



Paddington Academy

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OCR AS LEVEL CHEMISTRY A

1.1.1 ATOMS

1.2.1 ELECTRON STRUCTURE

1.3.1 PERIODICITY (a) – (d)

ASSESSED HOMEWORK

Answer all questions

Max 77 marks

Name		
Mark/77%	Grade

1. The element titanium, Ti, atomic number 22, is a metal that is used in the aerospace industry for both airframes and engines.

A sample of titanium for aircraft construction was analysed using a mass spectrometer and was found to contain three isotopes, ^{46}Ti , ^{47}Ti and ^{48}Ti . The results of the analysis are shown in the table below.

isotope	^{46}Ti	^{47}Ti	^{48}Ti
relative isotopic mass	46.00	47.00	48.00
percentage composition	8.9	9.8	81.3

- (a) (i) Explain the term *isotopes*.

.....
.....

[1]

- (ii) Complete the table below for atoms of two of the titanium isotopes.

isotope	protons	neutrons	electrons
^{46}Ti			
^{47}Ti			

[2]

- (b) Using the information in the first table, calculate the relative atomic mass of this sample of titanium.

Give your answer to three significant figures.

[2]

[Total 5 marks]

2. A fifty pence coin contains nickel alloyed with a metal **A**.

Nickel exists as a mixture of three isotopes, nickel-58, nickel-60 and nickel-62.

Complete the table below to show the atomic structures of the isotopes in metallic nickel.

isotope	protons	neutrons	electrons
nickel-58			
nickel-60			
nickel-62			

[Total 3 marks]

3. The Group 2 element magnesium was first isolated by Sir Humphry Davy in 1808.

Magnesium has three stable isotopes, which are ^{24}Mg , ^{25}Mg and ^{26}Mg .

- (i) Complete the table below to show the atomic structures of ^{24}Mg and ^{25}Mg .

	protons	neutrons	electrons
^{24}Mg			
^{25}Mg			

[2]

- (ii) A sample of magnesium contained ^{24}Mg : 78.60%; ^{25}Mg : 10.11%; ^{26}Mg : 11.29%.

Calculate the relative atomic mass of this sample of Mg.

Give your answer to **four** significant figures.

answer =

[2]

(iii) Define the term *relative atomic mass*.

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[3]

[Total 7 marks]

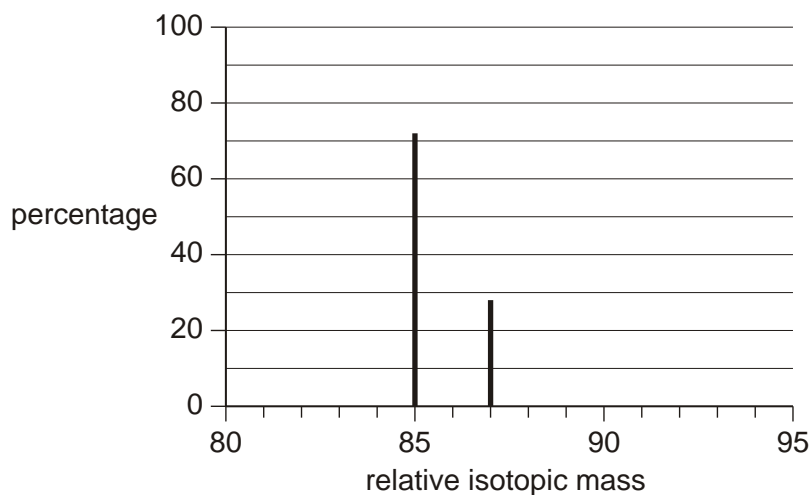
4. Rubidium, atomic number 37, was discovered in 1861 by Bunsen and Kirchoff. Rubidium is in Group 1 of the Periodic Table and the element has two natural isotopes, ^{85}Rb and ^{87}Rb .

(a) Explain the term *isotopes*.

.....
.....

[1]

(b) A sample of rubidium was analysed in a mass spectrometer to produce the mass spectrum below.



(i) Use this mass spectrum to help you complete the table below.

isotope	percentage	number of		
		protons	neutrons	electrons
^{85}Rb				
^{87}Rb				

[3]

(ii) Calculate the relative atomic mass of this rubidium sample. Give your answer to three significant figures.

$$A_r = \dots\dots\dots$$

[2]

(c) Which isotope is used as the standard against which the masses of the two rubidium isotopes are measured?

.....

[1]

[Total 7 marks]

5. The Group 7 element bromine was discovered in 1826. Bromine gets its name from the Greek *brōmos* meaning stench because of its strong smell.

Bromine consists of a mixture of two isotopes, ^{79}Br and ^{81}Br .

- (i) What is the difference between the atomic structures of ^{79}Br and ^{81}Br ?

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.....

[2]

- (ii) State **two** similarities between the atomic structures of ^{79}Br and ^{81}Br .

.....
.....

[2]

[Total 4 marks]

6. Chemists use the Periodic Table to predict the behaviour of elements.

Early attempts at developing a Periodic Table arranged elements in order of increasing atomic mass.

- (i) State which two elements from the **first twenty** elements of the modern Periodic Table are not arranged in order of increasing atomic mass.

.....

[1]

- (ii) Why does the modern Periodic Table **not** arrange some elements, such as those in (i), in order of increasing atomic mass?

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.....

[1]

[Total 2 marks]

7. Complete the electronic configuration of carbon.

$1s^2$

[Total 1 mark]

8. The electron configuration of bromine contains outermost electrons in the 4th shell.

Using your knowledge of Group 7 elements, complete the electron configuration of bromine.

$1s^2 2s^2 2p^6 3s^2 3p^6$

[Total 1 mark]

9. Complete the electronic configuration of a titanium atom.

$1s^2 2s^2 2p^6$

[Total 1 mark]

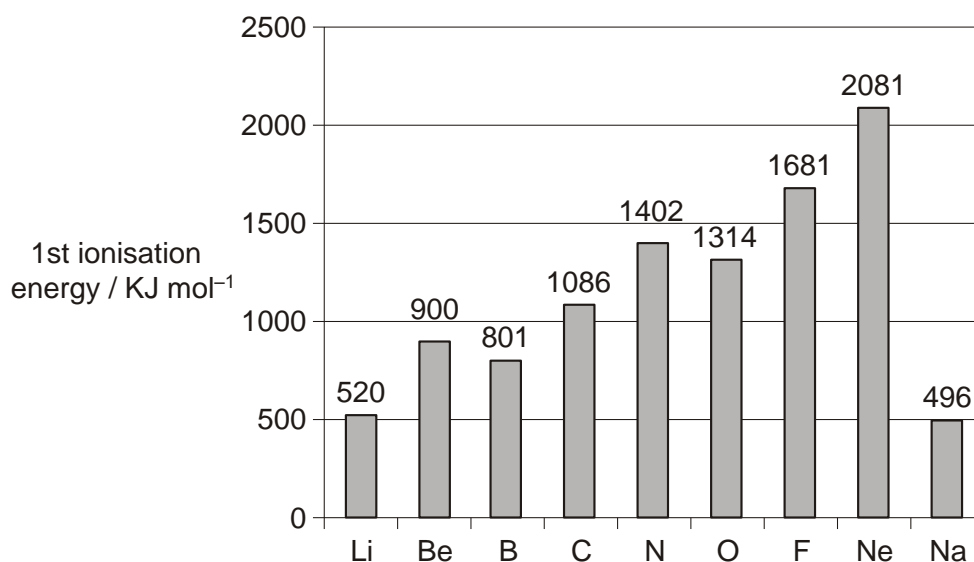
10. Complete the electron configuration of the Cl^- ion.

$1s^2$

[Total 1 mark]

11. Ionisation energies have been used to develop the model of the atom.

The first ionisation energies of the elements Li to Na are shown in the figure below.



Define the term *first ionisation energy*.

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[Total 3 marks]

12. State and explain the trend in first ionisation energies shown by the elements with the atomic numbers 2, 10 and 18.

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[Total 4 marks]

13. Reactions of the Group 2 metals involve removal of electrons. The electrons are removed more easily as the group is descended and this helps to explain the increasing trend in reactivity.

(i) The removal of one electron from each atom in 1 mole of gaseous radium atoms is called the

[2]

The equation for this process in radium is:

.....

[2]

(ii) Atoms of radium have a greater nuclear charge than atoms of calcium.

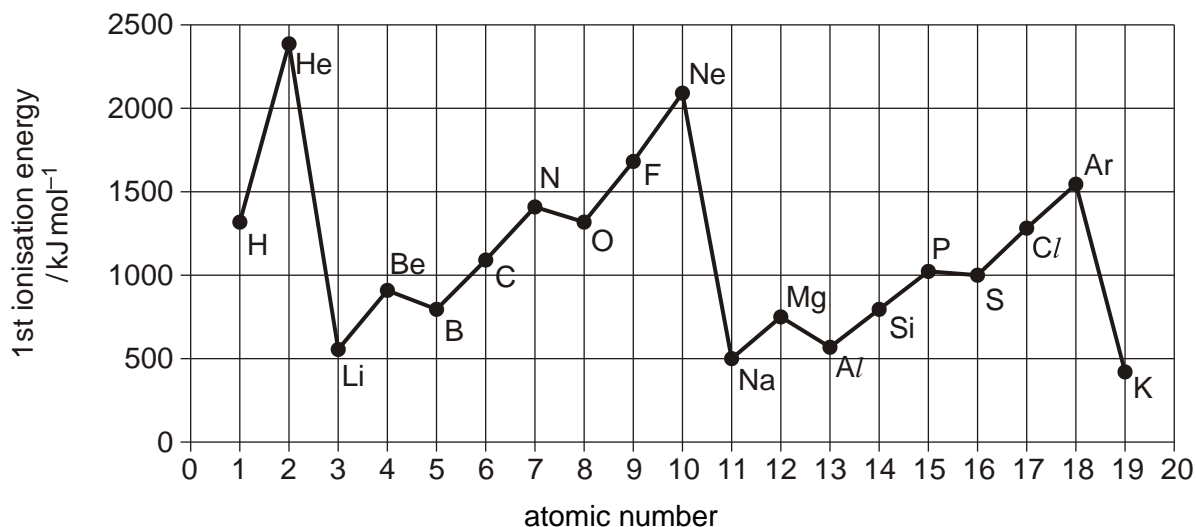
Explain why, despite this, **less** energy is needed to remove an electron from a radium atom than from a calcium atom.

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[3]

[Total 7 marks]

14. The first ionisation energies of the elements H to K are shown below. Use this diagram to help with your answers to this question.



- (a) Define the term *first ionisation energy*.

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[3]

- (b) Explain why the first ionisation energies show a **general** increase across Period 2 (Li to Ne).

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[2]

[Total 5 marks]

15. Successive ionisation energies provide evidence for the arrangement of electrons in atoms. The table below shows the eight successive ionisation energies of oxygen.

ionisation number	1st	2nd	3rd	4th	5th	6th	7th	8th
ionisation energy / kJ mol^{-1}	1 314	3 388	5 301	7 469	10 989	13 327	71 337	84 080

- (i) Define the term **first ionisation energy**.

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[3]

- (ii) Write an equation, with state symbols, to represent the **third** ionisation energy of oxygen.

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[2]

- (iii) Explain how the information in the table above provides evidence for two electron shells in oxygen.

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[2]

[Total 7 marks]

16. In this question, you are provided with information about ionisation energies of elements. You are also provided with some additional information that will help you answer part (b).

(a) Define the term *first ionisation energy*.

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[3]

(b) In this question, one mark is available for the quality of use and organisation of scientific terms.

Table 1 provides data on elements in **Period 2** of the Periodic Table.

Table 2 shows the first 6 successive ionisation energies of an element **X**, which is in **Period 3** of the Periodic Table.

element	Li	Be	B	C	N
number of protons	3	4	5	6	7
electron configuration	$1s^2 2s^1$	$1s^2 2s^2$	$1s^2 2s^2 2p^1$	$1s^2 2s^2 2p^2$	$1s^2 2s^2 2p^3$
1st ionisation energy / kJ mol^{-1}	520	900	801	1086	1402

Table 1

element	ionisation energy / kJ mol^{-1}					
	1st	2nd	3rd	4th	5th	6th
X	578	1817	2745	11 578	14 831	18 378

Table 2

- Using Table 1, describe and explain the trend in first ionisation energies shown by the Period 2 elements, Li–N.
- Using Table 2, identify element **X**. Explain how you decided on your answer.

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[10]

[Total 13 marks]

17. The first ionisation energy of oxygen is 1314 kJ mol^{-1} and the second ionisation energy of oxygen is 3388 kJ mol^{-1} .

(i) Write an equation to represent the **second** ionisation energy of oxygen.

Include state symbols.

.....

[1]

(ii) Suggest why the second ionisation energy of oxygen has a greater value than the first ionisation energy of oxygen.

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[1]

[Total 2 marks]

18. The atomic radii of nitrogen and oxygen are shown below.

element	nitrogen	oxygen
atomic radius/nm	0.075	0.073

Explain why a nitrogen atom is larger than an oxygen atom.

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[Total 4 marks]