AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.2.1 CHEMICAL BONDS: IONIC, COVALENT AND METALLIC (PACK 5)

SCORE	PERCENTAGE
/244	%

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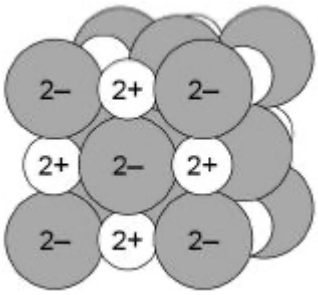
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Q1.

This question is about structure and bonding.

(a) **Figure 1** shows part of the structure of calcium oxide (CaO).

Figure 1



What type of bonding is present in calcium oxide?

Tick **one** box.

Covalent ☐

Ionic ☐

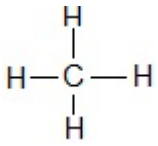
Macromolecular ☐

Metallic ☐

(1)

(b) **Figure 2** shows a particle of methane (CH_4).

Figure 2



What type of particle is present in **Figure 2**?

Tick **one** box.

An ion ☐

A lattice ☐

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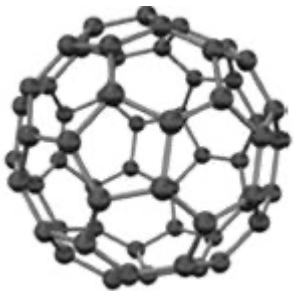
A molecule ☐

A polymer ☐

(1)

(c) **Figure 3** shows the structure of C_{60}

Figure 3



Complete the sentence.

Choose the answer from the box.

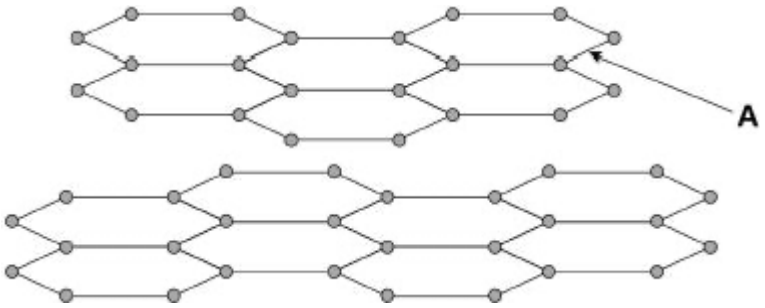
diatomic	**giant ionic**	**a fullerene**	**giant metallic**

The structure of C_{60} is _____ .

(1)

Figure 4 shows the structure of graphite.

Figure 4



(d) What type of bond is labelled **A** in **Figure 4**?

Tick **one** box.

covalent ☐

double ☐

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ionic ☐

metallic ☐

(1)

(e) In graphite, each carbon atom forms bonds with other carbon atoms as shown in **Figure 4**

How many electrons does **one** carbon atom use to form **one** bond?

Tick **one** box.

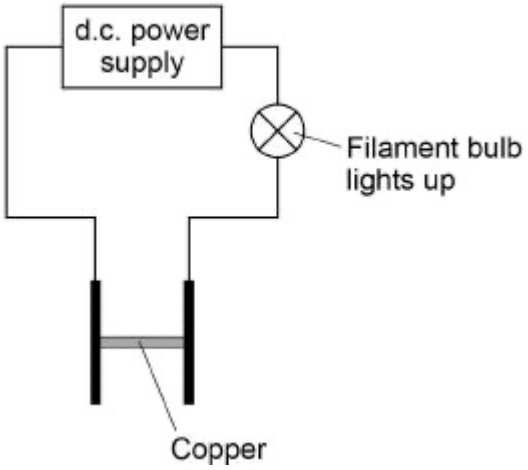
1 ☐ **2** ☐ **3** ☐ **4** ☐

(1)

An electric current is passed through copper.

Figure 5 shows the apparatus used.

Figure 5



(f) Complete the sentence.

Choose the answer from the box.

gas	**liquid**	**solid**	**solution**

Figure 5 shows that copper conducts electricity as a _____ .

(1)

(g) Complete the sentence.

Choose the answer from the box.

atoms	**electrons**	**ions**	**molecules**

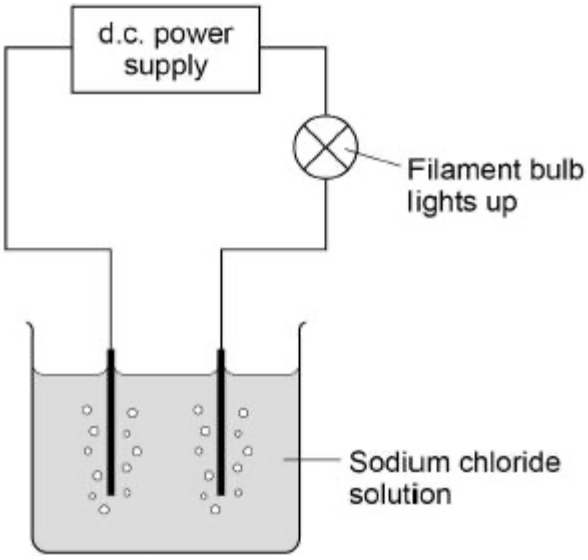
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Copper conducts electricity because of the movement of delocalised _____ .

(1)

(h) **Figure 6** shows the apparatus used to investigate the effect of electricity on sodium chloride solution.

Figure 6



Complete the sentence.

Choose the answer from the box.

dissolved	**gaseous**	**molten**

Figure 6 shows that sodium chloride conducts electricity when _____ .

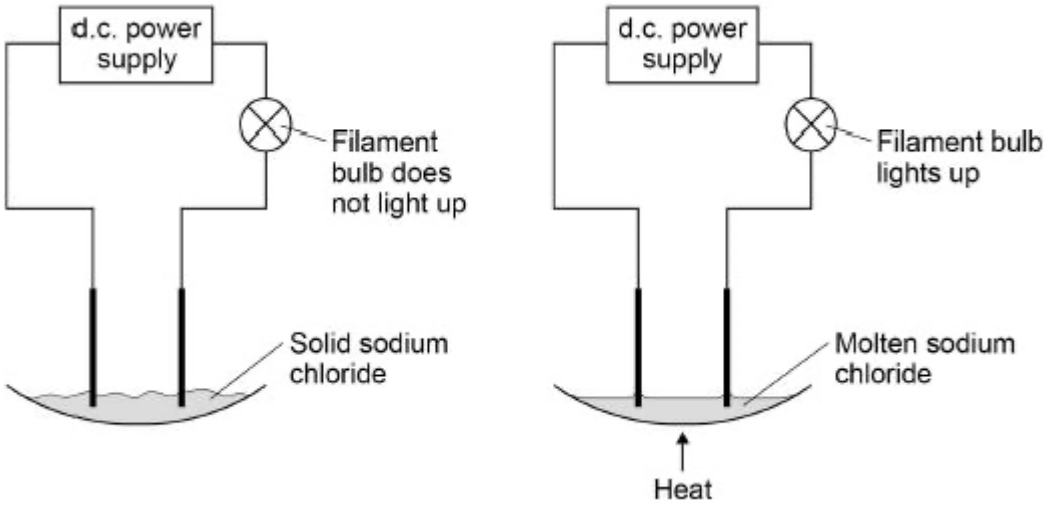
(1)

(i) Sodium chloride is made up of ions.

Figure 7 shows the apparatus used to investigate the effect of electricity on solid sodium chloride and molten sodium chloride.

Figure 7

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The table below shows the results.

	Solid sodium chloride	**Molten sodium chloride**
Observation	The filament bulb does not light up	The filament bulb lights up
Deduction	Does not conduct electricity	Does conduct electricity

Draw **one** line from each statement to the correct reason.

Statement	**Reason**
	The ions are fixed.
Solid sodium chloride does not conduct electricity.	The ions are mobile.
Molten sodium chloride conducts electricity.	The ions are neutral.
	The ions are vibrating.

(2)

(Total 10 marks)

Q2.

This question is about the halogens.

(a) Which group in the periodic table is known as the halogens?

Tick **one** box.

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Group 1 ☐

Group 2 ☐

Group 7 ☐

Group 0 ☐

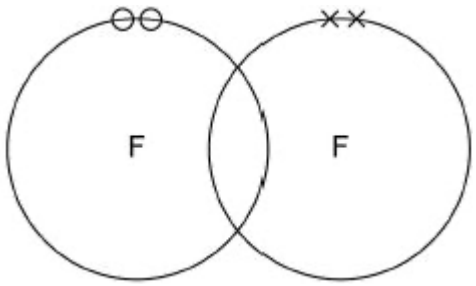
(1)

(b) A fluorine atom has 7 electrons in the outer shell.

The diagram below shows part of a dot and cross diagram to represent a molecule of fluorine (F_2).

Complete the dot and cross diagram.

You should show only the electrons in the outer shells.



(2)

(c) Chlorine reacts with potassium bromide solution.

Complete the word equation.

chlorine + potassium bromide → _____ + _____

(2)

(d) What type of reaction happens when chlorine reacts with potassium bromide solution?

Tick **one** box.

decomposition ☐

displacement ☐

neutralisation ☐

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precipitation ☐

(1)

(e) Complete the sentence.

Choose the answer from the box.

an atom	**an electron**	**a neutron**	**a proton**

Chlorine is more reactive than bromine.

This is because chlorine gains _____ more easily.

(1)

(f) How does the size of a chlorine atom compare with the size of a bromine atom?

Complete the sentence.

Choose the answer from the box.

bigger than	**the same size as**	**smaller than**

A chlorine atom is _____ a bromine atom.

(1)

(g) Give a reason for your answer to part **(f)**

Reason _____

_____

(1)

(h) Fluorine reacts with chlorine to produce ClF_3

Balance the chemical equation for the reaction.

$$Cl_2 + _____F_2 \longrightarrow 2\ ClF_3$$

(1)

(i) Explain why fluorine is a gas at room temperature.

Use the following words in your answer:

energy **forces** **molecules** **weak**

_____

_____

_____

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(3)

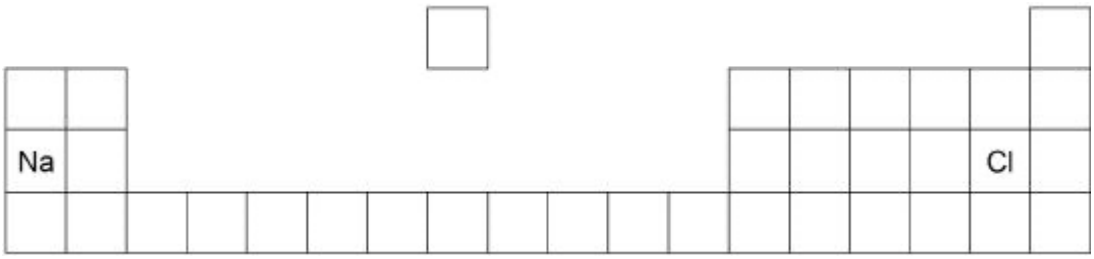
(Total 13 marks)

Q3.

This question is about sodium and chlorine.

Figure 1 shows the positions of sodium and chlorine in the periodic table.

Figure 1



(a) State **one** difference and **one** similarity in the electronic structure of sodium and of chlorine.

Difference _____

Similarity _____

(2)

(b) Sodium atoms react with chlorine atoms to produce sodium chloride (NaCl).

Describe what happens when a sodium atom reacts with a chlorine atom.

Write about electron transfer in your answer.

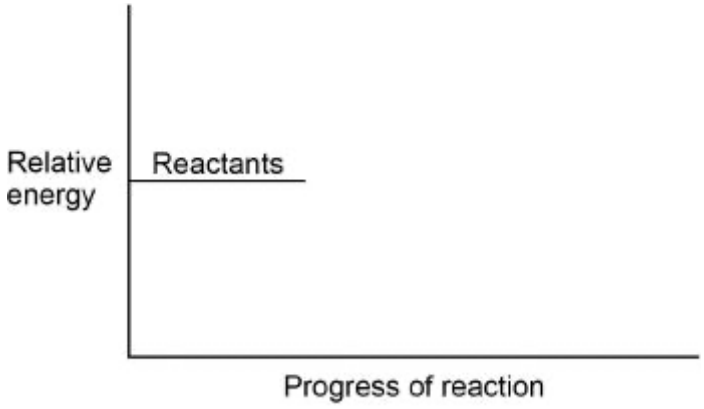
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(4)

(c) The reaction between sodium and chlorine is an exothermic reaction.

Complete the reaction profile for the reaction between sodium and chlorine.

Figure 2



(2)
(Total 8 marks)

Q4.

This question is about the halogens.

(a) Write the state symbol for chlorine at room temperature.

Cl_2 (_____)

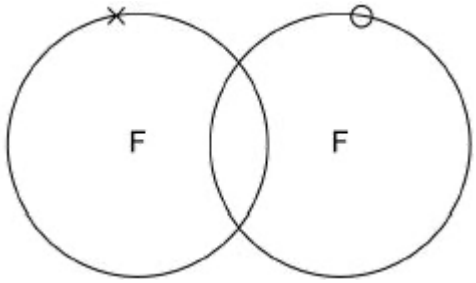
(1)

(b) The diagram below represents one molecule of fluorine.

Complete the dot and cross diagram on the diagram above.

You should show only the electrons in the outer shells.

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(2)

(c) A fluorine atom can be represented as $^{19}_{9}F$

What is the total number of electrons in a fluorine molecule (F_2)?

Tick **one** box.

9 ☐ 14 ☐ 18 ☐ 38 ☐

(1)

(d) Aluminium reacts with bromine to produce aluminium bromide.

Complete the balanced chemical equation for this reaction.

_____Al + _____Br_2 ⟶ 2_____

(2)

(e) When chlorine reacts with potassium bromide, chlorine displaces bromine.

$$Cl_2 + 2\ KBr \longrightarrow Br_2 + 2\ KCl$$

Explain why chlorine is more reactive than bromine.

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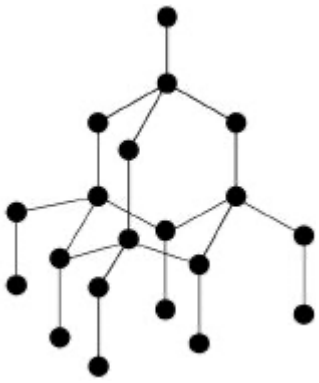
(3)
(Total 9 marks)

Q5.

This question is about structure and bonding.

(a) **Figure 1** shows part of the structure and bonding in diamond.

Figure 1



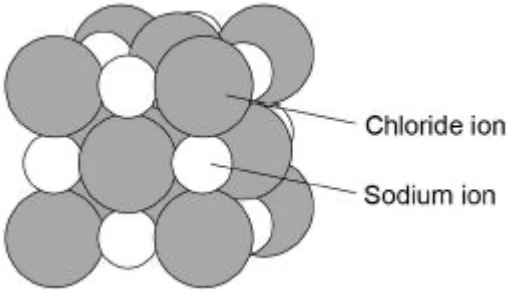
Explain why diamond has a high melting point.

(3)

(b) **Figure 2** shows part of the structure and bonding in sodium chloride (NaCl).

Figure 2

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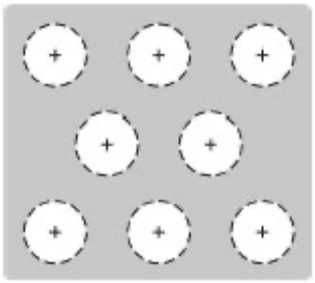


Explain the conditions needed for sodium chloride to conduct electricity.

(3)

(c) **Figure 3** shows the structure of sodium.

Figure 3



Describe how sodium conducts thermal energy.

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(3)

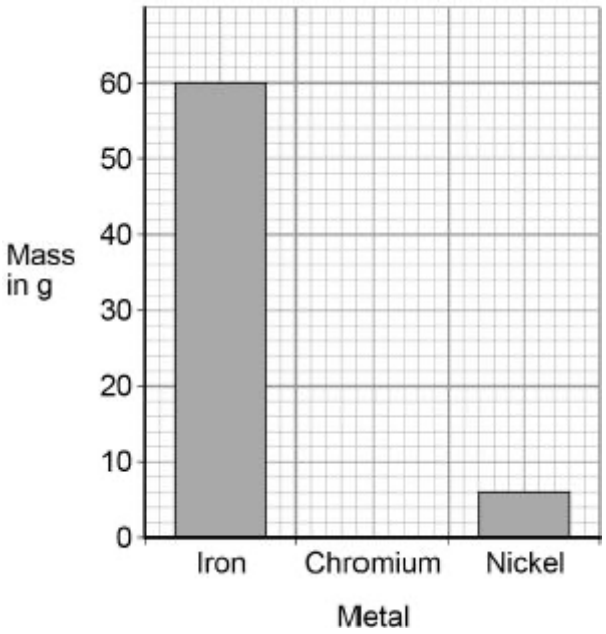
(Total 9 marks)

Q6.

One alloy contains iron, chromium and nickel.

Figure 1 shows the mass of iron and the mass of nickel in 80 g of this alloy.

Figure 1



(a) Determine the mass of iron and nickel in 80 g of the alloy.

Use **Figure 1**.

Mass of iron = _____ g

Mass of nickel = _____ g

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(1)

(b) Calculate the mass of chromium in 80 g of the alloy.

Draw a bar on **Figure 1** to show the mass of chromium in 80 g of the alloy.

_____

_____

Mass of chromium = _____ g

(2)

(c) What mass of iron is present in **0.80 kg** of the alloy?

Give your answer in grams.

_____

_____

Mass of iron = _____ g

(1)

(d) What is an alloy?

_____

_____

(1)

(e) Give **one** reason why alloys are used instead of pure metals.

_____

_____

(1)

(f) Iron and nickel are both magnetic metals.

Which is also a magnetic metal?

Tick **one** box.

Cobalt ☐

Copper ☐

Sodium ☐

Zinc ☐

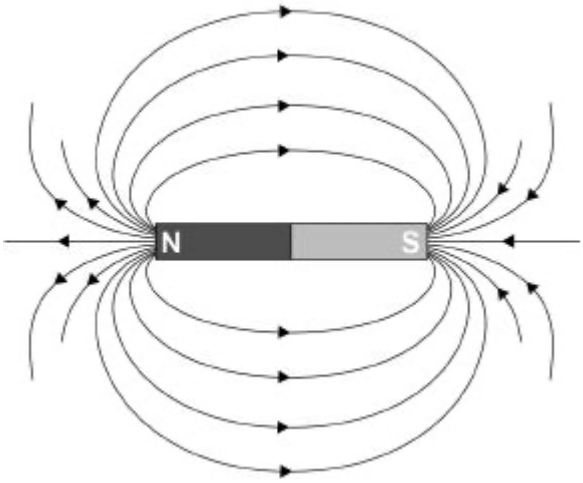
(1)

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A student plotted the magnetic field pattern around a bar magnet.

Figure 2 shows the magnetic field pattern.

Figure 2



(g) Complete the sentence.

Choose the answer from the box.

induced	permanent	temporary

Bar magnets produce their own magnetic fields.

Bar magnets are described as _____ magnets.

(1)

(h) Which statement about the magnetic field around a bar magnet is correct?

Tick **one** box.

The magnetic field is the same strength all around the magnet. ☐

The magnetic field is strongest at the poles of the magnet. ☐

The magnetic field is strongest near the middle of the magnet. ☐

(1)

(i) This is the start of a method used to plot a magnetic field pattern around a bar magnet.

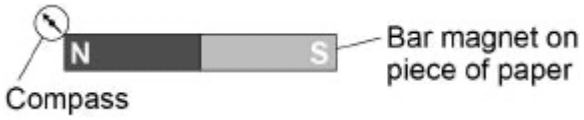
1. Place the magnet on a piece of paper.
2. Draw around the magnet.
3. Mark a dot by a pole of the magnet.

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4. Place the compass on the dot.

Figure 3 shows the apparatus after steps 1−4.

Figure 3



Describe the rest of the method to plot the magnetic field pattern.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 13 marks)

Q7.

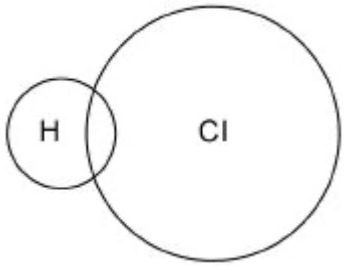
This question is about hydrogen chloride.

(a) A hydrogen atom contains 1 electron and a chlorine atom contains 17 electrons.

Complete **Figure 1** to show a dot and cross diagram for a hydrogen chloride molecule.

Show the outer electrons only.

Figure 1



(2)

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Hydrogen gas (H_2) reacts with chlorine gas to produce hydrogen chloride.

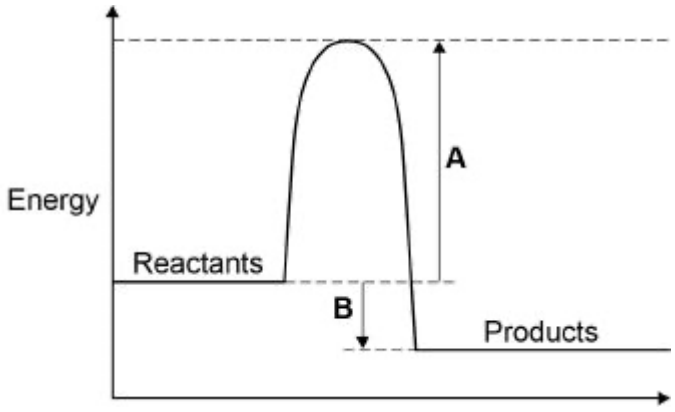
(b) Complete the balanced chemical equation for the reaction between hydrogen and chlorine.

$$H_2 + _____ \rightarrow _____$$

(2)

Figure 2 shows the reaction profile diagram for the reaction between hydrogen and chlorine.

Figure 2



(c) What do **A** and **B** represent on **Figure 2**?

A _____

B _____

(2)

(d) How does the reaction profile diagram show that the reaction is exothermic?

_____

_____

(1)

(e) Hydrogen chloride gas dissolves in water to form hydrochloric acid.

Hydrochloric acid contains hydrogen ions and chloride ions.

Explain why hydrogen chloride gas does not conduct electricity but hydrochloric acid is able to conduct electricity.

_____

_____

_____

_____

_____

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(3)

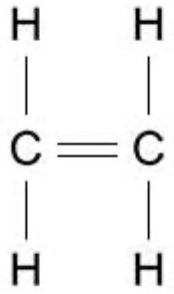
(Total 10 marks)

Q8.

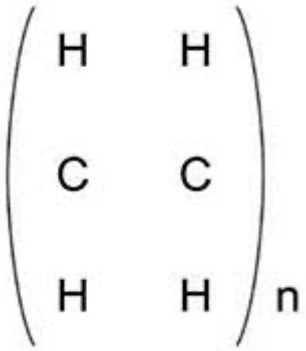
Supermarket carrier bags can be made from poly(ethene).

(a) Poly(ethene) is produced from ethene.

The structure of ethene is:



Complete the structure of poly(ethene).



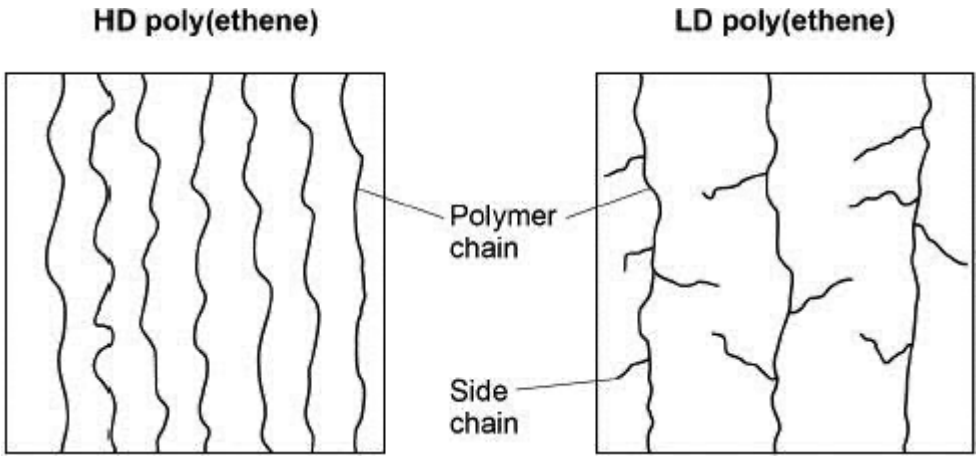
(2)

There are two types of poly(ethene): HD poly(ethene) and LD poly(ethene).

(b) **Figure 1** shows the polymer chains in HD poly(ethene) and LD poly(ethene).

Figure 1

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Describe the differences in the structure and arrangement of the polymer chains in the two types of poly(ethene).

(2)

A student investigated how poly(ethene) extends when a force is applied.

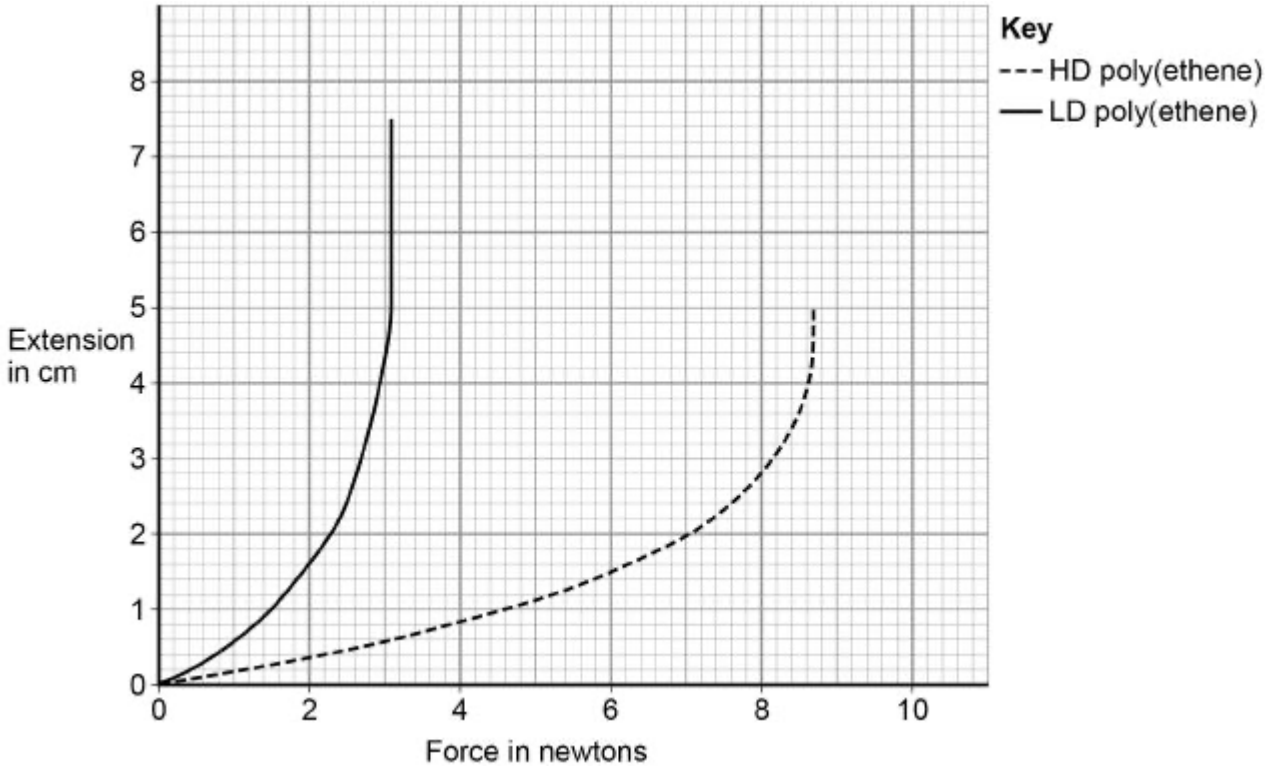
(c) Describe a method to investigate how the extension of poly(ethene) changes with the force applied.

(4)

Figure 2 shows the results for HD poly(ethene) and LD poly(ethene).

Figure 2

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(d) Give **two** comparisons between the results for HD poly(ethene) and for LD poly(ethene).

Use **Figure 2**.

1. _____

_____

2. _____

_____

(2)

(e) Carrier bags in supermarkets used to be provided free. Supermarkets now make customers pay for carrier bags.

When they were free, 8.0 billion new carrier bags were used each year.

After supermarkets started making customers pay for carrier bags, the use of new bags dropped by 85%.

Calculate how many carrier bags are now used each year.

_____

_____

_____

Number of bags = _____

(2)

(f) There are two types of carrier bag in common use:

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- disposable bags
- bags for life.

Bags for life can be returned to the supermarket when no longer usable.

The supermarket replaces the bag for life free of charge and arranges for the bag to be recycled.

The table below shows data from a life cycle assessment (LCA) for the two types of carrier bag.

	Disposable bag	**Bag for life**
Type of polymer	HD poly(ethene)	LD poly(ethene)
Raw material from which polymer is made	Crude oil	Crude oil
Mass of waste material per bag from production in grams	0.42	0.17
Mass of carbon dioxide emitted per bag during production and transport in grams	1.6	6.9
Mean number of times used	1	6
Possible disposal methods	Landfill Incineration Recycling	Landfill Incineration Recycling

Evaluate the use of each type of carrier bag.

Use data from the table above and your own knowledge.

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_____

_____

_____

_____

_____

_____

_____

_____

(6)

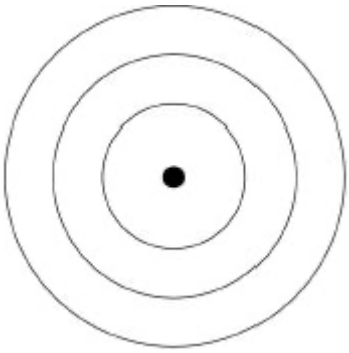
(Total 18 marks)

Q9.

This question is about Group 1 elements.

(a) A sodium atom is represented as $^{23}_{11}Na$

Complete the diagram below to show the electronic structure of a sodium atom.



(1)

A teacher demonstrated the reaction between lithium and water.

The teacher repeated the demonstration using sodium and then potassium with water.

(b) The teacher wore eye protection.

Suggest **two** other safety precautions the teacher should take.

1. _____

_____

2. _____

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(2)

(c) Universal indicator is added to the solution formed in the reaction between potassium and water. The universal indicator becomes purple in colour.

Which ion causes universal indicator to turn purple?

Tick **one** box.

H^+ ☐

K^+ ☐

OH^- ☐

O^{2-} ☐

(1)

(d) The table below gives the diameter of atoms of Group 1 elements.

Element	**Diameter of atom in nm**
Lithium	0.304
Sodium	0.372
Potassium	0.454
Rubidium	0.496
Caesium	0.530

Explain how the diameter of the atom affects the reactivity of Group 1 elements.

(4)

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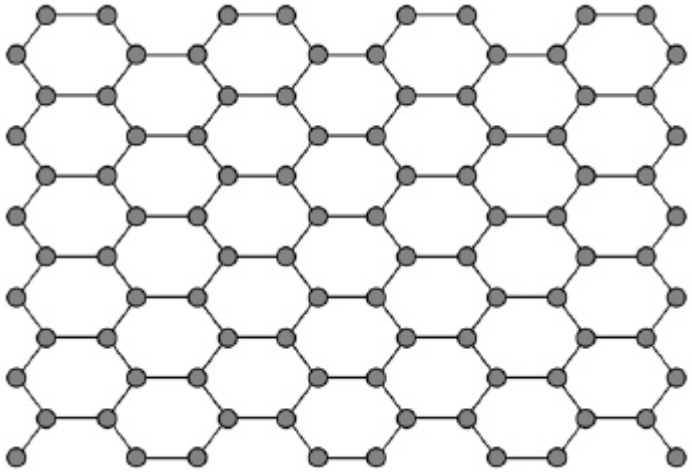
(Total 8 marks)

Q10.

This question is about structure and bonding.

(a) **Figure 1** shows part of one layer of graphene.

Figure 1



Which element is graphene made from?

Tick **one** box.

Carbon	☐
Copper	☐
Hydrogen	☐
Sodium	☐

(1)

(b) Each atom in graphene has one delocalised electron.

Complete the sentence.

Choose the answer from the box.

act as a lubricant	**be used as a fuel**
conduct electricity	**dissolve in water**

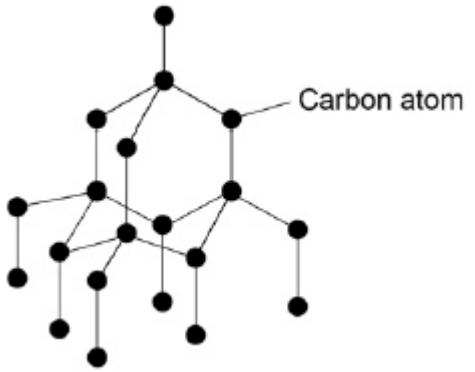
Delocalised electrons allow graphene to _____ .

(1)

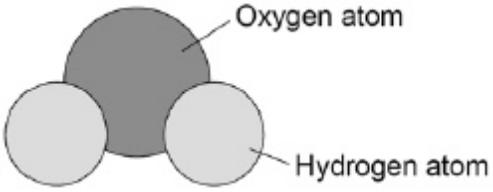
(c) Which structure is a fullerene?

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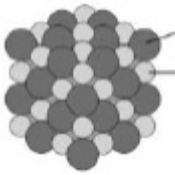
Tick **one** box.



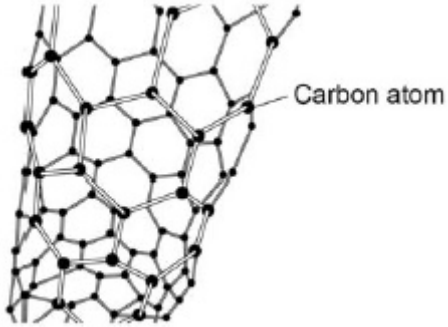
☐



☐



☐

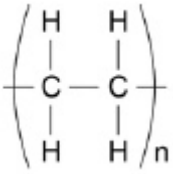


☐

(1)

Figure 2 shows part of a large hydrocarbon molecule.

Figure 2



(d) Which **two** elements are in all hydrocarbons?

1. _____

2. _____

(2)

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(e) Complete the sentence.

Choose the answer from the box.

an atom	**a metal**	**a polymer**	**a salt**

The large molecule represented in **Figure 2** is _____ .

(1)

(f) Complete the sentence.

Choose the answer from the box.

attract	**bond**	**slide**	**vibrate**

Metals can be stretched into wires

because the layers of atoms can _____ .

(1)

(Total 7 marks)

Q11.

This question is about compounds of fluorine.

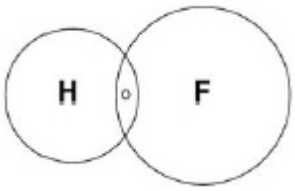
(a) A fluorine atom has 7 electrons in the outer shell.

Figure 1 shows part of a dot and cross diagram of a molecule of hydrogen fluoride (HF).

Complete the dot and cross diagram in **Figure 1**.

You should show only the electrons in the outer shells.

Figure 1

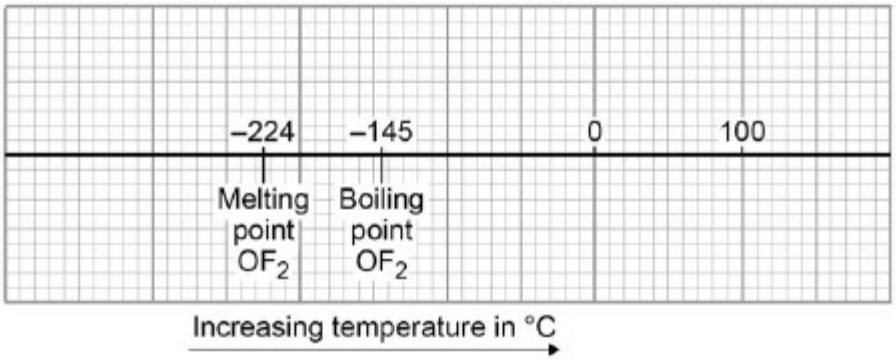


(1)

Figure 2 shows the boiling point and melting point of oxygen difluoride (OF_2).

Figure 2

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(b) What is the state of oxygen difluoride at –200 °C?

Tick **one** box.

Aqueous (aq) ☐

Gas (g) ☐

Liquid (l) ☐

Solid (s) ☐

(1)

(c) What change of state occurs when oxygen difluoride is cooled from –220 °C to –230 °C?

Tick **one** box.

Condensing ☐

Evaporating ☐

Freezing ☐

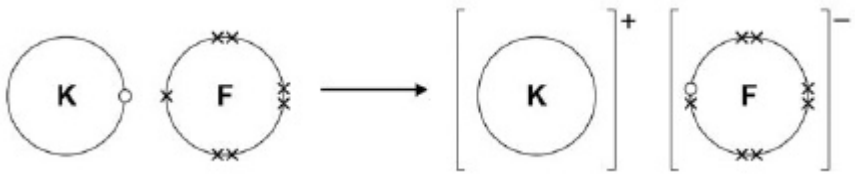
Melting ☐

(1)

Potassium reacts with fluorine to produce the ionic compound potassium fluoride (KF).

Figure 3 shows the transfer of electrons during the reaction.

Figure 3



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(d) Describe what happens when potassium reacts with fluorine to produce potassium fluoride.

Write about electron transfer in your answer.

(5)

(e) Potassium fluoride is an ionic compound.

Explain why ionic compounds have high melting points.

Use the following words in your answer:

- attraction
- energy
- ions.

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_____

_____

(4)

(Total 13 marks)

Q12.

Three substances are all solid at room temperature.

The table describes tests and the result of each test on the three substances.

Substance	**Effect of large force applied**	**Effect of heating gently at first, then strongly**	**Effect of passing electricity through solid**	**Effect of passing electricity through liquid**
A	Breaks into many pieces	Easily melts and then boils	Does not conduct	Does not conduct
B	Breaks into many pieces	No change	Does not conduct	Conducts
C	Becomes thinner	No change	Conducts	Conducts

(a) The covalent bonds in the molecules are not overcome when substance **A** is heated.

What forces are overcome when substance **A** melts?

_____

(1)

(b) What could substance **A** be?

Tick **one** box.

Graphite ☐

Iron ☐

Sodium chloride ☐

Sulfur ☐

(1)

(c) Suggest why substance **B** conducts electricity as a liquid but does **not** conduct electricity as a solid.

_____

_____

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(3)

(d) Suggest why substance **C** becomes thinner when a large force is applied.

(2)

(e) What could substance **C** be?

Tick **one** box.

Copper	☐
Diamond	☐
Iodine	☐
Magnesium oxide	☐

(1)
(Total 8 marks)

Q13.

This question is about fluorine.

(a) Calcium reacts with fluorine to produce calcium fluoride (CaF_2).

Explain how oxidation and reduction have taken place in this reaction.

Write about electron transfer in your answer.

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(4)

(b) Explain why calcium fluoride has a high melting point.

(4)

(c) Fluorine reacts with sulfur to produce sulfur hexafluoride (SF_6).

$$S + 3F_2 \rightarrow SF_6$$

Relative formula masses, M_r: $F_2 = 38$ $SF_6 = 146$

Calculate the mass of sulfur hexafluoride produced when 0.950 g of fluorine is reacted with an excess of sulfur.

Give your answer to 3 significant figures.

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Mass = _____ g

(5)

(Total 13 marks)

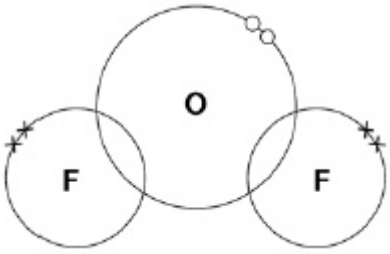
Q14.

This question is about oxygen.

(a) One oxygen atom shares one pair of electrons with each fluorine atom in oxygen difluoride (OF_2).

Complete the dot and cross diagram of oxygen difluoride below.

You should show only the electrons in the outer shells.



(2)

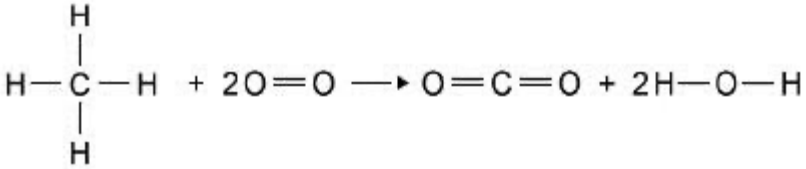
(b) Oxygen difluoride (OF_2) has a melting point of – 224 °C and a boiling point of –145 °C

What is the state of oxygen difluoride at room temperature?

Explain your answer in terms of structure and bonding.

(4)

(c) The equation shows the reaction of methane with oxygen.



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The table shows the bond energies.

Bond	C–H	O=O	C=O	O–H
Bond dissociation energy in kJ per mole	412	496	803	463

Calculate the overall energy change for the combustion of one mole of methane.

Energy change = _____ kJ mol^{-1}

(3)

(Total 9 marks)

Q15.

Crude oil and natural gas are natural resources in many countries.

The table shows percentages of hydrocarbons in natural gas from three different countries.

Hydrocarbon	Percentage (%) of hydrocarbon in natural gas		
	Country X	**Country Y**	**Country Z**
Methane	78.03	88.10	94.36
Ethane	9.70	5.30	2.37
Propane	4.82	2.16	0.15
Butane	1.33	0.72	0.02
Pentane	0.30	0.18	0.00

(a) Calculate the mean percentage of propane from countries **X**, **Y** and **Z**.

Give your answer to 2 decimal places.

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_____

_____

_____

Mean percentage of propane = _____ %

(2)

(b) Suggest why natural gas from different countries has different percentages of hydrocarbons.

_____

_____

(1)

(c) Complete the sentence.

Choose the answer from the box.

an atom	**an electron**	**an ion**	**a molecule**

The formula CH_4 represents _____ of methane.

(1)

(d) Complete the sentence.

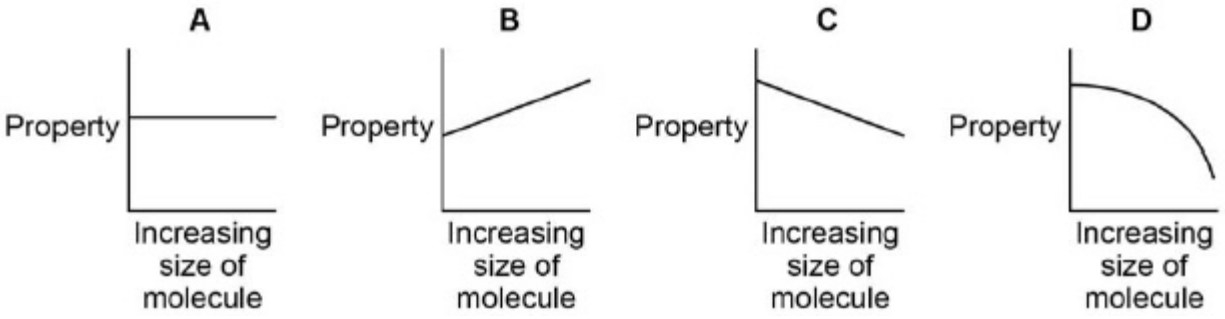
The hydrocarbons in the table belong to the homologous series of

_____ .

(1)

Figure 1 shows how properties vary with the increasing size of molecule in this homologous series.

Figure 1



(e) Which graph shows how boiling points vary?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

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(f) Which graph shows how viscosity varies?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(g) Crude oil is fractionally distilled.

Fractions with larger molecules are cracked.

Describe **two** differences between fractional distillation and cracking.

1. _____

_____

2. _____

_____

(2)

(h) Ethene is a product of crude oil.

Complete the sentence.

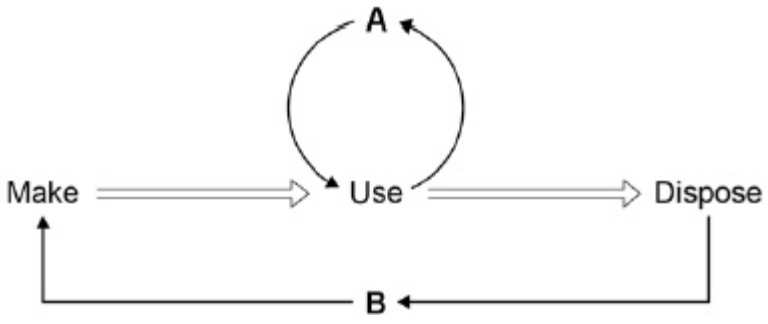
Ethene polymerises to produce _____ .

(1)

(i) The production of plastic bags uses limited resources.

Figure 2 shows two ways (**A** and **B**) of saving limited resources.

Figure 2



Name **A** and **B**.

Choose the answers from the box.

recycle	**reduce**	**release**	**reuse**	**reverse**

A _____

B _____

(2)

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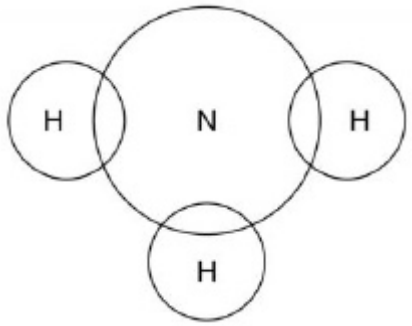
(Total 12 marks)

Q16.

This question is about ammonia (NH_3).

(a) Complete the diagram to show the bonding electrons in ammonia.

Show the outer electrons only.



(2)

Ammonia is produced from nitrogen and hydrogen.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.

(b) A low pressure is used.

Explain the effect on the yield of ammonia.

_____

_____

_____

_____

(2)

(c) A high temperature is used.

Explain the effect on the yield of ammonia.

_____

_____

_____

_____

(2)

(d) Ammonia is removed from the reaction mixture.

Explain the effect on the position of equilibrium.

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_____

_____

_____

_____

(2)

(Total 8 marks)

Q17.

John Newlands arranged the known elements into a table in order of atomic weight.

Figure 1 shows part of Newlands' table.

Figure 1

Group	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	H	Li	Be	B	C	N	O
	F	Na	Mg	Al	Si	P	S
	Cl	K	Ca				

(a) What are the names of the elements in Group 5 of Newlands' table?

Tick **one** box.

Calcium and sulfur ☐

Carbon and silicon ☐

Chlorine and silver ☐

Chromium and tin ☐

(1)

(b) In what order is the modern periodic table arranged?

Tick **one** box.

Atomic mass ☐

Atomic number ☐

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Atomic size ☐

Atomic weight ☐

(1)

(c) Give **two** differences between Group 1 of Newlands' table and Group 1 of the periodic table.

_____

_____

_____

_____

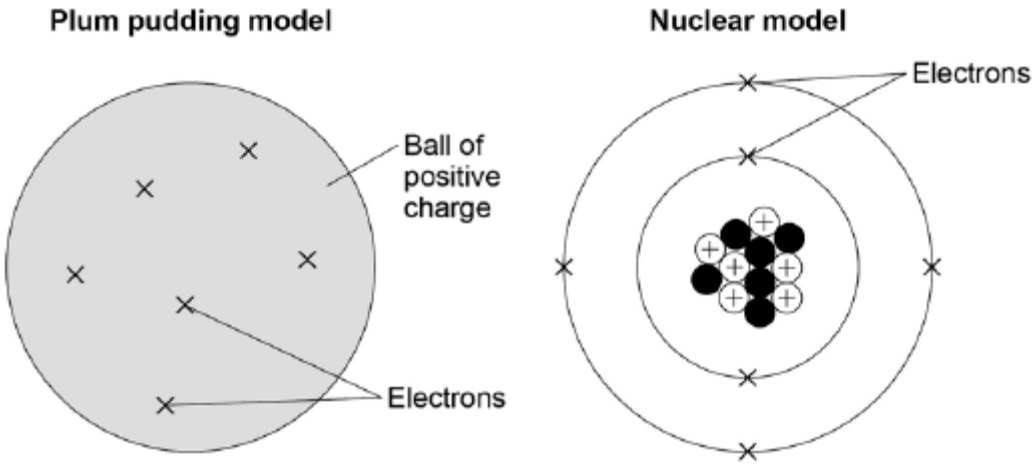
(2)

(d) In 1864, atoms were thought to be particles that could not be divided up into smaller particles.

By 1898, the electron had been discovered and the plum pudding model of an atom was proposed.

Figure 2 shows the plum pudding model of an atom of carbon and the nuclear model of an atom of carbon.

Figure 2



Compare the position of the subatomic particles in the plum pudding model with the nuclear model.

_____

_____

_____

_____

_____

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_____

_____

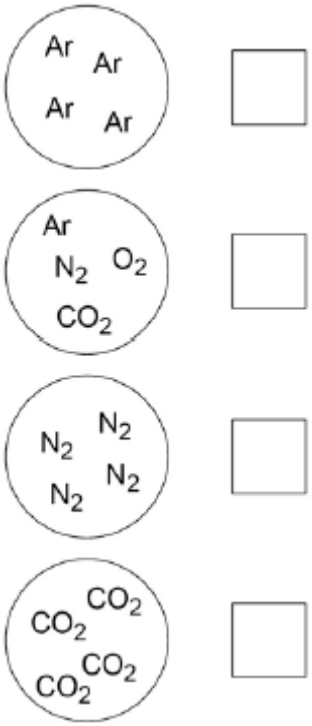
_____

(4)

(e) Models are used to show the differences between elements, compounds and mixtures.

Which circle shows a model of a mixture?

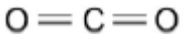
Tick **one** box.



(1)

(f) **Figure 3** shows a model of carbon dioxide.

Figure 3



What does each line between the atoms in **Figure 3** represent?

Tick **one** box.

Covalent bond ☐

Intermolecular force ☐

Ionic bond ☐

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Metallic bond ☐

(1)

(Total 10 marks)

Q18.

This question is about calcium.

(a) What type of compound is calcium oxide?

Tick **one** box.

An acid ☐

A base ☐

A carbonate ☐

A salt ☐

(1)

(b) Ionic compounds, such as calcium oxide, have high melting points.

Complete the sentences. Use words from the box.

bonds	**forces**	**ions**
	layers	

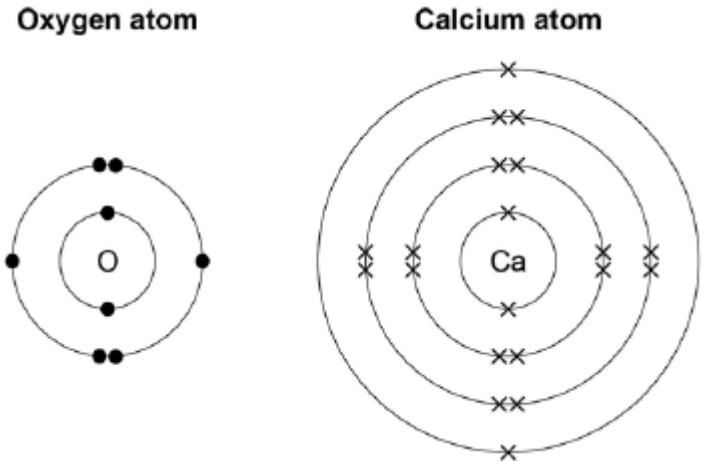
Calcium oxide has a giant ionic lattice in which there are strong electrostatic

_____ of attraction in all directions.

(1)

(c) The figure below shows the electronic structure of an oxygen atom and a calcium atom.

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Describe how the calcium atom and the oxygen atom forms calcium oxide.

You should give the charge on each ion formed.

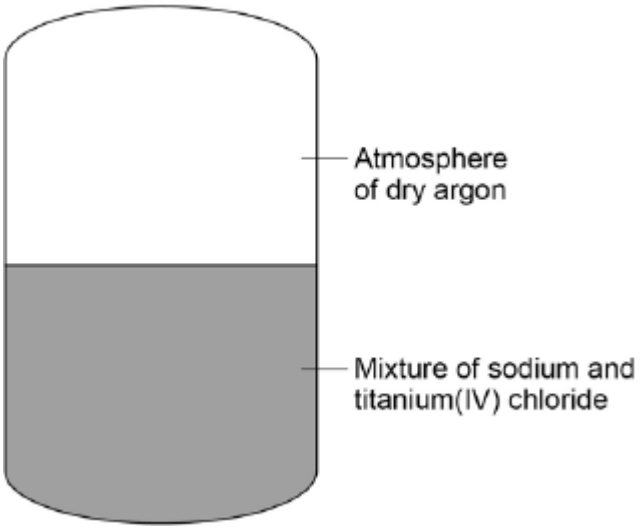
(4)
(Total 6 marks)

Q19.

Figure 1 shows a reactor used to produce titanium from titanium(IV) chloride.

Figure 1

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The chemical equation for the reaction of titanium(IV) chloride with sodium is:

$TiCl_4 + 4Na \rightarrow Ti + 4NaCl$

titanium(IV) chloride + sodium → titanium + sodium chloride

(a) For one reaction:

- 1615 kg titanium(IV) chloride reacted completely with 782 kg sodium
- 1989 kg sodium chloride was produced.

Calculate the mass of titanium produced from this reaction.

_____

_____

Mass of titanium = _____ kg

(1)

(b) The table below shows the solubility of sodium chloride in 100 cm^3 of aqueous solution at different temperatures.

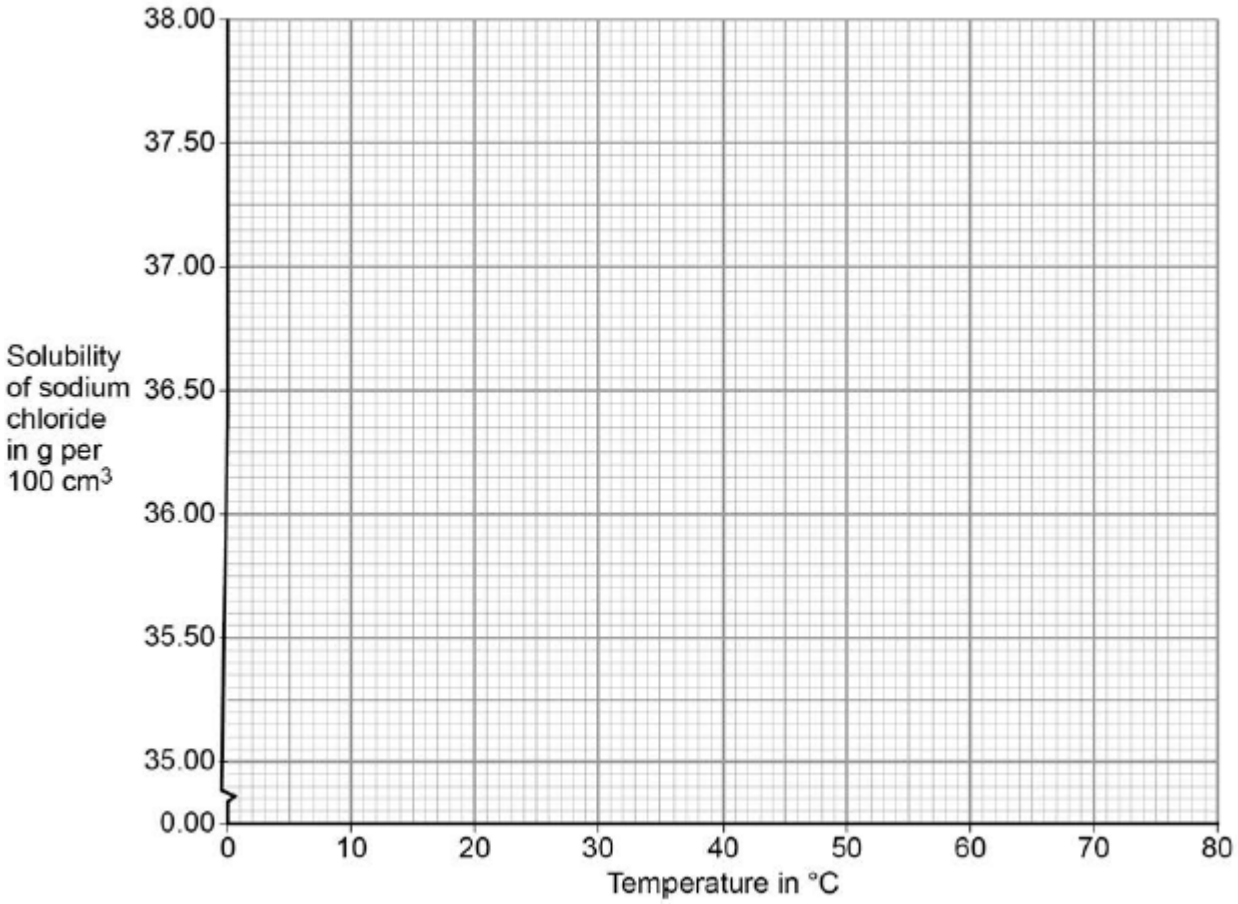
Solubility of sodium chloride in g per 100cm^3	**Temperature in °C**
35.72	10
35.89	20
36.09	30
37.37	40
36.69	50
37.04	60

On **Figure 2**:

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- plot this data on the grid
- draw a line of best fit.

Figure 2



(3)

(c) The product sodium chloride is dissolved in water to separate it from titanium.

At 30 °C the solubility of sodium chloride is 36 kg per 100 dm^3.

Calculate the minimum volume of water in dm^3, at 30 °C, needed to dissolve 1989 kg sodium chloride.

Volume of water = _____ dm^3

(2)

(d) Calculate the percentage by mass of titanium in titanium(IV) chloride ($TiCl_4$).

Give your answer to 3 significant figures.

Relative atomic masses (A_r): Cl = 35.5; Ti = 48

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Percentage of titanium by mass = _____ %

(3)

(e) Suggest why the reaction is done in an atmosphere of dry argon instead of air containing water vapour.

(3)

(f) Explain why titanium conducts electricity.

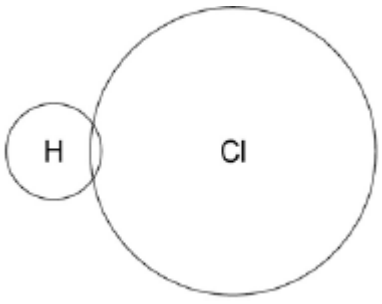
(3)

(Total 15 marks)

Q20.

Hydrogen chloride (HCl) is a gas.

(a) Complete the diagram to show all of the arrangement of the outer shell electrons of the hydrogen and chlorine atoms in hydrogen chloride.



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(1)

(b) Hydrochloric acid is a strong acid.
Ethanoic acid is a weak acid.

Describe a reaction that could be used to show the difference between a weak acid and a strong acid.

You should explain why the weak acid and the strong acid give different results.

(6)
(Total 7 marks)

Q21.

Aqamed is a medicine for children.

(a) The medicine is a formulation.

What is meant by a formulation?

(1)

(b) Children often do not like taking medicine.

Suggest a substance that could be added to Aqamed to increase the desire for children to take it.

Give a reason for your suggestion.

Substance _____

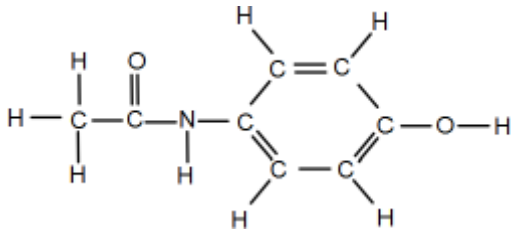
Reason _____

(2)

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(c) The main ingredient in Aqamed is a painkiller called paracetamol.

The figure below represents a molecule of paracetamol.



Give the molecular formula of paracetamol.

Calculate its relative formula mass (M_r).

Relative atomic masses (A_r): H = 1; C = 12; N = 14; O = 16

Molecular formula _____

Relative formula mass _____

_____

M_r = _____

(2)

(d) Aspirin is a medicine for use by adults.

An aspirin tablet contains 300 mg of acetylsalicylic acid.

Calculate the number of moles of acetylsalicylic acid in one aspirin tablet.

Give your answer in standard form to three significant figures.

Relative formula mass (M_r) of aspirin = 180

_____

_____

_____

_____

_____

_____

Number of moles = _____

(4)

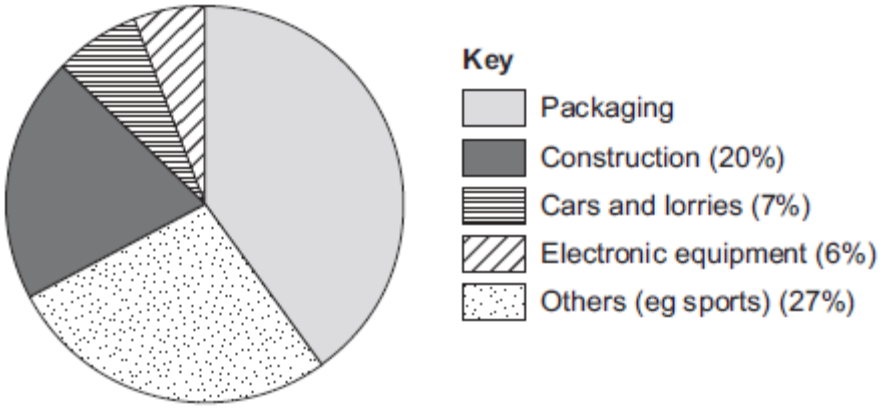
(Total 9 marks)

Q116.

Polymers have many important uses.

The pie chart shows the percentage (%) of polymers used in different ways.

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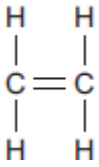
(a) What is the percentage of polymers used for packaging?

Percentage of polymers used for packaging = _____ %

(1)

(b) (i) Shrink-wrap is a form of poly(ethene). Poly(ethene) is produced from ethene.

The displayed structure of a molecule of ethene is

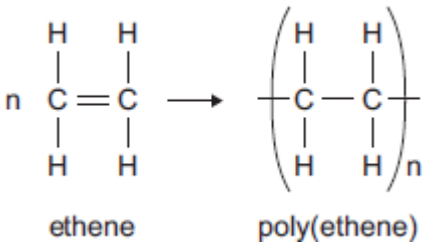


What is the chemical formula of a molecule of ethene?

(1)

(ii) Poly(ethene) is produced from ethene in a polymerisation reaction.

The equation for the reaction is



Which **two** statements about the polymerisation reaction to form poly(ethene) are correct?

Tick (✓) **two** boxes.

	Tick (✓)
A polymer is a small molecule.	

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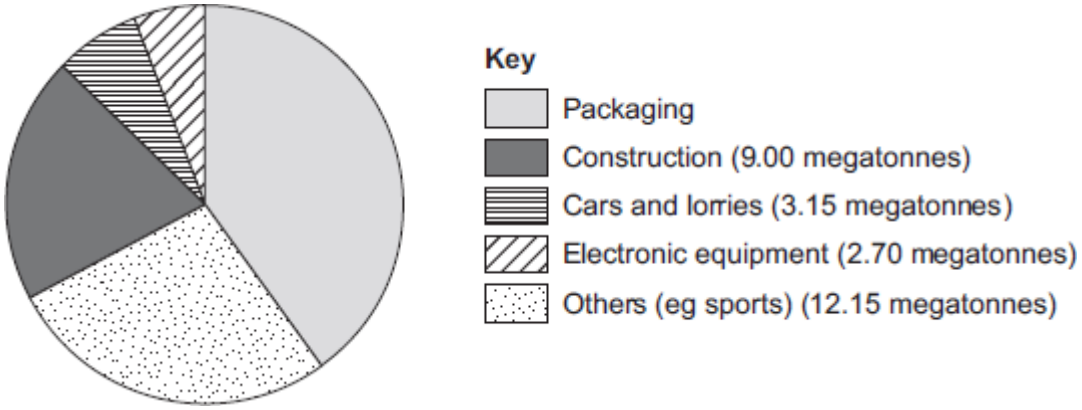
Many ethene molecules join together.	
Poly(ethene) contains a double bond.	
The monomer is ethene.	

(2)
(Total 4 marks)

Q117.

Polymers have many important uses. Each year 45 megatonnes of polymers are used.

The pie chart below shows the mass in megatonnes of polymers used in different ways.



(a) What percentage of polymers is used in packaging?

_____

_____

_____

_____

Percentage of polymers used in packaging = _____ %

(2)

(b) (i) Poly(ethene) is often used for packaging. Poly(ethene) is made from ethene.

Ethene is an alkene with the chemical formula C_2H_4

Draw the displayed structure for ethene.

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(1)

(ii) Poly(ethene) is formed from ethene in a polymerisation reaction.

Describe, in terms of molecules, what happens in a polymerisation reaction.

_____

_____

_____

_____

_____

_____

(3)
(Total 6 marks)

Q118.

Figure 1 shows some Australian bank notes. In Australia, bank notes are made of poly(propene) not paper.

Figure 1



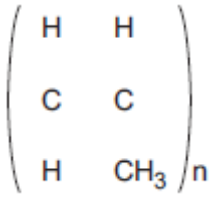
© Max Blain/Hemera/Thinkstock

(a) Complete **Figure 3** to show the structure of poly(propene).

Figure 3

Poly(propene)

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(2)

(b) Propene is an alkene.
Describe a test that can be done to show that an alkene is present.

_____

_____

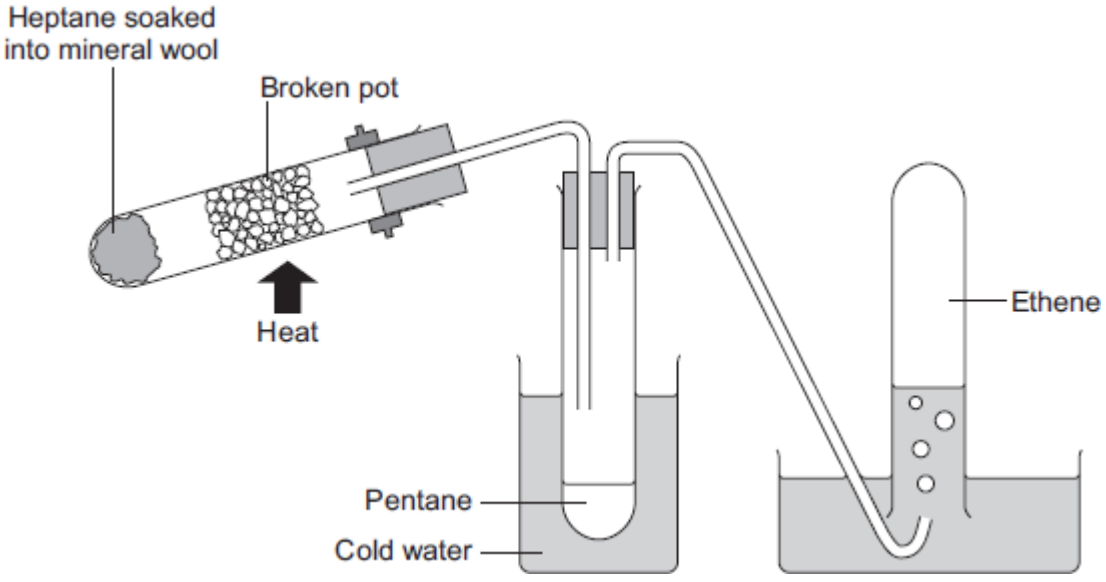
_____

_____

(2)
(Total 4 marks)

Q119.

In the laboratory, ethene can be made using the apparatus shown.



(a) (i) Complete the symbol equation for this reaction.

$$\underset{\text{heptane}}{C_7H_{16}} \rightarrow \underline{\qquad\qquad} + \underset{\text{ethene}}{C_2H_4}$$
$$\text{pentane}$$

(1)

(ii) Explain how you can tell pentane has a higher boiling point than ethene.

Use information from the diagram.

_____

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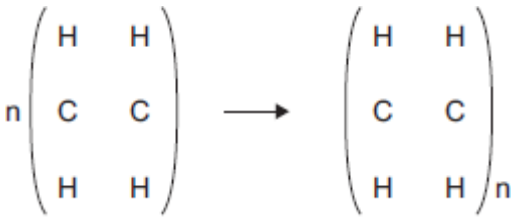
_____

(1)

(b) Ethene molecules are polymerised to form poly(ethene).

Complete the displayed (structural) formula of ethene and poly(ethene) in the equation to show this reaction.

Draw lines to represent each bond.



Ethene **Poly(ethene)**

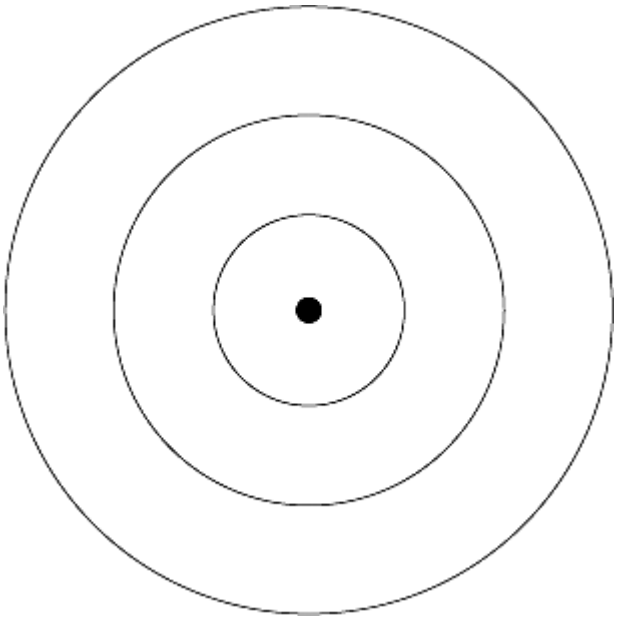
(3)

(Total 5 marks)

Q120.

Sodium is a reactive element.

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



(2)

(b) Sodium reacts with chlorine to form sodium chloride.

Explain how in terms of electrons, atoms and ions.

_____

_____

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(4)
(Total 6 marks)

Q121.

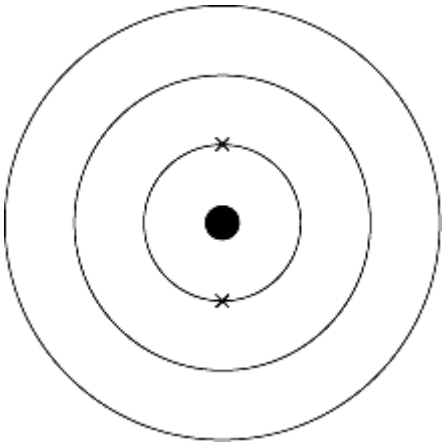
Lithium chloride can be used to colour flames dark red.



By Alchimista (Own work) [CC-BY-SA-3.0] via Wikimedia Commons

(a) A chlorine atom has 17 electrons.

Complete the diagram to show the electronic structure of a chlorine atom.

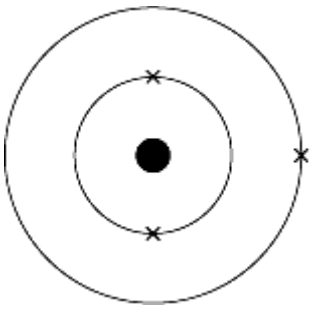


(1)

(b) Lithium chloride (LiCl) can be made by reacting lithium with chlorine.

The electronic structure of a lithium atom is shown below.

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Describe what happens to a lithium atom when the atom reacts with chlorine.

_____

_____

_____

_____

_____

_____

(3)

(Total 4 marks)

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