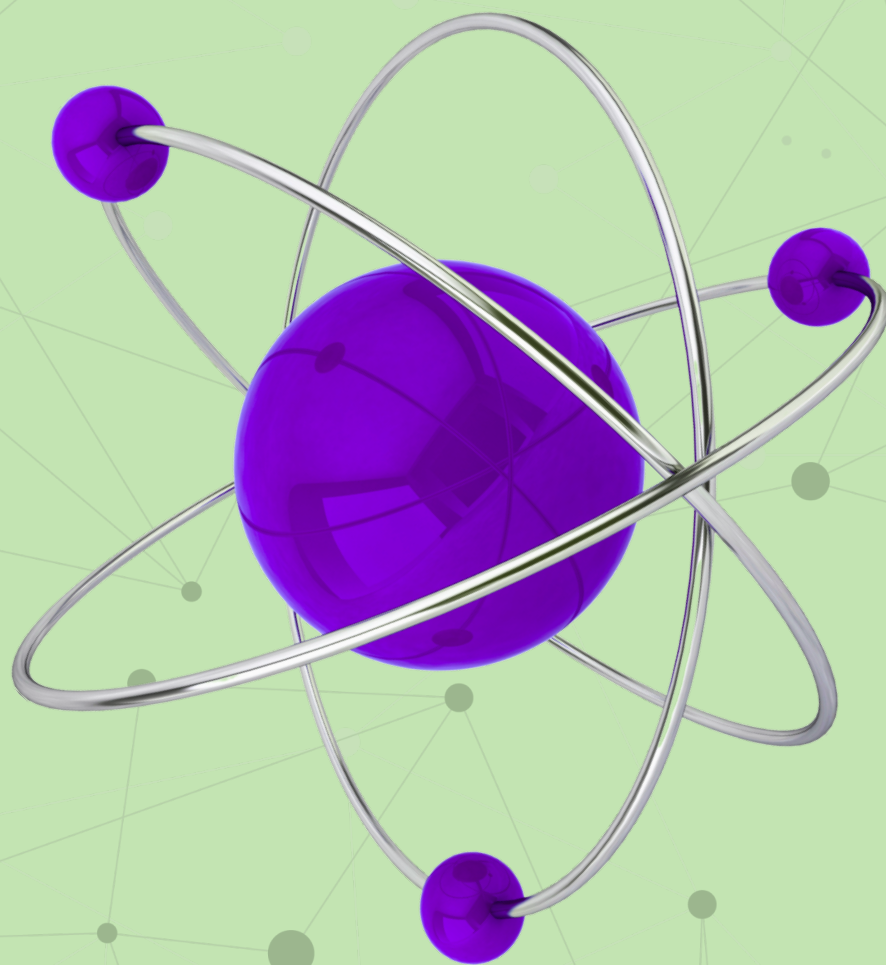
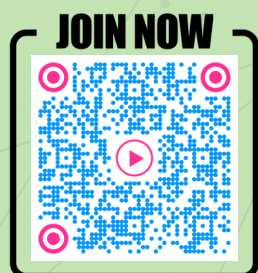
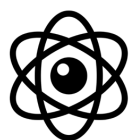


Cambridge IGCSE Chemistry



Classified Past Papers Paper 4





ATOMIC STRUCTURE



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

(i) Define the term *isotope*.

.....
..... [2]

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

number of protons
number of electrons
number of neutrons [2]

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

What is the name of this element?

..... [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

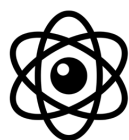
(a) Which particles are atoms? Explain your choice.

.....
..... [2]

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

.....
..... [2]





ATOMIC STRUCTURE



(c) Which particles are positive ions?

..... [1]

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

.....

..... [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							
valency							

[2]

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

.....

..... [1]

(iii) Explain the relationship between the number of valency electrons and the valency for the elements Na to Al,

.....

.....

.....

for the elements P to Cl.

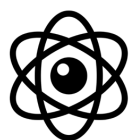
.....

.....

.....

[4]





- 4** ${}^{45}_{21}\text{Sc}$ represents an atom of scandium.

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

number of nucleons

number of charged particles

[2]

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

(i) Explain why these two atoms are isotopes.

.....
..... [2]

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

Identify this element.

..... [1]

- (iii) State **two** uses of radioactive isotopes.

.....
..... [2]

- 5** The table gives the composition of three particles.

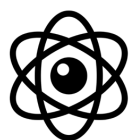
particle	number of protons	number of electrons	number of neutrons
A	15	15	16
B	15	18	16
C	15	15	17

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

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

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





ATOMIC STRUCTURE



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

..... [1]

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

.....
..... [2]

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

..... [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.



Complete the following table.

atom	number of protons	number of neutrons	number of electrons
${}_{31}^{69}\text{Ga}$			
${}_{31}^{71}\text{Ga}$			

[3]

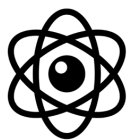
7 Protons, neutrons and electrons are subatomic particles.

(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		
neutron		
electron	$\frac{1}{1840}$	

[3]





ATOMIC STRUCTURE



(b) Bromine has two isotopes.

(i) Define the term *isotope*.

.....
..... [2]

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

.....
..... [2]

8

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

..... [1]

(ii) Define the term *nucleon number*.

.....
..... [2]

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

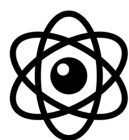
Complete the table. The first line is given as an example.

particle	number of protons	number of electrons	number of neutrons	symbol or formula
A	6	6	6	$^{12}_6\text{C}$
B	12	12	12	
C	8			$^{16}_8\text{O}^{2-}$
D	11	10	13	

[6]

[Total: 9]





ATOMIC STRUCTURE



9 This question is about atoms, ions and isotopes.

(a) Define the term *nucleon number*.

.....
..... [2]

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

Na
 P^{3-} [2]

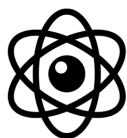
(d) What is meant by the term *relative atomic mass*?

.....
.....
..... [2]

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

.....
.....
..... [2]





ATOMIC STRUCTURE

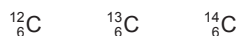


- 10** (a) Complete the table.

particle	charge	relative mass
proton	+1	
neutron		1
electron		

[2]

- (b) The following are isotopes of carbon.



- (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

.....

They are different because

.....

[3]

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

..... [1]

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

..... and [1]

- 11** This question is about subatomic particles.

- (a) Define the terms

proton number,

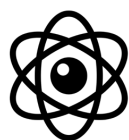
.....

nucleon number,

.....

[3]





ATOMIC STRUCTURE



- (b) Why is the ${}^1_1\text{H}$ hydrogen atom the **only** atom to have an identical proton number and nucleon number?

.....
..... [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) Define the term *isotopes*.

.....
..... [2]

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

	carbon	silicon
proton number		
electronic structure		
nucleon number	12	28
number of neutrons in one atom		

[3]

- 13** Six different atoms can be represented as follows.



- (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

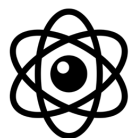
- (i) has exactly seven protons,

..... [1]

- (ii) has exactly six neutrons,

..... [1]





ATOMIC STRUCTURE



(iii) has more protons than neutrons,

..... [1]

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

..... [1]

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

..... [1]

(vi) is an atom of a noble gas.

..... [1]

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

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

.....
..... [2]

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

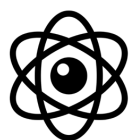
..... [1]

(iii) Why do isotopes have identical chemical properties?

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

[Total: 10]





ATOMIC STRUCTURE



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

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,

..... [1]

(ii) is an atom with nucleon number 14,

..... [1]

(iii) is an ion with a positive charge,

..... [1]

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

..... [1]

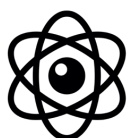
(b) **D** is an ion of an element.

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

..... [2]

[Total: 6]





ATOMIC STRUCTURE



15

Flerovium, Fl, 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.

..... [1]

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

..... [1]

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

..... [1]

- (d) Two isotopes of flerovium are ^{286}Fl and ^{289}Fl . The nuclei of both of these isotopes are unstable and emit energy when they split up.

- (i) State the term used to describe isotopes with unstable nuclei.

..... [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			
^{289}Fl			

[2]

16

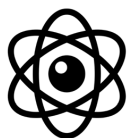
- (a) The table gives information about some atoms or ions, A, B and C.

Complete the table.

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

[4]





ATOMIC STRUCTURE



- (b) (i) Carbon is an element.

Define the term *element*.

..... [1]

- (ii) $^{12}_6\text{C}$, $^{13}_6\text{C}$ and $^{14}_6\text{C}$ are isotopes of carbon.

Complete the table.

	number of protons	number of neutrons
$^{12}_6\text{C}$		
$^{13}_6\text{C}$		
$^{14}_6\text{C}$		

[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 [1]
- (ii) has atoms with 0 neutrons [1]
- (iii) has atoms with exactly 23 electrons [1]
- (iv) has atoms with an electronic structure of 2,8,6 [1]
- (v) forms ions with a charge of 3– containing 18 electrons [1]
- (vi) forms ions with a charge of 2+ containing 10 electrons [1]
- (vii) has a relative atomic mass that shows it has at least two isotopes. [1]

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

- (i) is the Group I element which reacts most vigorously with water [1]
- (ii) reacts with air to form lime. [1]

[Total: 9]





ATOMIC STRUCTURE



18 The Periodic Table is a method of classifying elements.

(a) Identify the element which is in Group VI and Period 4.

..... [1]

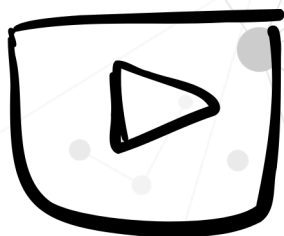
(b) Calcium is in Group II and chlorine is in Group VII of the Periodic Table.

Explain, in terms of number of outer shell electrons and electron transfer, how calcium atoms and chlorine atoms form ions. Give the formulae of the ions formed.

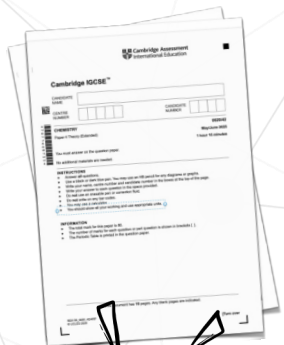
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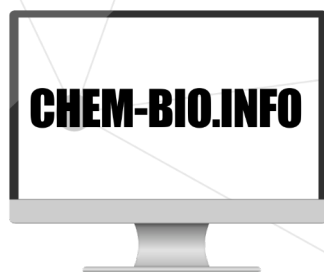
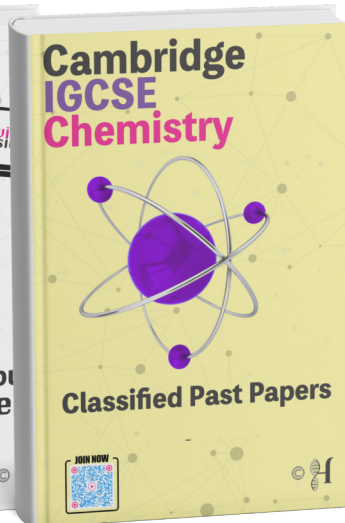
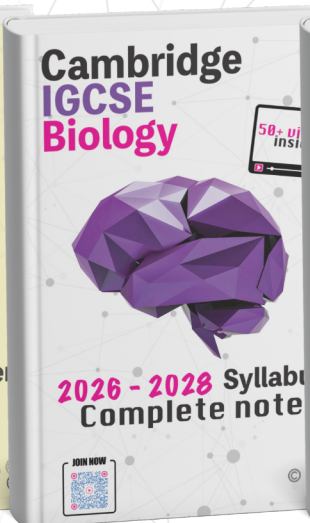
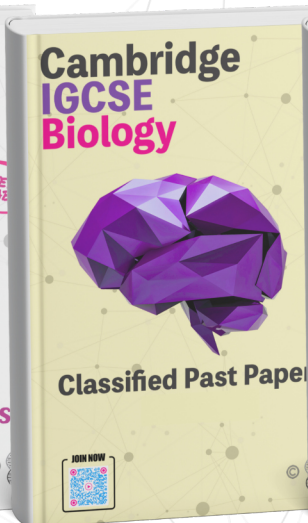
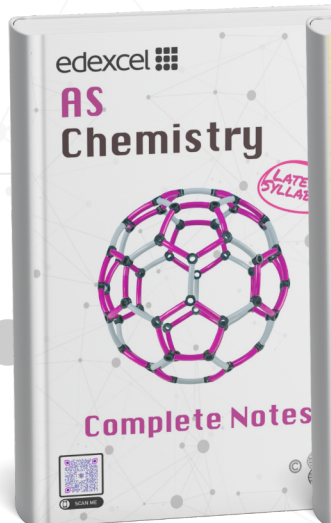


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