C1 Atomic Structure Homework task 2

Q1.

Carbon can exist in a number of different structures.

(a) What is the approximate radius of a carbon atom?

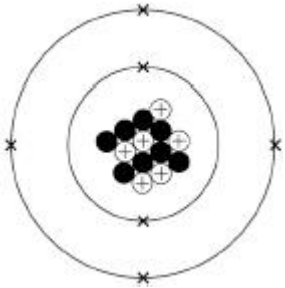
Tick (✓) **one** box.

0.1 m ☐ 0.1 mm ☐ 0.1 nm ☐

(1)

(b) **Figure 1** shows an atom of carbon.

Figure 1



Describe the atomic structure of this carbon atom.

You should include the number of electrons, neutrons and protons.

_____

_____

_____

_____

_____

_____

_____

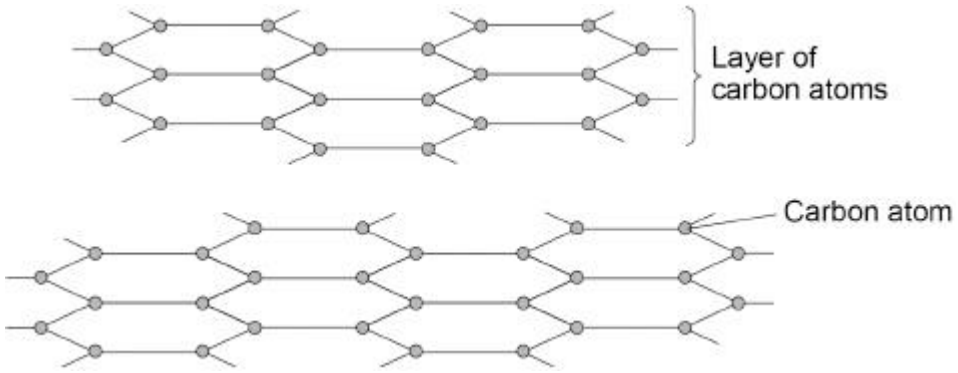
_____

(6)

In graphite the carbon atoms are held together by bonds.

Figure 2 represents part of the structure of graphite.

Figure 2



(c) How many bonds does each carbon atom have in graphite?

Use **Figure 2**.

Tick (✓) **one** box.

1 ☐ 2 ☐ 3 ☐ 4 ☐

(1)

(d) What type of bonds hold the carbon atoms together in graphite?

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

(1)

(e) Lubricants allow objects to slide over each other easily.

Suggest why graphite can be used as a lubricant.

Use **Figure 2**.

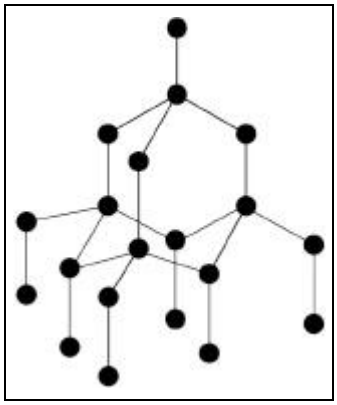
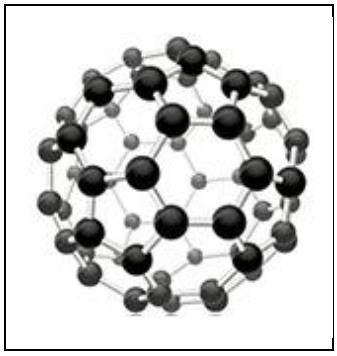
_____

_____

(1)

(f) The two structures represent different forms of carbon.

Draw **one** line from each structure to the form of carbon.

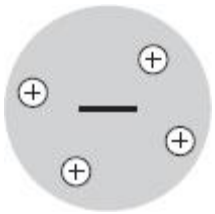
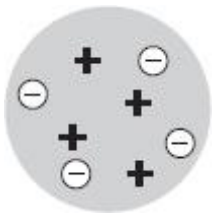
Structure	**Form of carbon**
	Buckminsterfullerene
	Diamond
	Graphene
	Nanotube

(2)

(Total 12 marks)

Q2.

The model of the atom has changed over time. (a) Draw **one** line from each atomic model to the representation of that model.

Atomic model	Representation of model
Dalton atom	
Plum pudding model	
	

(2)

Scientists investigated the structure of the atom.

The scientists directed alpha particles at a thin sheet of gold foil.

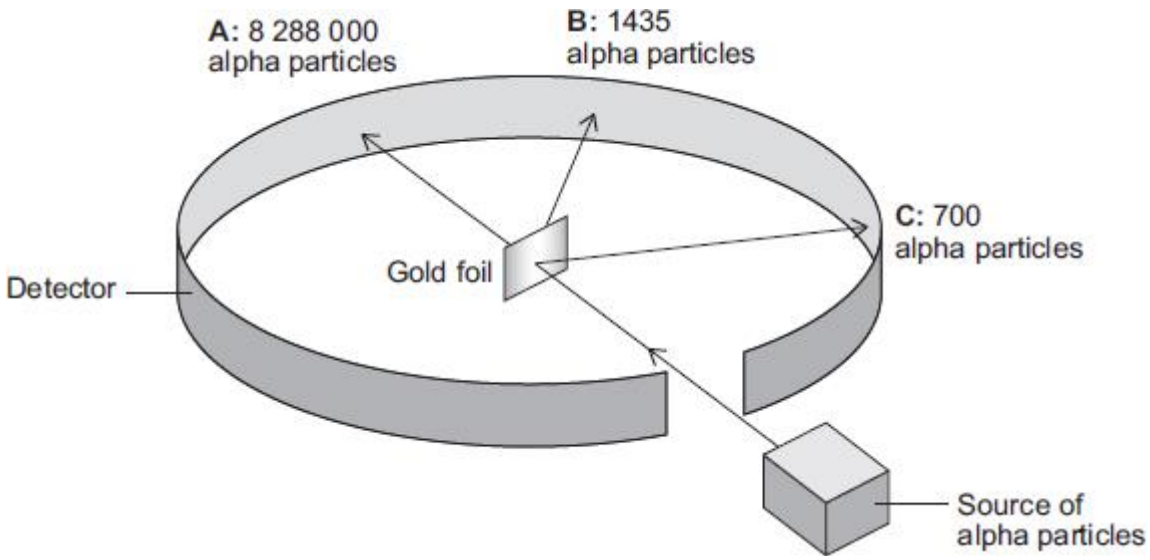
(b) What is an alpha particle the same as?

Tick (✓) **one** box.

- A fast-moving electron ☐
- A helium nucleus ☐
- A radioactive isotope ☐
- Electromagnetic radiation ☐

(1)

The diagram below shows:
- three of the pathways the alpha particles take
- the number of alpha particles detected at positions **A**, **B** and **C**.



(c) Determine the simplest ratio of the number of alpha particles detected at **A** to those detected at **C**.

Use the diagram above.

_____

_____

_____

Simplest ratio of **A** : **C** = _____ : 1

(2)

The scientists concluded that a gold atom:
- is mostly empty space
- has a charged nucleus at its centre.

(d) How do the results in the diagram above show that a gold atom is mostly empty space?

_____

_____

(1)

(e) Explain how the results in the diagram above show that a gold atom contains a charged nucleus.

_____

_____(2)_

(f) A gold atom can be represented as:

$^{197}_{79}Au$

Describe the atomic structure of this gold atom.

You should include the numbers of each type of sub-atomic particle.

_____

_____

_____

_____

_____

(5)

(Total 13 marks)

HIGHER TIER QUESTIONS

Q3.

The diagram below shows two isotopes of neon.

Neon-20	Neon-21
$^{20}_{10}Ne$	$^{21}_{10}Ne$

(a) Compare the number of sub-atomic particles in an atom of neon-20 and an atom of neon-21

_____

_____

(2)

(b) There are 18 neon atoms in every million particles of air.

Of these 18 neon atoms, 0.27% are neon-21 atoms.

Calculate the percentage of particles in air that are neon-21 atoms.

_____

_____

_____ %

(2)

(c) The image below shows a sign containing neon.

The sign is connected to an electrical supply.

The neon atoms gain energy when the sign is switched on.

Explain why the sign glows when the electrical supply is switched on.

_____

_____

_____

(4) (Total 8 marks)

Q4.

This question is about halogens.

Bromine reacts with sodium to produce sodium bromide.

(a) Describe the structure of and bonding in sodium bromide.

_____

_____

_____

_____

(2)

(b) The equation for the reaction is:

$$2\ Na + Br_2 \rightarrow 2\ NaBr$$

1 g of bromine reacts with sodium.

Calculate the number of bromine molecules in 1 g of bromine.

1 mole of bromine contains 6.02×10^{23} bromine molecules.

Relative formula mass (M_r) of bromine = 160

_____

_____

_____

Number of bromine molecules = _____

(3)

(c) The table below shows the boiling points of some halogens.

Halogen	**Boiling point in °C**
Bromine	60
Chlorine	−34
Fluorine	−188

Explain the trend in the boiling points of the halogens.

_____

_____

_____

_____

(4)

(Total 9 marks)

Mark schemes

Q1.

(a) 0.1 nm

1

(b) 6 protons

1

8 neutrons

1

6 electrons

allow electron (structure) 2,4

1

protons in nucleus

1

neutrons in nucleus

1

electrons (around nucleus) in energy levels / shells

1

(c) 3

1

(d) covalent

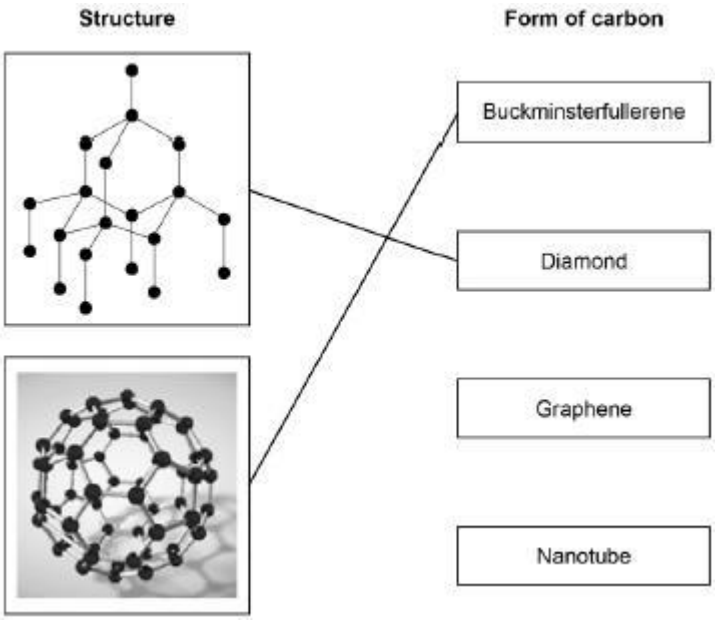
1

(e) layers slide (over each other)

allow atoms slide over each other

1

(f)



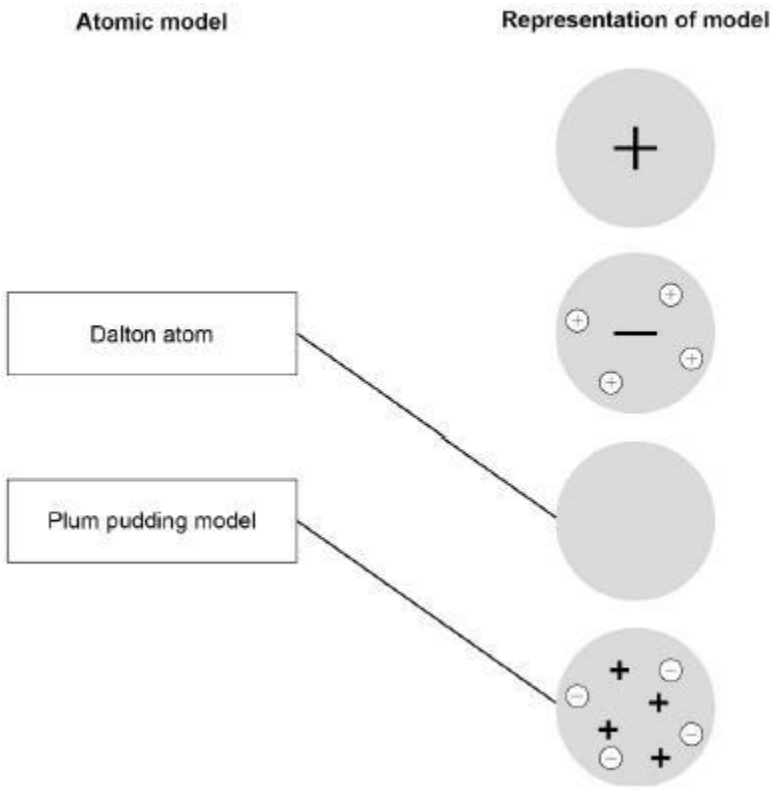
do **not** accept more than **one** line from a box on the left

1
1

[12]

Q2.

(a)



do **not** accept more than one line from a box on the left

1
1

(b) a helium nucleus

1

(c) $\frac{8\ 288\ 000}{700}$

or

8 288 000 : 700

1

11 840 (:1)

1

(d) most of the (alpha) particles pass straight through

*allow most of the (alpha) particles are **not** deflected / repelled / bounced back*

1

(e) some of the (alpha) particles bounce back
or
some of the (alpha) particles are deflected

1

(because the charged) alpha particles were repelled (by the charged nucleus)

1

(f) 79 protons **and** 79 electrons

1

118 neutrons

1

protons in the nucleus

1

neutrons in the nucleus

1

electrons are arranged in energy levels (around the nucleus)

allow electrons are arranged in shells (around the nucleus)

1

[13]

Q3.

(a) allow both have 10 electrons **and** 10 protons

1

neon-21 has 1 more neutron
or
neon-20 has 1 less neutron

*allow neon-20 has 10 neutrons **and** neon-21 has 11 neutrons*

*if no other mark awarded allow **1** mark for describing the number of particles in each of the isotopes*

for max marks comparisons must be made

1

(b) (calculation of percentage of neon atoms in air)

$\left(\frac{18 \times 100}{1\,000\,000}\right)$ = 0.0018

1

(calculation of isotope percentage)

$\frac{0.27}{100}$ = 0.0000049 (%)

allow 0.00000486 (%)
or *4.86×10^{-6} (%)*
or *4.9×10^{-6} (%)*

allow correct calculation using incorrect calculation for percentage of neon in air

1

(c) (when the supply is switched on)

electron(s) (in neon) gain energy

1

(which) moves (electrons) to higher energy level

1

(then) electrons drop back to lower levels releasing energy

1

(that energy is) in the visible region of the spectrum

1

[8]

Q4.

(a) giant structure of ions

1

with strong electrostatic forces of attraction

*if no other mark awarded allow **1** mark for ionic bonding*

1

(b) (moles bromine = $\frac{1}{160}$)
0.00625

1

(molecules of bromine =)
$0.00625 \times 6.02 \times 10^{23}$

allow correct use of an incorrectly calculated value for moles of bromine

1

(molecules of bromine =)
3.76×10^{21} (molecules)

allow 3.7625×10^{21} (molecules)

1

allow converse

(c) boiling point decreases up the group

allow boiling point decreases down the table

1

(because) the relative formula / molecular mass decreases
or
(because) the size of the molecule decreases

1

(so) the intermolecular forces decrease (in strength)

allow (so) the forces between molecules decrease (in strength)

1

(so) less energy is needed to overcome the intermolecular forces

allow (so) less energy is needed to separate the molecules

*do **not** accept a reference to breaking bonds unless specifically between molecules*

1

[9]