Atomic Structure 3

Name: _____

Class: _____

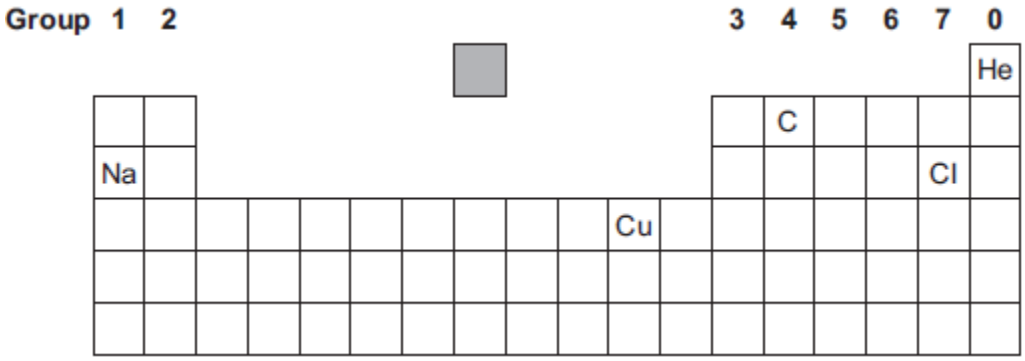
Date: _____

Time: **71 minutes**

Marks: **71 marks**

Comments:

1. The diagram shows the chemical symbols of five elements in the periodic table.



(a) Choose the correct chemical symbol to complete each sentence.

(i) The element that is an alkali metal is _____ .

(1)

(ii) The element that is a transition metal is _____ .

(1)

(iii) The element in Group 4 is _____ .

(1)

(iv) The element with a full outer energy level (shell) of electrons is

_____ .

(1)

(b) Which other element goes in the shaded box?

_____

(1)

(Total 5 marks)

2. In 1866 John Newlands produced an early version of the periodic table.

Part of Newlands' periodic table is shown below.

Column	1	2	3	4	5	6	7
	H	Li	Be	B	C	N	O
	F	Na	Mg	Al	Si	P	S
	Cl	K	Ca	Cr	Ti	Mn	Fe

Newlands' periodic table arranged all the known elements into columns in order of their atomic weight.

Newlands was trying to show a pattern by putting the elements into columns.

(a) Iron (Fe) does **not** fit the pattern in column 7.

Give a reason why.

_____

_____

(1)

(b) In 1869 Dmitri Mendeleev produced his version of the periodic table.

Why did Mendeleev leave gaps for undiscovered elements in his periodic table?

_____

_____

(1)

(c) Newlands and Mendeleev placed the elements in order of atomic weight.

Complete the sentence.

The modern periodic table places the elements in order of

_____ .

(1)

(d) Lithium, sodium and potassium are all in Group 1 of the modern periodic table.

Explain why.

_____

_____

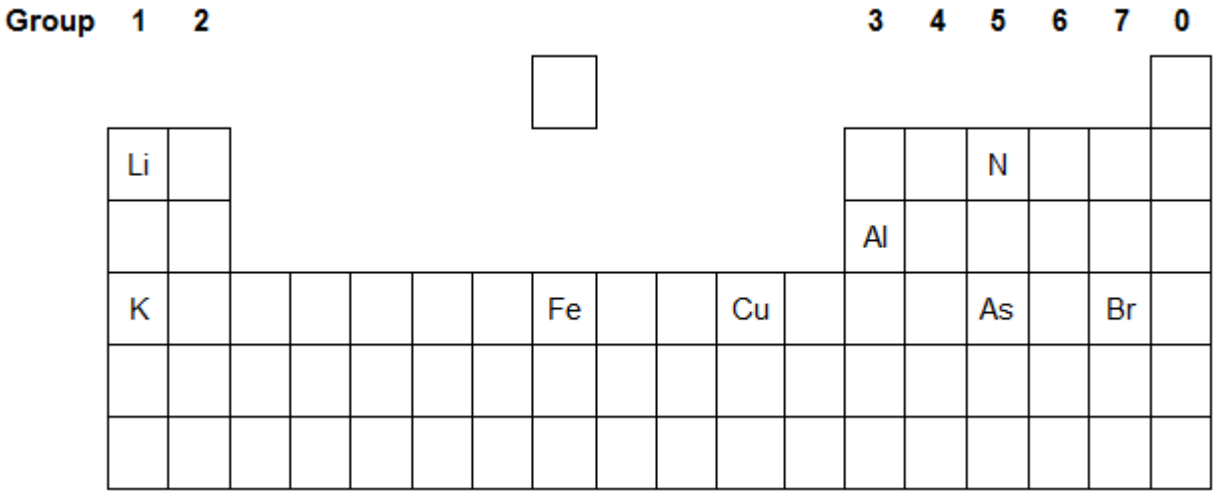
_____

_____

(2)

(Total 5 marks)

3. The positions of eight elements in the modern periodic table are shown below.



Choose the correct chemical symbols to complete each sentence.

(a) The **two** metals that react vigorously with water are _____ and

_____ .

(1)

(b) The element used as a catalyst in the Haber process is _____ .

(1)

(c) The **two** elements with five electrons in their outer shell (highest energy

level) are _____ and _____ .

(1)

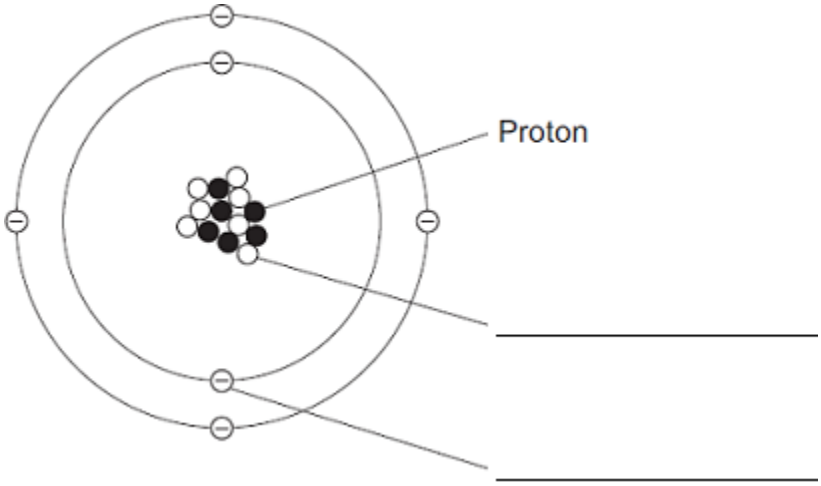
(d) Iron has ions with different charges.

The other metal that has ions with different charges is _____ .

(1)

(Total 4 marks)

4. The diagram shows a carbon atom.



(a) (i) A proton is labelled.

Use the correct answer from the box to label each of the other sub-atomic particles.

electron	**ion**	**molecule**	**neutron**

(2)

(ii) The atom of carbon is represented as:

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

What is the mass number of this carbon atom?

Draw a ring around the correct answer.

6 **13** **19**

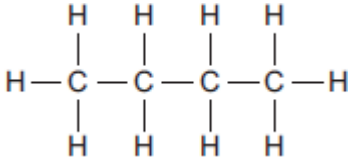
(1)

(iii) Complete the sentence.

Atoms of carbon have no overall electrical charge because the number of protons is the same as the number of _____ .

(1)

(b) Butane is represented as:



(i) Use the correct answer from the box to complete each sentence.

bond	compound	helium	hydrogen	mixture	oxygen

Butane is a _____ .

Butane contains atoms of carbon and _____ .

Each line between the atoms in butane represents a chemical

_____ .

(3)

(ii) Which is the correct formula for butane?

Tick (✓) **one** box.

C_4H_4 ☐

C_4H_8 ☐

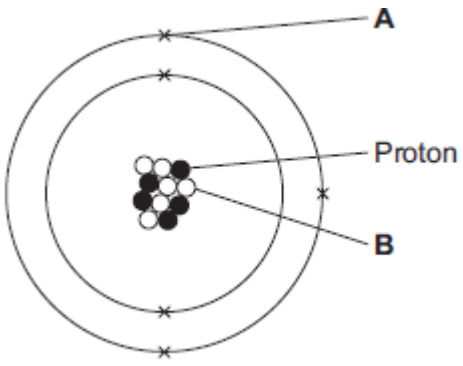
C_4H_{10} ☐

(1)

(Total 8 marks)

5. (a) **Figure 1** shows an atom of element **G**.

Figure 1



Draw a ring around the correct answer to complete each sentence.

(i) Label **A** shows

an electron **an ion** **a nucleus**

(1)

(ii) The particle labelled **B** is

an isotope **a molecule** **a neutron**

(1)

(iii) The mass number of element **G** is

5 **6** **11**

(1)

(iv) Use the periodic table to identify element **G**.

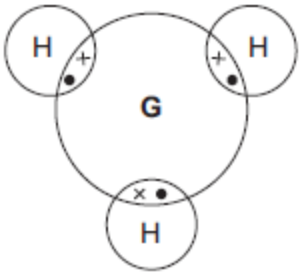
Element **G** is

boron **carbon** **sodium**

(1)

(b) **Figure 2** shows a compound of **G** and hydrogen.

Figure 2



Draw a ring around the correct answer to complete each sentence.

(i) The formula of the compound in **Figure 2** is

GH_3 **G_3H** **3HG**

(1)

(ii) The type of bonding shown in **Figure 2** is

covalent **ionic** **metallic**

(1)

(Total 6 marks)

6. (a) The symbols for seven different elements are shown in **Figure 1**.

Figure 1

																	He
	Be																
Na															S		Ar
	Ca						Fe										

Choose the correct symbol from **Figure 1** to answer each question.

You may use each symbol once, more than once or not at all.

Write the symbol that represents:

(i) a Group 1 element

_____

(1)

(ii) a transition metal

_____

(1)

(iii) an element with electrons in the same number of energy levels as an atom of argon (Ar)

_____

(1)

(iv) an element which forms an oxide that dissolves in water to form an acidic solution

_____

(1)

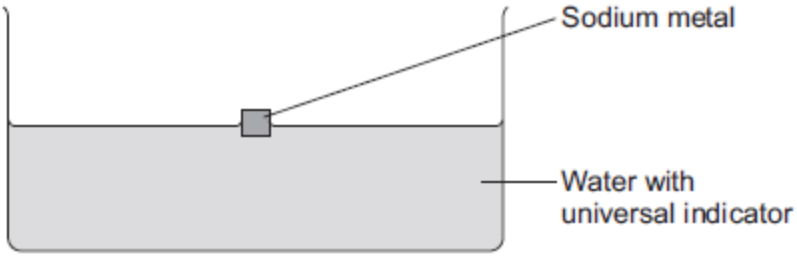
(v) an element that forms a chloride with the formula XCl

_____

(1)

(b) A teacher put a cube of sodium metal into water containing universal indicator, as shown in **Figure 2**.

Figure 2



The equation for the reaction is:

$$2Na(s) + 2H_2O(l) \longrightarrow 2NaOH\ (aq) + H_2(g)$$

sodium + water → sodium hydroxide + hydrogen

(i) The sodium floated on the surface of the water. The universal indicator turned purple.

Give **three other** observations that would be seen during the reaction.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

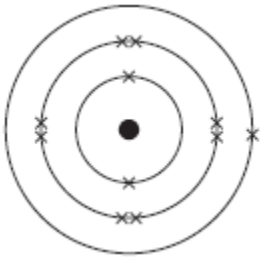
(ii) Name the ion that made the universal indicator turn purple.

_____

(1)

(c) **Figure 3** represents the electronic structure of a sodium atom.

Figure 3



In the space below, draw the electronic structure of a sodium ion. Include the charge on the ion.

(2)

(Total 11 marks)

7. This question is about the periodic table of elements.

Use the Chemistry Data Sheet to help you to answer these questions.

In 1869 Dmitri Mendeleev produced an early version of the periodic table.

(a) Draw a ring around the correct answer to complete each sentence.

(i) Mendeleev first arranged the elements in order of

their

atomic weight.
date of discovery.
electron number.

(1)

(ii) Mendeleev then placed elements with similar properties in columns

called

groups.
periods.
shells.

(1)

(iii) When the next element did not fit the pattern,

Mendeleev

- ignored the element.
- left a gap.
- put the element at the end of the row.

(1)

(iv) Mendeleev was not able to include the noble gases (Group 0) in his periodic table because the noble gases

- are not elements.
- are not reactive.
- had not been discovered by 1869.

(1)

(b) Use the correct word from the box to complete each sentence.

electrons	**molecules**	**neutrons**	**protons**

In the modern periodic table elements are arranged in order of the number of _____ in their nucleus. Elements in the same group have the same number of _____ in their highest energy level (outer shell).

(2)

(c) Sodium (Na) is in Group 1 of the periodic table.

Nickel (Ni) is a transition element.

Tick (✓) **two** correct statements about sodium and nickel.

Statement	**Tick (✓)**
Sodium and nickel are both metals.	
Sodium has a higher melting point than nickel.	
Sodium is more reactive than nickel.	
Sodium is harder than nickel.	

(2)

(d) Chlorine, bromine and iodine are in Group 7 of the periodic table.

Chlorine is more reactive than bromine.

(i) Complete the word equation for the reaction between chlorine and sodium bromide.

chlorine + sodium bromide ⟶ _____ + sodium chloride

(1)

(ii) Why does iodine **not** react with sodium bromide solution?

_____

_____

(1)

(Total 10 marks)

8. In 1869, Dmitri Mendeleev produced his periodic table of the elements.

Mendeleev placed the alkali metals in the same group.

(a) What evidence did Mendeleev use to decide that the alkali metals should be in the same group?

_____

_____

(1)

(b) Describe how the elements in the modern periodic table are arranged:

(i) in terms of protons

_____

_____

(1)

(ii) in terms of electrons.

_____

_____

(1)

(c) State **two** properties of transition elements that make them more useful than alkali metals for making water pipes.

(2)

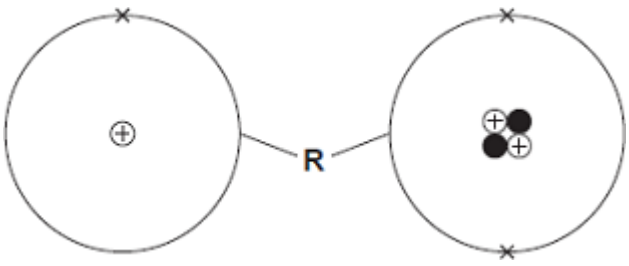
(d) Describe and explain the trend in reactivity of the alkali metals (Group 1).

(4)

(Total 9 marks)

9. The Sun is mainly hydrogen and helium.
The diagrams show an atom of hydrogen and an atom of helium.

Hydrogen **Helium**



(a) Draw a ring around the correct answer to complete each sentence.

(i) The centre of each atom is called the

molecule.

nucleus.

shell.

(1)

(ii) The circle (labelled **R**) around the centre of each atom

is called

a bond.

an electrical charge.

an energy level (shell).

(1)

(b) Use the diagrams in part (a) to help you to answer these questions.

Draw **one** line from each question to its correct answer.

Question	Answer
How many protons are there in the hydrogen atom?	1
How many electrons are there in the helium atom?	2
What is the mass number of the helium atom?	3
	4

(3)

(c) The Sun is 73% hydrogen and 25% helium. The rest is other elements.

What is the percentage of other elements in the Sun?

_____ %

(1)

(d) One of the other elements in the Sun is neon.
Neon is in the same group of the periodic table as helium.

Use the Chemistry Data Sheet to help you to answer these questions.

(i) How many protons are there in a neon atom?

_____

(1)

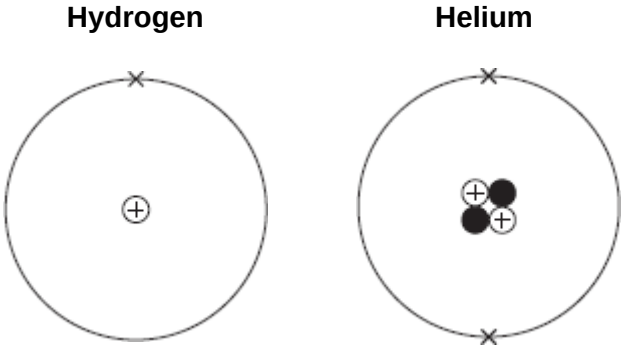
(ii) Which group of the periodic table are helium and neon in?

_____

(1)

(Total 8 marks)

10. The Sun produces helium atoms from hydrogen atoms by nuclear fusion reactions.



(a) Describe the differences in the atomic structures of a hydrogen atom and a helium atom.

_____

_____

_____

_____

_____

_____

_____

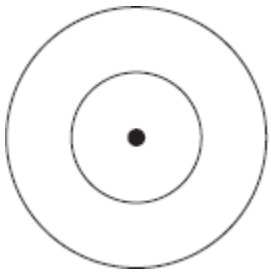
_____

(3)

(b) The Sun consists of 73% hydrogen and 25% helium.
The rest is other elements.
One of the other elements in the Sun is neon.

Use the Chemistry Data Sheet to help you to answer these questions.

(i) Complete the diagram to show the electronic structure of a neon atom.



(1)

(ii) Why is neon in the same group of the periodic table as helium?

_____

_____

_____

(1)

(Total 5 marks)

1.

(a) (i) Na

allow sodium

1

(ii) Cu

allow copper

1

(iii) C

allow carbon

1

(iv) He

allow helium

1

(b) H

allow hydrogen

*do **not** allow H_2*

1

[5]

2.

(a) (iron) is a metal

accept transition element

allow (iron) had different properties (to oxygen and sulfur)

ignore electrons

1

(b) so that elements with similar properties could be placed together

allow to make the pattern fit

ignore undiscovered elements

1

(c) atomic number(s)

allow proton number(s)

1

(d) all have one electron in the outer shell (highest energy level)

allow same number of electrons in the outer shell (highest energy level)

1

(so they) have similar properties

or

react in the same way

allow specific reactions e.g. with water

1

[5]

3. (a) Li **and** K

either order

*allow lithium **and** potassium*

1

(b) Fe

allow iron

1

(c) N **and** As

either order

*allow nitrogen **and** arsenic*

1

(d) Cu

allow copper

1

[4]

4. (a) (i) Neutron (top label)

1

Electron (bottom label)

1

(ii) 13

1

(iii) electrons

1

(b) (i) compound

1

hydrogen

1

bond

1

(ii) C_4H_{10}

1

[8]

5. (a) (i) an electron

1

(ii) a neutron

1

(iii) 11

1

(iv) boron

1

(b) (i) GH_3

1

(ii) covalent

1

[6]

6. (a) (i) Na

allow sodium / phonetic spelling

if more than one answer is given apply list principle

1

(ii) Fe

allow iron / phonetic spelling

if more than one answer is given apply list principle

1

(iii) Na **or** S

allow sodium or sulfur / sulphur / phonetic spelling

if more than one answer is given apply list principle

1

(iv) S

allow sulfur / sulphur / phonetic spelling

if more than one answer is given apply list principle

1

(v) Na

allow sodium / phonetic spelling

if more than one answer is given apply list principle

1

(b) (i) any **three** from:

- effervescence / fizzing **or** bubbles **or** gas produced

  *do **not** allow incorrectly named gas*
- sodium melts **or** turns into a ball
- sodium moves (on the surface)
- steam / mist / vapour is produced

  ignore heat / temperature / flame / spark
- sodium gets smaller / disappears

  allow dissolves
- colour of indicator is darker / more intense near the sodium

  Must be linked to near the sodium.

3

(ii) hydroxide **or** OH^-

allow OH without a charge

*do **not** allow OH^+*

1

(c)

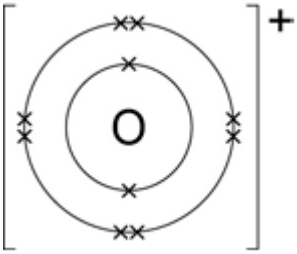


diagram showing electron configuration of ion is 2,8

1

charge on ion is +

Bracket not necessary

$[2,8]^+$ is worth 1 mark as there is no diagram

1

[11]

7. (a) (i) atomic weight

1

(ii) groups

1

(iii) left a gap

1

(iv) had not been discovered by 1869

1

(b) protons

must be in correct order

1

electrons

1

(c) sodium and nickel are both metals

1

sodium is more reactive than nickel

1

(d) (i) bromine

allow Br_2 / Br

*do **not** allow bromide*

1

(ii) iodine is less reactive (than bromine)

it = iodine

allow converse

*do **not** allow bromide*

1

[10]

8. (a) similar properties

allow same properties

allow correct example of property

ignore answers in terms of atomic structure

1

(b) (i) in order of atomic / *proton* number

allow increasing number (of protons)

1

(ii) elements in same group have same number (*of electrons*) in outer shell **or** *highest energy level*

allow number (of electrons) increases across a period

1

(c) any **two** from:

statements must be comparative

- stronger / harder

ignore higher densities

- less reactive
- higher melting points

ignore boiling point

2

(d) *reactivity increases down group*

allow converse throughout

*for next three marks, outer electron needs to be mentioned once otherwise max = **2***

1

outer electron is further from nucleus

allow more energy levels / shells

allow larger atoms

1

less attraction between outer electron and nucleus

allow more shielding

1

therefore outer electron lost more easily

1

[9]

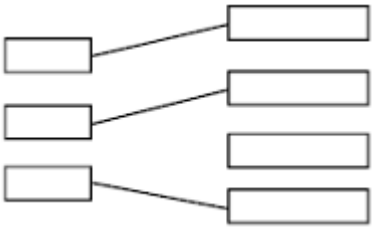
9. (a) (i) nucleus

1

(ii) an energy level (shell)

1

(b)



3

(c) 2 / two(%)

1

(d) (i) 10 / ten

1

(ii) (group) 0

accept noble gases
ignore (group) 8

1

[8]

10. (a) hydrogen has one proton whereas helium has two protons

accept numbers for words
accept hydrogen only has one proton
ignore references to groups

1

hydrogen has one electron whereas helium has two electrons

accept hydrogen only has one electron
allow helium has a full outer shell (of electrons)

1

hydrogen has no neutrons **or** helium has two neutrons

*if no other mark awarded, allow helium has more electrons / protons / neutrons for **1** mark*

1

(b) (i) 2 electrons on first shell **and**

8 electrons on outer shell

1

(ii) they have a stable arrangement of electrons

accept they have full outer energy level / shell of electrons
*do **not** accept they have the same number of electrons in their outer energy level / shell*
allow they are noble gases
ignore they are in group 0

1

[5]