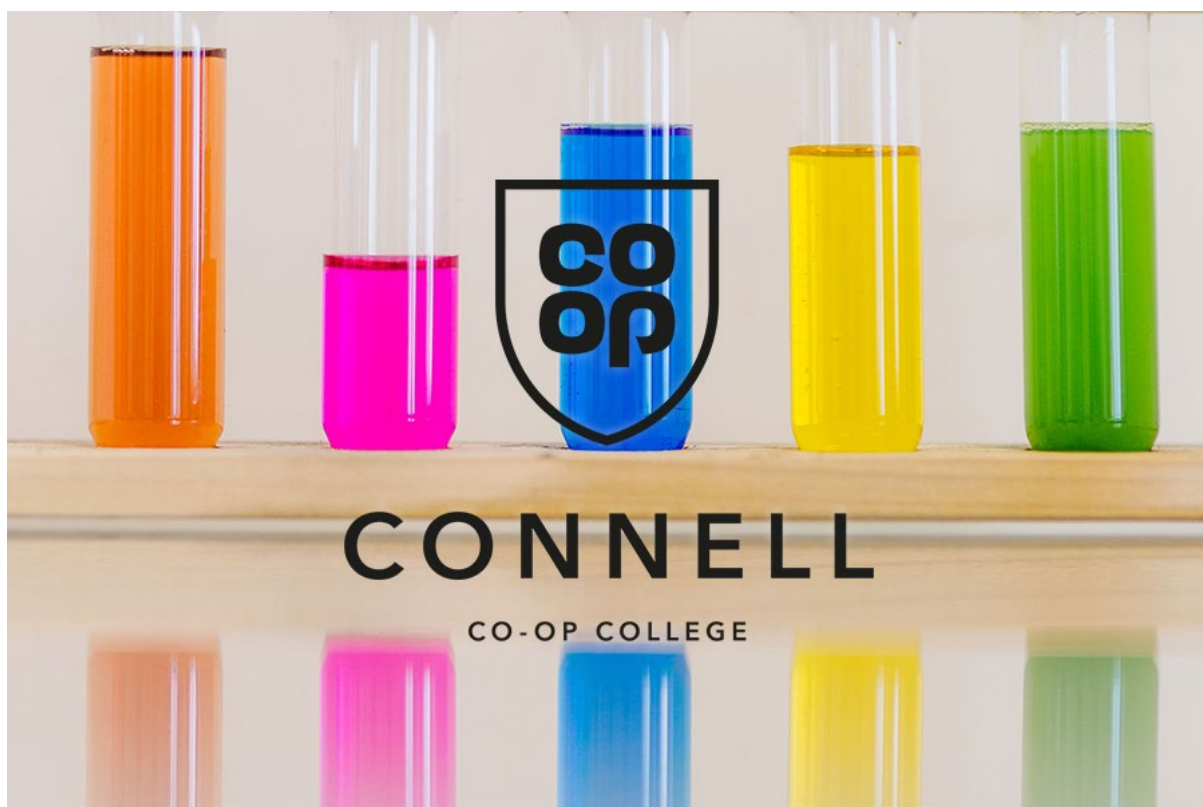




INTRODUCTION TO A-LEVEL CHEMISTRY

Chemistry A Level Transition Tasks

https://www.amazon.co.uk/Head-Start-level-Chemistry-Level-ebook/dp/B00VE2NIGG/ref=tmm_kin_swatch_0?_encoding=UTF8&qid=&sr=

1. Europium, atomic number 63, is used in some television screens to highlight colours. A chemist analysed a sample of europium using mass spectrometry. The results are shown in the table below.

isotope	relative isotopic mass	abundance (%)
^{151}Eu	151.0	47.77
^{153}Eu	153.0	52.23

- (a) Define the term *relative isotopic mass*.

.....
.....
.....
.....

[2]

- (b) Using the table above, calculate the relative atomic mass of the europium sample.
Give your answer to **two** decimal places.

answer =

[2]

[Total 4 marks]

2. Isotopes of europium have differences and similarities.

- (i) In terms of protons, neutrons and electrons, how is an atom of ^{151}Eu **different** from an atom of ^{153}Eu ?

.....
.....

[1]

- (ii) In terms of protons, neutrons and electrons, how is an atom of ^{151}Eu **similar** to an atom of ^{153}Eu ?

.....
.....

[1]

[Total 2 marks]

3. Carbon occurs in a wide range of compounds and is essential to living systems.

Two isotopes of carbon are ^{12}C and ^{13}C .

- (i) State what is meant by the term *isotopes*.

.....
.....

[1]

- (ii) Isotopes of carbon have the same chemical properties.

Explain why.

.....
.....

[1]

[Total 2 marks]

4. 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*.

.....

[3]

[Total 7 marks]

5. The Group 7 element bromine was discovered by Balard in 1826. Bromine gets its name from the Greek *bromos* meaning stench.

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

- (i) What is meant by the term *isotopes*?

.....

.....

[1]

- (ii) Complete the table below to show the atomic structures of the bromine isotopes.

	protons	neutrons	electrons
^{79}Br			
^{81}Br			

[2]

- (iii) Write the full electronic configuration of a bromine atom.

$1s^2$

[1]

[Total 4 marks]

6. Magnesium exists naturally as a mixture of its isotopes, ^{24}Mg , ^{25}Mg and ^{26}Mg .

The isotopes in magnesium can be separated by mass spectrometry. The diagram below shows a mass spectrometer.

- (i) Complete the table below to show the composition of the ^{25}Mg and ^{26}Mg isotopes.

	protons	neutrons	electrons
^{25}Mg			
^{26}Mg			

[2]

- (ii) Complete the electronic configuration of an atom of ^{24}Mg .

$1s^2$

[1]

- (iii) Results from the mass spectrum of a sample of magnesium are shown below.

isotope	^{24}Mg	^{25}Mg	^{26}Mg
relative isotopic mass	24.00	25.00	26.00
% abundance	78.60	10.11	11.29

Calculate the relative atomic mass of the sample of magnesium.
Give your answer to two decimal places.

answer

[2]

[Total 5 marks]

7. Antimony, Sb, is a metal used in alloys to make lead harder. Bullets contain about 1% of antimony for this reason.

Antimony has two main isotopes.

Complete the table below to show the properties of particles that make up isotopes.

	proton	neutron	electron
relative mass			
relative charge			

[2]

[Total 2 marks]

8. Relative atomic mass, A_r , can be used to compare the masses of atoms of different elements.

The antimony in a bullet was analysed by a forensic scientist to help solve a crime. The antimony was found to have the following percentage composition by mass: ^{121}Sb , 57.21%; ^{123}Sb , 42.79%.

Calculate a value for the relative atomic mass of the antimony. Give your answer to 4 significant figures.

A_r

[2]

[Total 2 marks]

9. Carbon is in the p-block of the Periodic Table. Naturally occurring carbon contains a mixture of two isotopes, ^{12}C and ^{13}C .

Complete the table below for the atomic structure of the isotopes ^{12}C and ^{13}C .

isotope	protons	neutrons	electrons
^{12}C			
^{13}C			

[Total 2 marks]

10. 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)

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 4 marks]

11. 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 ?

.....
.....

[2]

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

.....
.....

[2]

[Total 4 marks]

12. 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]

13. Metal **A** can be identified from its relative atomic mass.

Analysis of a fifty pence coin showed that two isotopes of metal **A** were present with the following percentage abundances.

isotope	isotope 1	isotope 2
relative isotopic mass	63.0	65.0
% abundance	77.2	22.8

- (i) What analytical method is used to obtain this information?

.....

[1]

- (ii) Calculate the relative atomic mass of the sample of metal **A**.

Give your answer to three significant figures.

answer

[2]

- (iii) Use your answer to (ii) and the Data Sheet to suggest the identity of metal **A**.

.....

[1]

[Total 4 marks]

14. A sample of carbon was found to contain 95% of ^{12}C and 5% of ^{13}C .

(i) How could this information be obtained experimentally?

.....

[1]

(iii) Calculate the relative atomic mass of this sample of carbon to three significant figures.

$A_r =$

[2]

[Total 3 marks]

1. (a) **Mass of the isotope compared to 1/12th**
OR
mass of the atom compared to 1/12th ✓

(the mass of a) carbon-12 **OR** ^{12}C (atom) ✓

IGNORE Reference to average **OR** weighted mean
 (i.e. correct definition of relative atomic mass will score both marks)

ALLOW mass of a **mole** of the isotope/atom with 1/12th the mass of a **mole** **OR** 12 g of carbon-12 for two marks.

ALLOW 2 marks for:

'Mass of the isotope **OR** mass of the atom compared to ^{12}C atom given a mass of 12.0'

i.e. 'given a mass of 12' **OR** C12 is 12 communicates the same idea as 1/12th.'

ALLOW 12C **OR** C12

ALLOW 2 marks for:

$$\frac{\text{mass of the isotope}}{\text{mass of } 1/12\text{th mass of carbon-12}}$$

i.e. fraction is equivalent to 'compared to'

ALLOW 1 mark for a mix of mass of atom and mass of mole of atoms, i.e. 'mass of the isotope/mass of an atom compared with 1/12th the mass of a **mole** **OR** 12 g of carbon-12.'

DO NOT ALLOW mass of 'ions' **OR** mass of element

2

(b)
$$\frac{(151 \times 47.77) + (153 \times 52.23)}{100}$$

OR

$$72.1327 + 79.9119$$

OR

$$152.0446 \text{ (calculator value) } \checkmark$$

$$A_r = 152.04 \checkmark$$

ALLOW Correct answer for two marks

ALLOW One mark for ECF from transcription error in first sum provided final answer is to 2 decimal points and is to between 151 and 153 and is a correct calculation of the transcription

2

[4]

2. (i) ^{153}Eu has (2) more neutrons

OR

^{153}Eu has 90 neutrons **AND** ^{151}Eu has 88 neutrons ✓

***ALLOW** There are a different number of neutrons*
***IGNORE** Correct references to protons / electrons*
***DO NOT ALLOW** Incorrect references to protons / electrons*

1

- (ii) (It has the) same number of protons **AND** electrons

OR

Both have 63 protons and 63 electrons ✓

***ALLOW** Same number of protons **AND** same electron configuration*

***DO NOT ALLOW** 'Same number of protons' without reference to electrons (and vice versa)*

1

[2]

3. (i) (atoms of the) same element **OR** same atomic no.
OR no. of protons

AND

with different numbers of neutrons **OR** different masses ✓

***IGNORE** 'same number of electrons'*

***DO NOT ALLOW** 'different numbers of electrons'*

***DO NOT ALLOW** 'different relative atomic masses'*

***DO NOT ALLOW** 'elements with different numbers of neutrons' **without** mention of same protons **OR** same atomic number*

1

- (ii) **same** (number of) **electrons** (in the outer shell)

OR

same **electron** configuration **OR** structure ✓

***DO NOT ALLOW** different number of protons*

***IGNORE** 'same number of protons'*

***IGNORE** 'they are both carbon' **OR** 'they are both the same element'*

1

[2]

4. (i)

	protons	neutrons	electrons
^{24}Mg	12	12	12

²⁵ Mg	12	13	12
------------------	----	----	----

²⁴Mg line correct ✓

²⁵Mg line correct ✓

mark by **row**

2

(ii)
$$\frac{24 \times 78.60 + 25 \times 10.11 + 26 \times 11.29}{100}$$

OR $18.8640 + 2.5275 + 2.9354$

OR 24.3269 ✓

$A_r = 24.33$ (to 4 sig figs) ✓

ALLOW two marks for $A_r = 24.33$ with no working out

ALLOW one mark for ecf from incorrect sum provided final answer is between 24 and 26 and is to 4 significant figures, e.g. 24.3235 ✗ gives ecf of 24.32 ✓

2

- (iii) The (weighted) mean **mass** of an **atom**
OR (weighted) average **mass** of an **atom** ✓

relative to $1/12^{\text{th}}$ (the mass) ✓

of (one atom of) ^{12}C ✓

ALLOW The (weighted) mean mass

OR (weighted) average mass of an atom

OR average atomic mass ✓

compared with (the mass of) carbon-12 ✓

which is 12 ✓

For 1st marking point, *ALLOW* mean mass of the isotopes

OR average mass of the isotopes

Do **NOT ALLOW** the singular: isotope

ALLOW mass of **one mole** of **atoms** ✓

compared to $1/12^{\text{th}}$ ✓

(the mass) of **one mole** / 12 g of carbon-12 ✓

mass of one mole of atoms ✓

$1/12^{\text{th}}$ ✓ the mass of one mole / 12 g of carbon-12 ✓

3

[7]

5. (i) atoms of the same element with different numbers of neutrons/different masses **(1)**

1

- (ii) ^{79}Br 35 protons, 44 neutrons, 35 electrons **(1)**

- ^{81}Br 35 protons, 46 neutrons, 35 electrons **(1)**

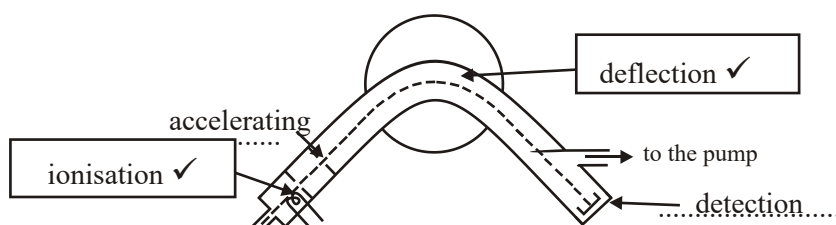
2

- (iii) $(1s^2)2s^22p^63s^23p^63d^{10}4s^24p^5$ **(1)**

1

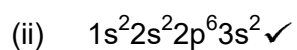
[4]

6. (i)



	protons	neutrons	electrons	
^{25}Mg	12	13	12	✓
^{26}Mg	12	14	12	✓

2



$$24 \times 78.60/100 + 25 \times 10.11/100 + 26 \times 11.29/100$$
 ✓

1

(iii) = 24.33 ✓ (calc value: 24.3269. This scores one mark)

24.32 with no working, award 1 mark only.

24.3 with no working, no marks (Periodic Table value)

2

[5]

7.

	proton	neutron	electron	
relative mass	1	1	$\frac{1}{1840}$ /	negligible ✓
relative charge	+1	0	-1	✓
<i>i.e. 1 mark for each correct row</i>				
<i>for electron, accept 1/1500 – 1/2000</i>				
<i>for charges, accept +; 0; –</i>				

2

[2]

8.

$$A_r = \frac{(121 \times 57.21) + (123 \times 42.79)}{100} / 121.8558$$
 ✓

$$= 121.9$$
 ✓

2

[2]

9.

isotope	protons	neutrons	electrons	
^{12}C	6	6	6	✓
^{13}C	6	7	6	✓

[2]

10. (a)

(ii)	isotope	protons	neutrons	electrons	
	^{46}Ti	22	24	22	✓
	^{47}Ti	22	25	22	✓

2

(b) $A_r = \frac{(46 \times 8.9) + (47 \times 9.8) + (48 \times 81.3)}{100} / 47.724$ ✓
 $= 47.7$ ✓

2

[4]

11. (i) ^{79}Br has two ✓ less neutrons than ^{81}Br ✓ 2

(ii) ^{79}Br have same numbers of protons ✓
 and same number of electrons ✓

2

[4]

12.

isotope	protons	neutrons	electrons
nickel-58	28	30	28
nickel-60	28	32	28
nickel-62	28	34	28
	✓	✓	✓

For ecf, 3rd column same as first column.

[3]

13. (i) mass spectrometry ✓
mass spec... /mass spectrometer should also be credited 1
- (ii) $63.0 \times 77.2/100 + 65.0 \times 22.8/100 / 63.456$ ✓ 2
= 63.5 (mark for significant figures) ✓
- (iii) copper/ Cu ✓ 1
[4]
14. (i) mass spectrometry ✓ 1
- (iii) $12 \times 95/100 + 13 \times 5/100$ OR 12.05 ✓
= 12.1 (mark for significant figures) ✓
(12.1 scores both marks) 2
[3]