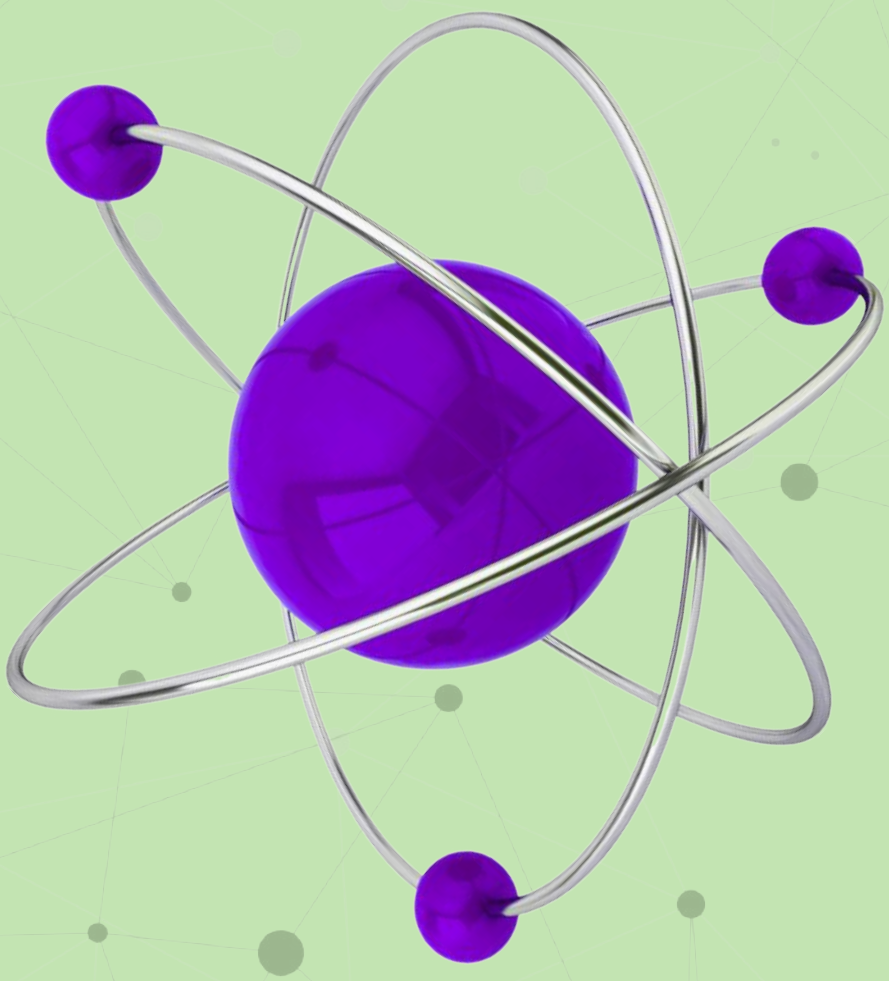
Cambridge IGCSE Chemistry



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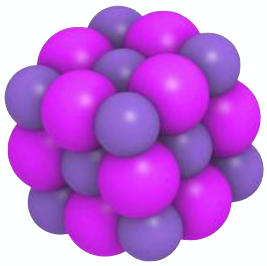
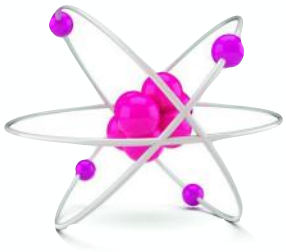
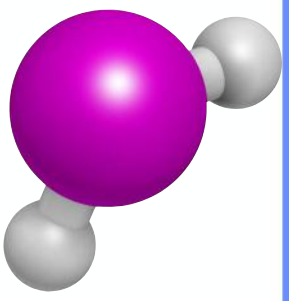






Contents

Guiding words to write perfect answers

Define
Give a definition – use the definitions given in the IGCSE complete notes; or the definition list at the end of this book

Describe
You may have to describe a process or the appearance of a structure. When describing data in a table or a graph, use the words increase, decrease, constant, peak, maximum, minimum, etc.

Sketch
This is usually used about graphs. You should put a line (straight or curved) on a pair of axes. This may be a graph that has a line on it already or it may be pair of axes printed on the exam paper without a line or curve

Predict
This means you should state what you think will happen. You may be asked to justify your prediction or explain it; explanation is not required if all the question says is "predict...."

Calculate
This is obvious; make sure you know how to calculate percentages, percentage changes, rates and ratios (for genetics). Always give your working even if not asked and always make sure you use the correct units

State
Brief answer – maybe one word or a phrase

List
A number of brief answers should be given; usually you're asked for a specific number of points. You don't gain extra marks by writing more than the number stated

Explain
This is not the same as describe. You should give an answer that has some reasons. You may have to explain why something happens or how it happens

Estimate
You don't have to give an accurate answer – but your answer (which is usually numerical) should only be approximate

Measure
You should use a suitable measuring instrument to take a reading. Usually this involves using a ruler to measure to the nearest mm. Make sure you write down the unit after the numerical answer

Suggest
This is often used when there is no single correct answer; you should look through the information you have been given for some clues as to what to 'suggest' in response to the question. Many problem-solving questions use this command word

IGCSE

ATOMIC STRUCTURE

CLICK FOR EXPLANATION

1 A radioactive isotope of iodine, $^{131}_{53}I$, is used to treat cancer.

(i) Define the term *isotope*.

Atom with same number of protons but different neutrons [2]

(ii) How many protons, electrons and neutrons are there in one atom of $^{131}_{53}I$?

number of protons 53

number of electrons 53

number of neutrons 78 [2]

(iii) When this isotope, $^{131}_{53}I$, emits radiation, a different element with a proton number of 54 is formed.
What is the name of this element?

Xe [1]

2 The table below gives the composition of six particles which are either atoms or ions.

particle	number of protons	number of neutrons	number of electrons
A	33	40	33
B	19	20	18
C	34	45	36
D	33	42	33
E	13	14	13
F	24	28	21

(a) Which particles are atoms? Explain your choice.

A - D - E

[2]

(b) Which particle is a negative ion and why has this particle got a negative charge?

C, GAINED 2 ELECTRONS

[2]

(c) Which particles are positive ions?

B – F

..... [1]

(d) Explain why particle **A** and particle **D** are isotopes.

Same protons but different neutrons

..... [2]

[Total: 7]

3 In the Periodic Table, the elements are arranged in columns called Groups and in rows called Periods.

(a) (i) Complete the table for some of the elements in Period 3.

group number	I	II	III	IV	V	VI	VII
symbol	Na	Mg	Al	Si	P	S	Cl
number of valency electrons	1	2	3	4	5	6	7
valency	1	2	3	4	3	2	1

[2]

CLICK FOR EXPLANATION

(ii) What is the relationship between the group number and the number of valency electrons?

group number = valency electrons

..... [1]

(iii) Explain the relationship between the number of valency electrons and the valency

for the elements Na to Al,

the valency is the same as the number of valency (outer) electrons because this is the number of electrons lost (for full energy level)

for the elements P to Cl.

the valency is 8 – [number of valency (outer) electrons]

..... [4]

CLICK FOR EXPLANATION

4 $^{45}_{21}Sc$ represents an atom of scandium.

How many nucleons and how many charged particles are there in one atom of scandium?

number of nucleons 45

number of charged particles ..... 42 (protons + electrons)

[2]

(c) Two different atoms of sodium are $^{23}_{11}Na$ and $^{24}_{11}Na$.

(i) Explain why these two atoms are isotopes.

..... same protons but different neutrons .....

..... [2]

(ii) $^{24}_{11}Na$ is radioactive. It changes into an atom of a different element which has one more proton.

Identify this element.

..... Mg ..... [1]

5 The table gives the composition of three particles.

particle	number of protons	number of electrons	number of neutrons
A	15	15	16
B	15	18	16
C	15	15	17

(a) What is the evidence in the table for each of the following?

(i) Particle **A** is an atom.

..... same protons but different neutrons .....

..... [1]

(ii) **A**, **B** and **C** are all particles of the same element.

Same number of protons ..... [1]

(iii) Particles **A** and **C** are isotopes of the same element.

same protons but different neutrons .....

..... [2]

(b) **(i)** What is the electronic structure of particle **A**?

2, 5 , 8 ..... [1]

(ii) Is element **A**, a metal or a non-metal? Give a reason for your choice.

..... [1]

[Total: 6]

6 The following are gallium atoms.

$^{69}_{31}Ga$ $^{71}_{31}Ga$

Complete the following table.

atom	number of protons	number of neutrons	number of electrons
$^{69}_{31}Ga$	31	38	31
$^{71}_{31}Ga$	31	40	31

[3]

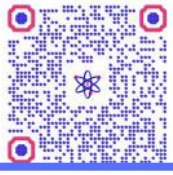
CLICK FOR EXPLANATION

7 Protons, neutrons and electrons are subatomic particles.

(a) Complete the table to show the relative mass and relative charge of a proton, a neutron and an electron.

particle	relative mass	relative charge
proton	1	+1
neutron	1	0
electron	$\frac{1}{1840}$	-1

[3]



(b) Bromine has two isotopes.

(i) Define the term *isotope*.

same number of protons. They can have different numbers of neutrons. [2]

(ii) Explain why the two isotopes of bromine have the same chemical properties.

same number of outer shell / valence electrons

[2]

8 **(a)** **(i)** Define the term *atomic number*.

Number of protons in the nucleus of the atom [1]

(ii) Define the term *nucleon number*.

total number of protons and neutrons in the atom which equal to the mass number of this atom [2]

CLICK FOR EXPLANATION

(b) The table shows the number of protons, neutrons and electrons in some atoms or ions.

Complete the table. The first line is given as an example.

particle	number of protons	number of electrons	number of neutrons	symbol or formula
A	6	6	6	$^{12}_{6}C$
B	12	12	12	12-Mg-24
C	8	10	8	$^{16}_{8}O^{2-}$
D	11	10	13	11-Na+-24

[6]

[Total: 9]

ATOMIC STRUCTURE

CLICK FOR EXPLANATION

9 This question is about atoms, ions and isotopes.

(a) Define the term *nucleon number*.

The total number of protons and neutrons in the atom is equal to the mass number of this atom. [2]

(b) Give the electronic structure of the following atom and ion.

Na 2,8,1

P^{3-} 2,8,8

[2]

(d) What is meant by the term *relative atomic mass*?

average mass of naturally occurring atoms of an element compared to an atom of carbon-12

[2]

(e) Suggest why the relative atomic mass of chlorine is **not** a whole number.

chlorine must have more than one isotope

the masses of these isotopes are averaged

[2]

ATOMIC STRUCTURE

CLICK FOR EXPLANATION

10 **(a)** Complete the table.

particle	charge	relative mass
proton	+1	1
neutron	0	1
electron	-1	close to 0

[2]

(b) The following are isotopes of carbon.

$^{12}_{6}C$ $^{13}_{6}C$ $^{14}_{6}C$

(i) In terms of numbers of protons, neutrons and electrons, how are these **three** isotopes the same and how are they different?

They are the same because ..... same protons and electrons .....

.....

They are different because ..... different neutrons .....

.....

[3]

(ii) Why do all isotopes of carbon have the same chemical properties?

..... same number of valence electrons ..... [1]

(c) Name **two** forms of the element carbon which have giant covalent structures.

..... diamond ..... and ..... graphite ..... [1]

---

11 This question is about subatomic particles.

(a) efine the terms

proton number, ... number of protons in the nucleus of an atom .....

.....

nucleon number. ..... The total number of protons and neutrons in the atom is equal to the mass number of this atom. .....

[3]

(b) Why is the $^{1}_{1}H$ hydrogen atom the **only** atom to have an identical proton number and nucleon number?

hydrogen is the only atom to have no neutrons

..... [1]

12 Carbon and silicon are elements in Group IV of the Periodic Table. Both carbon and silicon exist as more than one isotope.

(a) efine the term *isotopes*.

Atoms of the same element with same protons but different neutrons ..... [2]

CLICK FOR EXPLANATION

(b) Complete the following table which gives information about carbon atoms and silicon atoms.

	carbon	silicon
proton number	6	14
electronic structure	2, 4	2, 8, 4
nucleon number	12	28
number of neutrons in one atom	6	14

[3]

13 Six different atoms can be represented as follows.

$^{3}_{1}A$ $^{3}_{2}D$ $^{12}_{6}E$ $^{13}_{6}G$ $^{14}_{7}J$ $^{19}_{9}L$

(a) Answer the following questions using atoms from the list. Each atom may be used once, more than once or not at all.

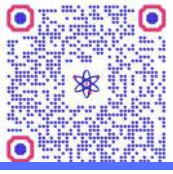
Select **one** atom from the six shown which

(i) has exactly seven protons,

J ..... [1]

(ii) has exactly six neutrons,

E ..... [1]



(iii) has more protons than neutrons,

D

..... [1]

(iv) has the electronic structure [2,5],

J

..... [1]

(v) is an atom of an element from Group VII of the Periodic Table,

L

..... [1]

(vi) is an atom of a noble gas.

D

..... [1]

(b) Two of the six atoms shown are isotopes of each other.

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

Atoms of the same element with same protons but different neutrons

..... [2]

(ii) Which **two** of the six atoms shown are isotopes of each other?

E & G

..... [1]

(iii) Why do isotopes have identical chemical properties?

Same number of valence electrons

..... [1]

[Total: 10]

14 The table gives information about five particles. The particles are all atoms or ions.

particle	number of protons	number of neutrons	number of electrons
A	6	8	6
B	12	12	12
C	13	14	10
D	8	8	10
E	11	12	11

CLICK FOR EXPLANATION

Answer the following questions using the information in the table.
Each particle may be used once, more than once or not at all.

(a) Which particle, **A**, **B**, **C**, **D** or **E**,

(i) is an atom with atomic number 12,

B ..... [1]

(ii) is an atom with nucleon number 14,

A ..... [1]

(iii) is an ion with a positive charge,

C ..... [1]

(iv) has only **one** electron in its outer shell?

E ..... [1]

(b) **D** is an ion of an element.

Identify the element and write the formula of **D**.

Oxygen O2- ..... [2]

[Total: 6]

CLICK FOR EXPLANATION

15 Flerovium, F*l*, atomic number 114, was first made in research laboratories in 1998.

(a) Flerovium was made by bombarding atoms of plutonium, Pu, atomic number 94, with atoms of element **Z**.

- The nucleus of **one** atom of plutonium combined with the nucleus of **one** atom of element **Z**.
- This formed the nucleus of **one** atom of flerovium.

Suggest the identity of element **Z**.

Calcium (114 – 94 = 20, which is the atomic number of Ca) [1]

(b) In which period of the Periodic Table is flerovium?

7 [1]

(c) Predict the number of outer shell electrons in an atom of flerovium.

7 [1]

(ii) Complete the table to show the number of protons, neutrons and electrons in the atoms of the isotopes shown.

isotope	number of protons	number of neutrons	number of electrons
^{286}Fl	114	172	114
^{289}Fl	114	175	114

[2]

16 **(a)** The table gives information about some atoms or ions, **A**, **B** and **C**.

Complete the table.

	number of protons	number of electrons	electronic structure	charge
A	11	10	2,8	1+
B	18	18	2,8,8	0
C	9	10	2,8	–1

[4]

(b) (i) Carbon is an element.

Define the term *element*.

A substance made of atoms with the same atomic number ..... [1]

(ii) $^{12}_{6}C$, $^{13}_{6}C$ and $^{14}_{6}C$ are isotopes of carbon.

Complete the table.

	number of protons	number of neutrons
$^{12}_{6}C$	6	6
$^{13}_{6}C$	6	7
$^{14}_{6}C$	6	8

[2]

[Total: 7]

17 The Periodic Table is very useful to chemists.

Refer only to elements with atomic numbers 1 to 36 in the Periodic Table provided when answering **Question 1**.

(a) Use information from the Periodic Table provided to identify **one** element which:

(i) has atoms with exactly 9 protons ..... fluorine ..... [1]

(ii) has atoms with 0 neutrons ..... hydorogen ..... [1]

(iii) has atoms with exactly 23 electrons ..... vanadium ..... [1]

(iv) has atoms with an electronic structure of 2,8,6 ..... sulfur ..... [1]

(v) forms ions with a charge of 3– containing 18 electrons ..... phosphorus ..... [1]

(vi) forms ions with a charge of 2+ containing 10 electrons ..... magnesium ..... [1]

(vii) has a relative atomic mass that shows it has at least two isotopes. ..... chlorine ..... [1]

(b) State which metal in the first 36 elements:

(i) is the Group I element which reacts most vigorously with water ..... potassium ..... [1]

[Total: 9]

CLICK FOR EXPLANATION

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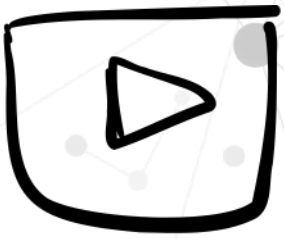

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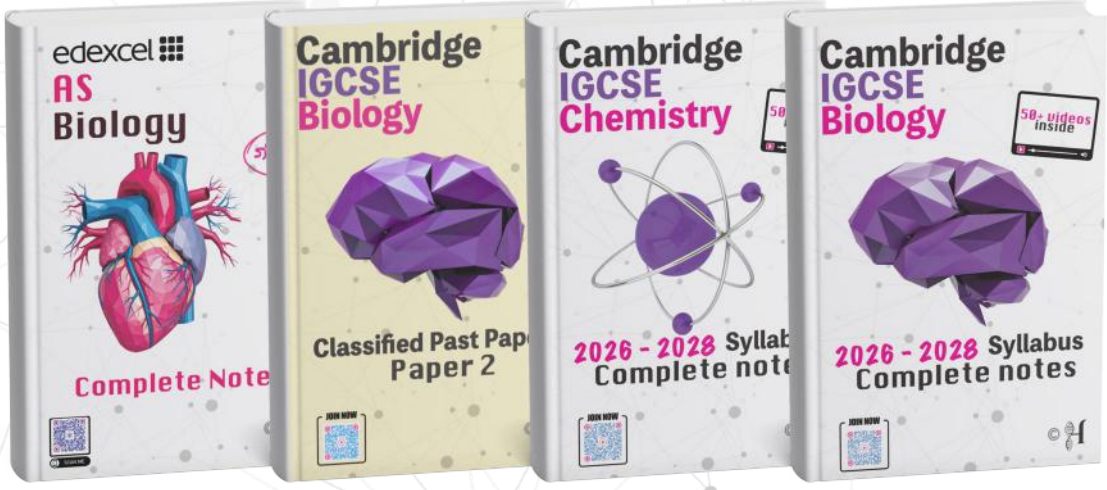

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