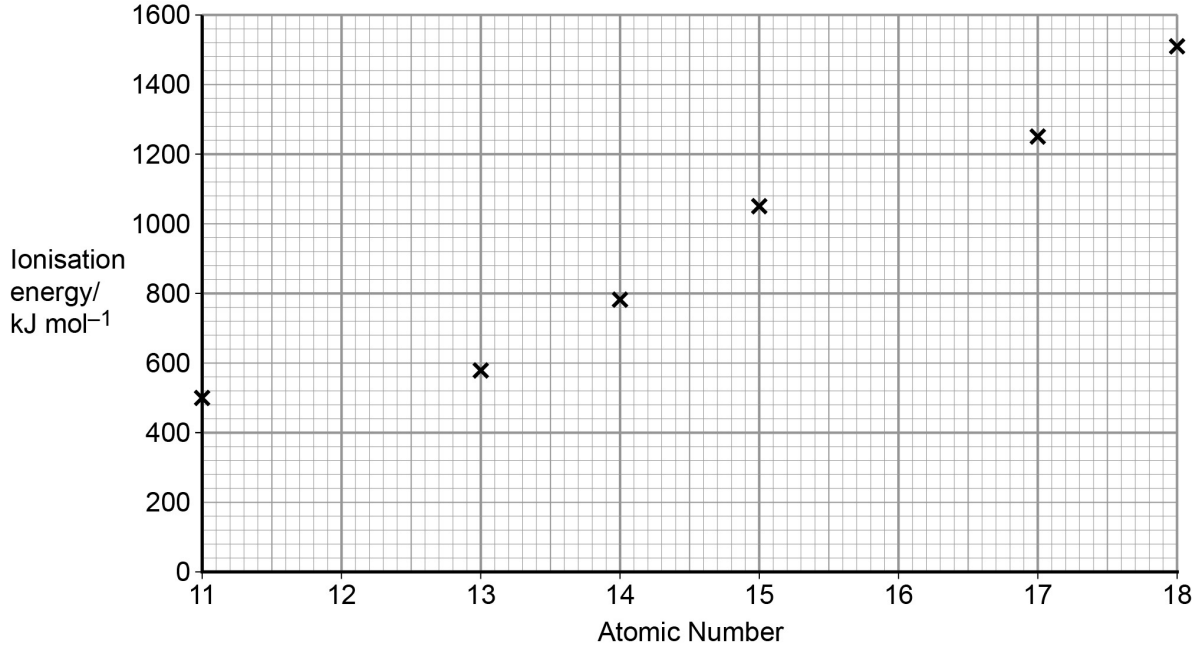
0 2 . 2 Write an equation to represent the process that occurs when the first ionisation energy for sodium is measured.

[1 mark]

_____

0 2 . 3 The first ionisation energies of some Period 3 elements are shown in **Figure 1**.

Figure 1



Complete **Figure 1** by plotting the approximate first ionisation energy values for magnesium and sulfur.

Explain why the first ionisation energy of sulfur is different from that of phosphorus.

[4 marks]

Question	Marking Guidance	Mark	Comments
01.1	$1s^2 2s^2 2p^6 3s^2 3p^1$ $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$	1 1	If noble gas core used correctly in both then scores 1 Allow subscripts and capitals Ignore $4s^0$
01.2	Sr^{2+}	1	Ignore name and correct proton/mass number Allow Sr^{+2}
01.3	Ca_3P_2	1	Allow reversed or ionic formula Ignore name

Question	Marking Guidance	Mark	Comments
02.1	$Mg^{(2+)}$ or Magnesium	1	Na^+ CE=0
	Because Mg^{2+} has more protons		Allow larger/stronger nuclear charge
	AND With the <u>same</u> shielding/screening/electron arrangement/number of electrons (or isoelectronic)	1	Ignore atomic radius
02.2	$Na(g) \rightarrow Na^+(g) + e^-$	1	1 for correct species and gas phase Allow e without charge Allow $Na(g) - e^- \rightarrow Na^+(g)$ $Na(g) + e^- \rightarrow Na^+(g) + 2e^-$
02.3	Mg between 600-800	1	
	S between 800-1040	1	If S not lower than P on graph then M1 only If no plots on graph must state S below P to access M3 & M4
	e^- paired in (3)p orbital in S (owtte)	1	Allow (3)p subshell/sublevel provided pair mentioned
	Paired e^- repel (so less energy needed to remove)	1	

Section A

Answer **all** questions in this section.

0 1 This question is about atomic structure.

0 1 . 1 Write the full electron configuration for each of the following species.

[2 marks]

Cl^- _____

Fe^{2+} _____

0 1 . 2 Write an equation, including state symbols, to represent the process that occurs when the third ionisation energy of manganese is measured.

[1 mark]

_____

_____

0 1 . 3 State which of the elements magnesium and aluminium has the lower first ionisation energy.

Explain your answer.

[3 marks]

_____

_____

_____

_____

_____

_____

_____

Question	Marking Guidance	Mark	Additional Comments/Guidance
01.1	Cl^- $1s^2 2s^2 2p^6 3s^2 3p^6$ Fe^{2+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$	1 1	If [Ne] or [Ar] used then Max 1if both correct Ignore $4s^0$ Allow subscripts
01.2	Mn^{2+} (g) → Mn^{3+} (g) + e^-	1	States symbols are required Allow Mn^{2+} (g) - e^- → Mn^{3+} (g) Negative charge needed on electron
01.3	Al (Outer) electron in (3)p sublevel/orbital Higher in energy/further from the nucleus so easier to remove OWTTE	1 1 1	Mg then CE=0 Not just level or shell Both required for M3 Ignore shielding

Section A

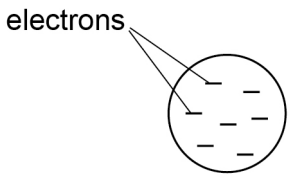
Answer **all** questions in this section.

0 1 This question is about atomic structure.

In the nineteenth century JJ Thomson discovered the electron. He suggested that negative electrons were found throughout an atom like 'plums in a pudding of positive charge'.

Figure 1 shows an atom of element **R** using the 'plum pudding' model.
An atom of **R** contains seven electrons.

Figure 1



0 1 . 1 State **two** differences between the 'plum pudding' model and the model of atomic structure used today.

[2 marks]

1 _____

_____

2 _____

_____

0 1 . 2 Deduce the full electron configuration of an atom of element **R**.

[1 mark]

_____

0 1 . 3 Identify **R** and deduce the formula of the compound formed when **R** reacts with the Group 2 metal in the same period as **R**.

[1 mark]

_____

4

Qu	Marking Guidance	Additional Comments	Mark
1.1	Assume current model unless otherwise stated. Statement about the nucleus: (Central) nucleus contains protons <u>and</u> neutrons. Statement about electrons Electrons are now arranged in energy levels/shells/orbitals	 Allow "protons and neutrons are in the centre of the atom" Ignore "mostly empty space" Ignore electrons surround / orbit nucleus Allow additional statement about neutrons but must be separate from statement about nucleus to score e.g. no neutrons in plum pudding / neutrons now recognised	 1 1
1.2	$1s^2 2s^2 2p^3$	Ignore commas, capitals and subscripts Allow $1s^2 2s^2 2px^1 2py^1 2pz^1$	1
1.3	(R is N (nitrogen)) Formula Be_3N_2	Accept Be_3R_2 only if stated R = nitrogen Accept N_2Be_3	1

Do not write outside the box

0 4 The first ionisation energies of the elements in Period 2 change as the atomic number increases.

Explain the pattern in the first ionisation energies of the elements from lithium to neon.

[6 marks]

Do not write outside the box

6

Turn over for the next question

Question	Marking guidance	Mark	Comments
04	This question is marked using levels of response.		**Indicative Chemistry Content**
	Level 3: ALL Stages with matching justifications All stages are covered and the explanation of each stage is generally correct and virtually complete. Answer is well structured with no repetition or irrelevant points. Accurate and clear expression of ideas with no errors in use of technical terms.	5-6	**Stage 1: General Trend (Li → Ne)** 1a.1st IE increases 1b.More protons/increased nuclear charge 1c.Electrons in same energy level / shell 1d.No extra/similar shielding 1e.Stronger attraction between nucleus and <u>outer</u> e OR <u>outer</u> e closer to nucleus (ignore radius decreases) **Stage 2: Deviation Be → B** 2a.B lower than Be 2b.Outer electron in (2)p 2c.higher in energy than (2)s If Al vs Mg then do not award 2a or 2b **Stage 3: Deviation N → O** 3a.O lower than N 3b.2 electrons in (2)p need to pair 3c.pairing causes repulsion (do not award if it is clear reference to repulsion is in s orbital) If S vs P then do not award 3a or 3b
	Level 2: TWO Stages with matching justifications OR THREE Stages with incomplete justifications. All stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete. Answer shows some attempt at structure Ideas are expressed with reasonable clarity with, perhaps, some repetition or some irrelevant points. Some minor errors in use of technical terms.	3-4	
	Level 1: ONE Stage with matching justification OR TWO Stages with incomplete justifications Two stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies, OR only one stage is covered but the explanation is generally correct and virtually complete. Answer includes isolated statements but these are not presented in a logical order or show confused reasoning. Answer may contain valid points which are not clearly linked to an argument structure. Errors in the use of technical terms.	1-2	
	Level 0 Insufficient correct chemistry to gain a mark.	0	

Do not write outside the box

Section A

Answer **all** questions in this section.

0 1 This question is about atomic structure.

0 1 . 1 There is a general trend for an increase in ionisation energy across Period 3.
Give **one** example of an element that deviates from this trend.

Explain why this deviation occurs.

[3 marks]

Element _____

Explanation _____

_____

_____

_____

_____

0 1 . 2 Give an equation, including state symbols, to represent the process that occurs when the **third** ionisation energy of sodium is measured.

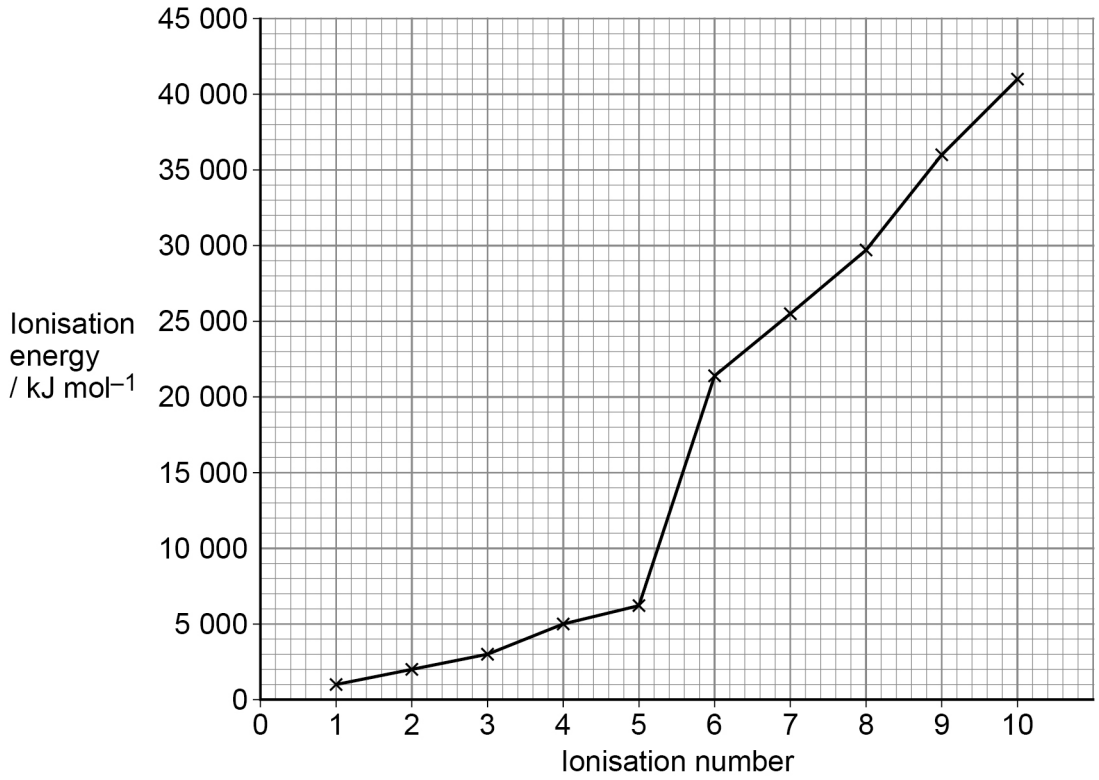
[1 mark]

_____

Do not write outside the box

0 1 . 3 **Figure 1** shows the successive ionisation energies of a Period 3 element, **X**.

Figure 1



Identify element **X**.
Explain your choice.

[3 marks]

Element _____

Explanation _____

_____

_____

_____

_____

_____

_____

_____

7

Turn over for the next question

Question	Marking guidance	Additional Comments/Guidelines	Mark
01.1	Aluminium / Al (Outer) electron in (3)p orbital / sub-shell (level) (3p) higher in energy / slightly more shielded (than 3s) / slightly further away (than 3s) or Sulfur / S (Outer) electrons in (3)p orbital begin to pair Repel	Allow M2/M3 if a Group 3 element is given Not energy level Allow M2/M3 if a Group 6 element is given Do not allow just p^4 vs p^3	1 1 1 OR 1 1 1
01.2	$Na^{2+}(g) \rightarrow Na^{3+}(g) + e^-$	State symbols essential. Allow $Na^{2+}(g) + e^- \rightarrow Na^{3+}(g) + 2\ e^-$	1
01.3	M1 Phosphorus / P M2 large jump in ionisation energy for the 6^{th} ionisation energy M3 This is when the electron is being removed from the 2^{nd} (principle) energy level / from a lower energy level / from a lower shell / from 2p / from an energy level that is closer to the nucleus	Mark independently Large jump after the 5 e^- is removed / when the 6^{th} e^- is removed	3

Do not write outside the box

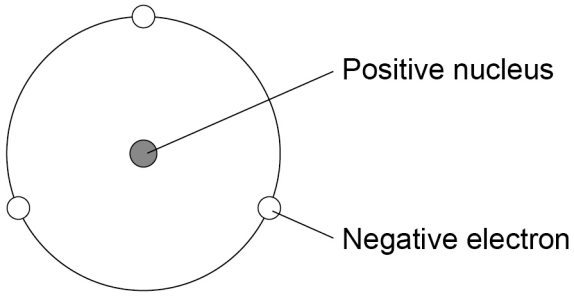
Section A

Answer **all** questions in this section.

0 1 This question is about atomic structure.

0 1 . 1 **Figure 1** is a model proposed by Rutherford to show the structure of an atom.

Figure 1



State **two** features of the current model that are not shown in the Rutherford model.

[2 marks]

Feature 1 of the current model _____

_____

_____

Feature 2 of the current model _____

_____

_____

Do not write outside the box

0 1 . 2 A sample of tin is analysed in a time of flight mass spectrometer.
The sample is ionised by electron impact to form 1+ ions.

Table 1 shows data about the four peaks in this spectrum.

Table 1

m/z	Percentage abundance
112	22.41
114	11.78
117	34.97
120	To be determined

Give the symbol, including mass number, of the ion that reaches the detector first.

Calculate the relative atomic mass of tin in this sample.
Give your answer to 1 decimal place.

[4 marks]

Symbol of ion _____

Relative atomic mass _____

6

Turn over ►

Question	Marking guidance	Additional Comments/Guidelines	Mark
01.1	Current model includes: neutrons <u>and</u> protons Current model shows electrons in different energy levels/orbitals	Rutherford model does not include neutrons and protons Rutherford model does not show electrons in different orbitals/energy levels Allow 1st energy level only holds 2 electrons	1 1

Question	Marking guidance	Additional Comments/Guidelines	Mark
01.2	M1: $^{112}Sn^{+}$ M2 missing abundance = 30.84% M3 $RAM = \frac{(112 \times 22.41) + (114 \times 11.78) + (117 \times 34.97) + (120 \times 30.84)}{100}$ M4 RAM = <u>116.5</u> answer must be to 1dp	 If M2 missing then allow M3 if denominator = 69.16 Allow M4 ecf	1 1 1 1

Do not write outside the box

Section A

Answer **all** questions in this section.

0 1 This question is about ionisation energies of Group 2 elements.

0 1 . 1 Explain why the first ionisation energy of the Group 2 elements decreases down the group.

[2 marks]

0 1 . 2 Give an equation, including state symbols, to represent the process that occurs when the third ionisation energy of magnesium is measured.

[1 mark]

0 1 . 3 Explain why the third ionisation energy of magnesium is much higher than the second ionisation energy of magnesium.

[2 marks]

5

Question	Marking guidance	Additional Comments/Guidelines	Mark
01.1	the outer electron is in a higher (energy) level / there is an increase in shielding / the atoms get larger / more shells There is a weaker attraction between the nucleus and the outer electron.	Mark independently	1 1 (2 x AO1)

Question	Marking guidance	Additional Comments/Guidelines	Mark
01.2	$Mg^{2+}(g) \rightarrow Mg^{3+}(g) + e^-$	$Mg^{2+}(g) + e^- \rightarrow Mg^{3+}(g) + 2\,e^-$	1 (AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
01.3	The electron is removed from 2p sub-shell / 2nd energy level / lower energy level / sub-shell that is closer to the nucleus (Electron being removed is) less shielded (than 3s)		1 1 (2 x AO2)