

Past-paper walk-through

Isotopes ■ 2.3

eXercise

Questions in this set

- 0620/22 N25 Q6 ■ 1 mark
- 0620/23 N25 Q6 ■ 1 mark
- 0620/22 J25 Q5 ■ 1 mark
- 0620/43 J25 Q2 ■ 9 marks
- 0620/22 M25 Q5 ■ 1 mark
- 0620/22 M25 Q6 ■ 1 mark

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 6

0620/22 N25 ■ Q6 ■ 1 mark

- 6 Which two values are used to calculate the relative atomic mass of a sample of boron?

	value 1	value 2
A	the total number of boron isotopes	the total number of boron atoms
B	the relative abundance of each boron isotope in the sample	the relative mass of each boron isotope
C	the relative abundance of each boron isotope in the sample	the total number of boron atoms
D	the total number of boron isotopes	the relative mass of each boron isotope

Question 6

Solution 6

Answer: **B**

Why

- A weighted mean needs both the mass of each isotope and how common it is.
- So you need the relative isotopic mass and the relative abundance of each isotope.
- How *many* isotopes exist, or how many atoms there are, tells you nothing about the average.

Question 6

0620/23 N25 ■ Q6 ■ 1 mark

- 6** A sample of copper has a relative atomic mass of 63.5.

What are the relative abundances of the isotopes in this sample of copper?

- A** 25% ^{63}Cu and 75% ^{65}Cu
- B** 50% ^{63}Cu and 50% ^{65}Cu
- C** 75% ^{63}Cu and 25% ^{65}Cu
- D** 90% ^{63}Cu and 10% ^{65}Cu

Solution 6

Answer: **C**

Why

- Let the fraction of ^{63}Cu be x : $63x + 65(1 - x) = 63.5$.
- $65 - 2x = 63.5$, so $x = 0.75$.
- That is 75% ^{63}Cu and 25% ^{65}Cu – the average sits nearer 63, so the lighter isotope must dominate.

Question 5

0620/22 J25 ■ Q5 ■ 1 mark

- 5** A sample of element Q has two isotopes.

Their relative masses and abundances are shown.

relative mass of isotope	abundance /%
238	66
244	34

What is the relative atomic mass of this sample of Q to three significant figures?

Question 5

A 240

B 241

C 242

D 243

Solution 5

Answer: **A**

Why

- $A_r = (238 \times 66 + 244 \times 34)/100.$
- $= (15\,708 + 8296)/100 = 240.04.$
- To three significant figures, 240.

Question 2

0620/43 J25 ■ Q2 ■ 9 marks

2 Atoms are made of electrons, neutrons and protons.

(a) State which of these particles are found in the nucleus of an atom [1]

(b) Atoms of the same element are known as isotopes.

$^{32}_{16}\text{S}$ and $^{34}_{16}\text{S}$ are isotopes of sulfur.

(i) Complete Table 2.1 to show the number of electrons, neutrons and protons in one atom or ion of these isotopes. Table 2.1

isotope	electrons	neutrons	protons
$^{34}_{16}\text{S}$			
$^{32}_{16}\text{S}^{2-}$			

[3]

(ii) Table 2.2 shows the relative masses and the percentage abundances of the two isotopes in a sample of sulfur. Table 2.2

isotope	relative mass	percentage abundance
$^{32}_{16}\text{S}$	32	95
$^{34}_{16}\text{S}$	34	5

Calculate the relative atomic mass of this sample of sulfur to one decimal place.

Question 2

relative atomic mass = [2]

(iii) The relative atomic masses of all elements are compared to one atom of an isotope.

Identify this isotope [1] , ,

(c) Ions are atoms or groups of atoms that have gained or lost one or more electrons.

An oxygen atom has the electronic configuration of 2,6.

Give the formula of one atom and one positive ion that has the same electronic configuration as O^{2-} . ■ atom ■ positive ion [2]

, ,

(a) (a) State which of these particles are found in the nucleus of an atom.

[1]

[1]

Question 2

isotope	electrons	neutrons	protons
$^{34}_{16}\text{S}$			
$^{32}_{16}\text{S}^{2-}$			

[3]

Question 2

relative mass of isotope	percentage abundance of isotope
32	95
34	5

Question 2

0620/43 J25 ■ Q2 ■ 9 marks

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(ii) Table 2.2 shows the relative masses and the percentage abundances of the two isotopes in a sample of sulfur. Table 2.2 relative mass of isotope percentage abundance of isotope $^{32}_{16}\text{S}$ 95 $^{34}_{16}\text{S}$ 5
Calculate the relative atomic mass of this sample of sulfur to one decimal place.

relative atomic mass = [2]

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Question 2

(c) Ions are atoms or groups of atoms that have gained or lost one or more electrons.

An oxygen atom has the electronic configuration of 2,6.

Give the formula of one atom and one positive ion that has the same electronic configuration as O^{2-} . atom positive ion [2]

(b)(i) (b) Atoms of the same element are known as isotopes. $^{34}_{16}\text{S}$ and $^{32}_{16}\text{S}$ are isotopes of sulfur. (i) Complete Table 2.1 to show the number of electrons, neutrons and protons in one atom or ion of these isotopes. Table 2.1

	electrons	isotope	neutrons	protons
$^{34}_{16}\text{S}$				
$^{32}_{16}\text{S}^{2-}$				

[3]

(b)(ii) (ii) Table 2.2 shows the relative masses and the percentage abundances of the two isotopes in a sample of sulfur. Table 2.2

	percentage abundance	isotope	relative mass
	95	$^{32}_{16}\text{S}$	32
	5	$^{34}_{16}\text{S}$	34

Calculate the relative atomic mass of this sample of sulfur to one decimal place. relative atomic mass = [2] [2]

Question 2

(b)(iii) (iii) The relative atomic masses of all elements are compared to one atom of an isotope. Identify this isotope.

.....
[1] , ,

[1]

Question 2

0620/43 J25 ■ Q2 ■ 9 marks

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.....
 ■ positive ion

..... [2] [2]

Solution 2

(a)

Mark scheme

- protons and neutrons
- 1

Solution 2

(b)(i) Mark scheme

- electron
- neutron
- proton
- 16
- 18
- 16
- 18
- 16

Solution 2

- 16
- 1 mark for each correct column
- 3

Solution 2

(b)(ii)

Mark scheme

- M1 $(32 \times 95) + (34 \times 5) = 3210$ M2
- $3210 / 100 = 32.1$
- 2

Solution 2

(b)(iii)

Mark scheme

- 12C
- 1

Solution 2

(c)

Mark scheme

- M1 Ne M2
- Na^+ OR Mg^{2+} OR Al^{3+}
- 2

Question 5

0620/22 M25 ■ Q5 ■ 1 mark

5 Element T has two isotopes, $^{12}_6\text{T}$ and $^{14}_6\text{T}$.

Which statement about these isotopes is correct?

- A** They have different chemical properties because they have different numbers of neutrons.
- B** They have the same chemical properties because they have the same number of outer shell electrons.
- C** They have the same nucleon number because the sum of the number of protons and electrons is the same.
- D** They have different positions in the Periodic Table because they have different numbers of neutrons.

Solution 5

Answer: **B**

Why

- Isotopes differ only in neutron number; the proton and electron counts are the same.
- Chemical behaviour depends on the outer electrons, which are identical.
- So their chemical properties match – only physical properties such as mass differ.

Question 6

0620/22 M25 ■ Q6 ■ 1 mark

- 6** Lithium is in Group I of the Periodic Table. Nitrogen is in Group V of the Periodic Table.

Lithium reacts with nitrogen to form the ionic compound lithium nitride, Li_3N .

What happens to the electrons when lithium atoms and nitrogen atoms form ions?

	lithium	nitrogen
A	each lithium atom loses one electron to form an Li^+ ion	each nitrogen atom gains three electrons to form an N^{3-} ion
B	each lithium atom loses one electron to form an Li^+ ion	each nitrogen atom gains five electrons to form an N^{5-} ion
C	each lithium atom gains one electron to form an Li^- ion	each nitrogen atom loses three electrons to form an N^{3+} ion

Question 6

D

each lithium atom gains one electron to form an Li^- ion

each nitrogen atom loses five electrons to form an N^{5+} ion

Solution 6

Answer: **A**

Why

- Lithium is in Group I, so each atom loses one electron to form Li^+ .
- Nitrogen is in Group V, so each atom gains three electrons to form N^{3-} .
- Three lithium atoms are needed per nitrogen, which is why the formula is Li_3N .