The Morley Academy

2. Bonding & Structure Mastery Booklet

(Chemistry Paper 1)

Name : _____

Teacher : _____

Date Given : _____

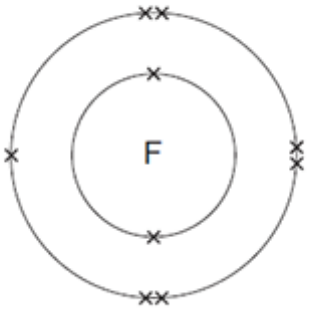
These booklets are a consolidation of your learning. They should be used in the following way - You should attempt the questions WITHOUT looking at the answers. Then mark your questions with **green pen** and add any missing marks you missed.

THESE BOOKLETS WILL IMPROVE YOUR GRADES...!!

Q1. This question is about fluorine.

(a) **Figure 1** shows the arrangement of electrons in a fluorine atom.

Figure 1



(i) In which group of the periodic table is fluorine?

Group _____

(1)

(ii) Complete the table below to show the particles in an atom and their relative masses.

Name of particle	Relative mass
Proton	
Neutron	1
	Very small

(2)

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

alkalis	**alloys**	**isotopes**

Atoms of fluorine with different numbers of neutrons are

called _____ .

(1)

(b) Sodium reacts with fluorine to produce sodium fluoride.

(i) Complete the word equation for this reaction.

sodium + _____ → _____

(1)

(ii) Complete the sentence.

Substances in which atoms of two or more different elements are chemically

combined are called _____ .

(1)

(iii) The relative formula mass (M_r) of sodium fluoride is 42.

Use the correct answer from the box to complete the sentence.

ion	mole	molecule

The relative formula mass (M_r), in grams, of sodium fluoride is one

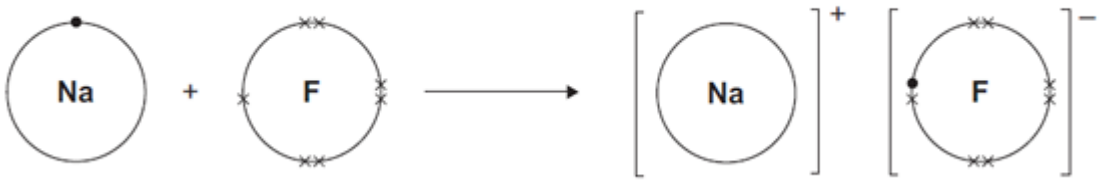
_____ of the substance.

(1)

(iv) **Figure 2** shows what happens to the electrons in the outer shells when a sodium atom reacts with a fluorine atom.

The dots (•) and crosses (×) represent electrons.

Figure 2



Use **Figure 2** to help you answer this question.

Describe, as fully as you can, what happens when sodium reacts with fluorine to produce sodium fluoride.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(v) Sodium fluoride is an ionic substance.

What are **two** properties of ionic substances?

Tick (✔) **two** boxes.

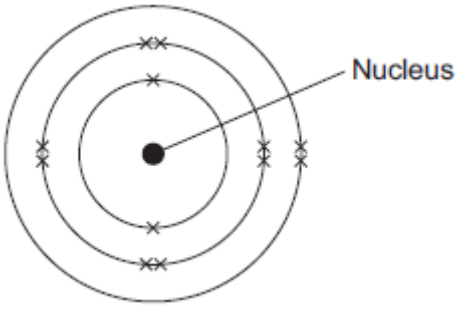
Dissolve in water	☐
Gas at room temperature	☐
High melting point	☐
Low boiling point	☐

(2)

(Total 13 marks)

Q2. This question is about magnesium.

(a) (i) The electronic structure of a magnesium atom is shown below.



Use the correct answer from the box to complete each sentence.

electrons	**neutrons**	**protons**	**shells**

The nucleus contains protons and _____ .

The particles with the smallest relative mass that move around the nucleus are called _____ .

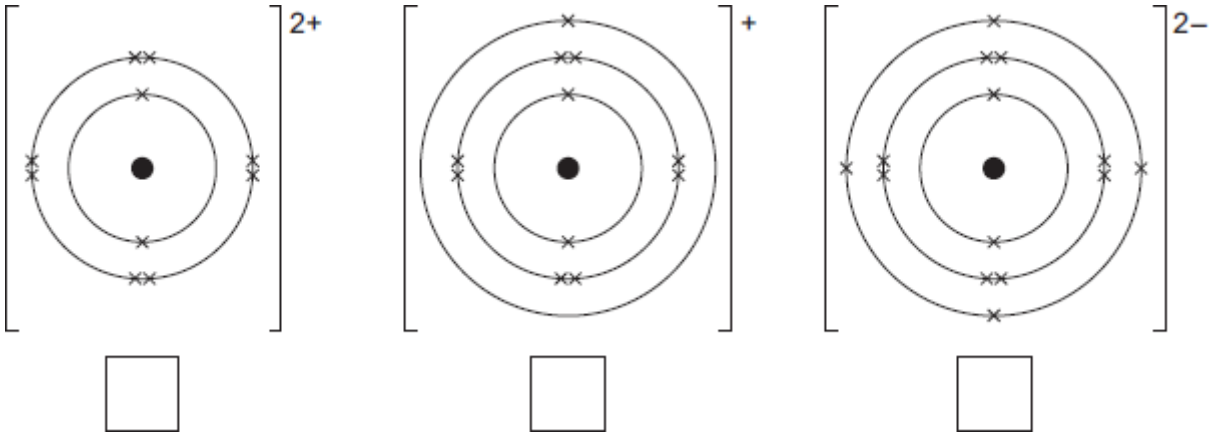
Atoms of magnesium are neutral because they contain the same number of electrons and _____ .

(3)

(ii) A magnesium atom reacts to produce a magnesium ion.

Which diagram shows a magnesium ion?

Tick (✓) **one** box.



(1)

(b) Magnesium and dilute hydrochloric acid react to produce magnesium chloride solution and hydrogen.

$$Mg(s) + 2\ HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

(i) State **two** observations that could be made during the reaction.

1. _____

2. _____

(2)

(ii) Describe a method for making pure crystals of magnesium chloride from magnesium and dilute hydrochloric acid.

In your method you should name the apparatus you will use.

You do **not** need to mention safety.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 12 marks)

Q3. Distress flares are used to attract attention in an emergency.

Flares often contain magnesium. Magnesium burns to form magnesium oxide.

(a) The distress flare burns with a bright flame because the reaction is very *exothermic*.

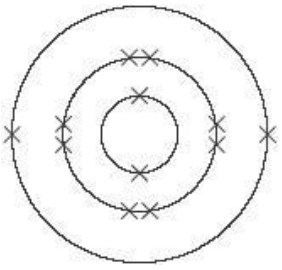
Complete the following sentence using the correct words from the box.

gives out heat	**stores heat**	**takes in heat**

An *exothermic* reaction is one which _____ .

(1)

(b) The diagram shows the electronic structure of a magnesium atom.
The atomic (proton) number of magnesium is 12.



Magnesium atom

The atomic (proton) number of oxygen is 8.

Which diagram, **A**, **B**, **C** or **D**, shows the electronic structure of an oxygen atom?

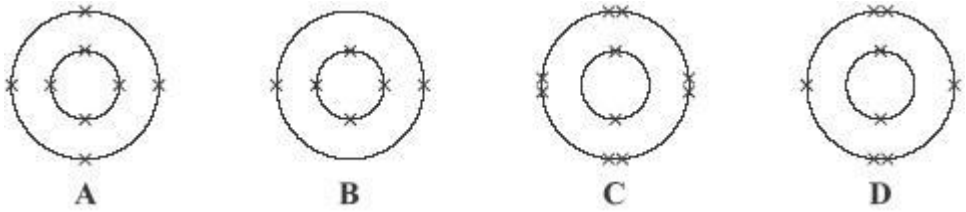
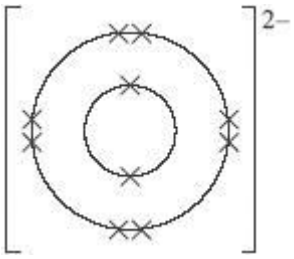


Diagram _____

(1)

(c) Magnesium ions and oxide ions are formed when magnesium reacts with oxygen. The diagram shows the electronic structure of an oxide ion.



Oxide ion

Which diagram, **J**, **K**, **L** or **M**, shows the electronic structure of a magnesium ion?

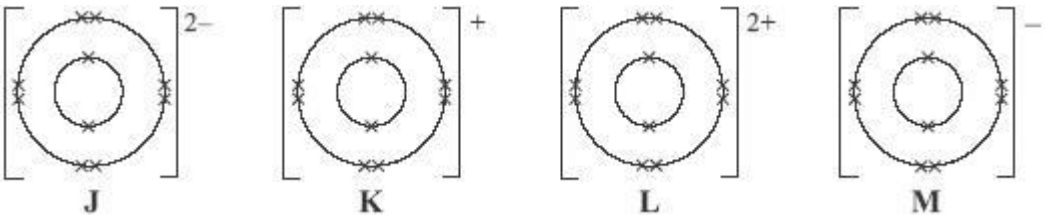


Diagram _____

(1)

(d) Indigestion tablets can be made from magnesium oxide. The magnesium oxide neutralises some of the hydrochloric acid in the stomach.

Draw a ring around the name of the salt formed when magnesium oxide reacts with hydrochloric acid.

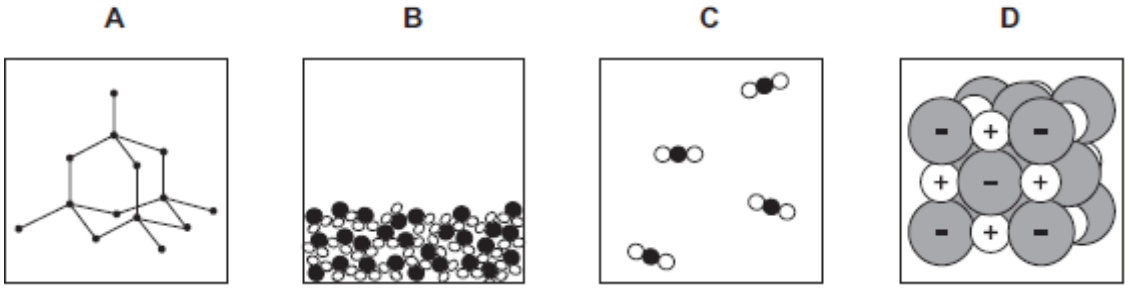
magnesium chloride **magnesium hydroxide** **magnesium sulfate**

(1)

(Total 4 marks)

Q4. The structures of four substances, **A**, **B**, **C** and **D**, are represented in **Figure 1**.

Figure 1



(a) Use the correct letter, **A**, **B**, **C** or **D**, to answer each question.

(i) Which substance is a gas?

(1)

(ii) Which substance is a liquid?

(1)

(iii) Which substance is an element?

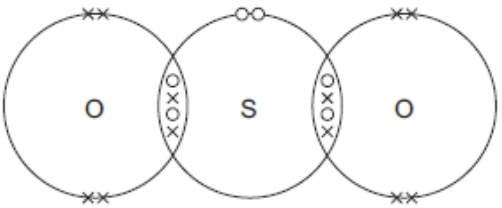
(1)

(iv) Which substance is made of ions?

(1)

(b) **Figure 2** shows the bonding in substance **C**.

Figure 2



(i) What is the formula of substance **C**?

Draw a ring around the correct answer.

SO_2 **SO^2** **S_2O**

(1)

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

delocalised	**shared**	**transferred**

When a sulfur atom and an oxygen atom bond to produce substance **C**,

electrons are _____

(1)

(iii) What is the type of bonding in substance **C**?

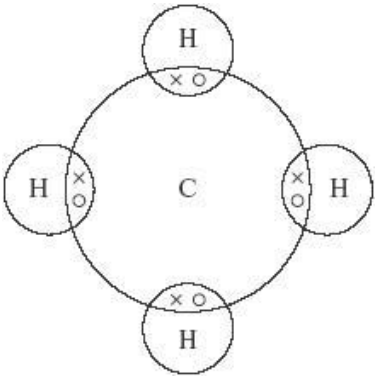
Draw a ring around the correct answer.

covalent **ionic** **metallic**

(1)

(Total 7 marks)

Q5. The diagram represents a particle of methane.



(a) What is the formula of methane? _____

(1)

(b) Choose a word from the box to answer the question.

atom	**ion**	**molecule**

Which of the words best describes the methane particle shown in the diagram?

_____

(1)

(c) Choose a word from the box to answer the question.

covalent	ionic	metallic

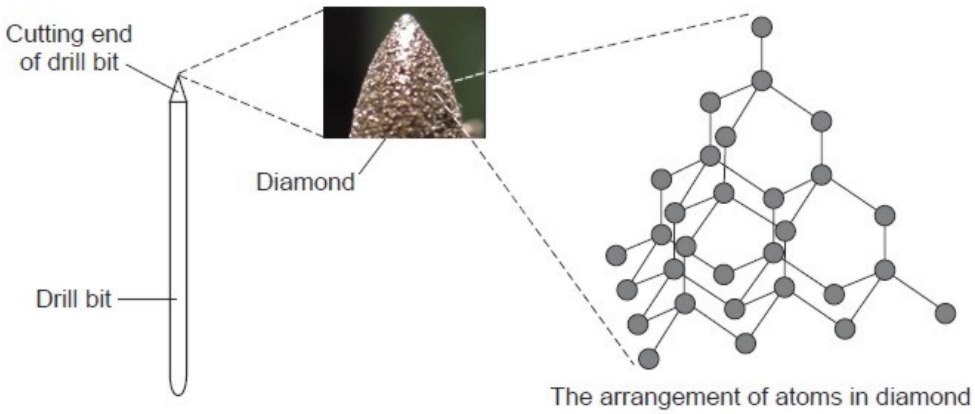
What is the type of bonding shown in the diagram?

_____

(1)

(Total 3 marks)

Q6. A drill bit is used to cut holes through materials. The cutting end of this drill bit is covered with very small diamonds.



By Wanderlinse [CC By 2.0], via Flickr

Draw a ring around the correct word in each box.

(a) Diamond is made from

carbon
nitrogen
oxygen

atoms.

(1)

(b) Diamond has a giant structure in which

none
some
all

of the atoms are joined together.

(1)

(c) The atoms in diamond are joined together by

covalent
ionic
metallic

bonds.

(1)

(d) In diamond each atom is joined to

two
three

other atoms.

four

(1)

(e) Diamond is suitable for the cutting end of a drill bit because it is

hard.

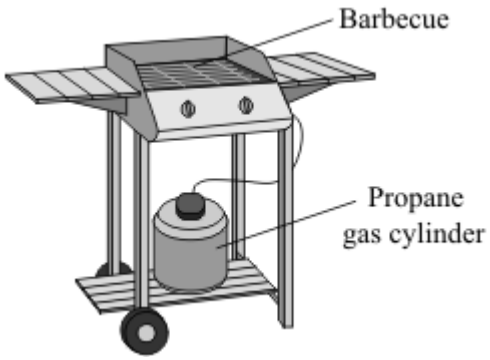
shiny.

soft

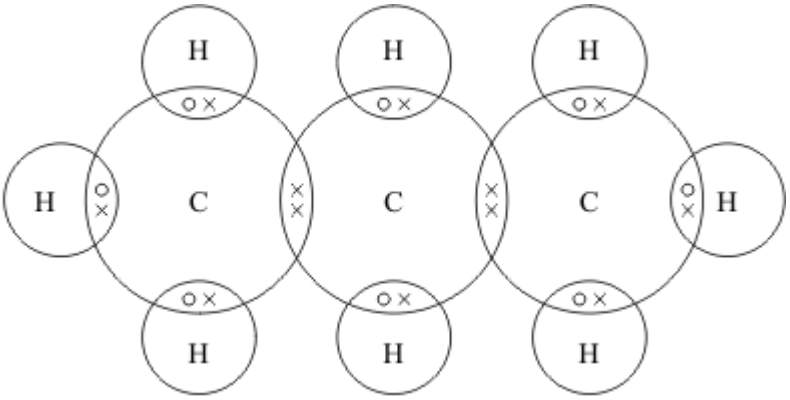
(1)

(Total 5 marks)

Q7. This barbecue burns propane gas.



The diagram represents a propane molecule.



(a) What is the formula of propane?

_____

(1)

(b) (i) Draw a ring around the name of the particle represented by the symbols ○ and × in the diagram.

electron **neutron** **proton**

(1)

(ii) Draw a ring around the type of bonding that holds the atoms together in a propane molecule.

covalent **ionic** **metallic**

(1)

(c) Under high pressure in the cylinder propane is a liquid.
Liquid propane evaporates easily to form a gas when the tap on the cylinder is opened.

Draw a ring around the correct answer in each box to explain why propane evaporates easily.

Propane has a [high / low] boiling point because it consists of [large / small] molecules.

(1)

(Total 4 marks)

Q8. Read the article and then answer the questions that follow.

Nanotennis!

Tennis balls contain air under pressure, which gives them their bounce. Normal tennis balls are changed at regular intervals during tennis matches because they slowly lose some of the air. This means that a large number of balls are needed for a tennis tournament, using up a lot of materials.

'Nanocoated' tennis balls have a 'nanosize' layer of butyl rubber. This layer slows down the escape of air so that the ball does not lose its pressure as quickly. The 'nanocoated' tennis balls last much longer and do not need to be replaced as often.

(a) How does the 'nanosize' layer make the tennis balls last longer?

_____

_____

(1)

(b) Put a tick (✓) next to the best description of a 'nanosize' layer.

Description	(✓)
A layer one atom thick.	
A layer a few hundred atoms thick.	
A layer millions of atoms thick.	

(1)

(c) Suggest why using 'nanocoated' tennis balls would be good for the environment.

_____

_____

_____

_____

_____

(2)
(Total 4 marks)

Q9. Glass is made from silicon dioxide.

© Velirina/iStock/Thinkstock

(a) Silicon dioxide has a very high melting point.

Other substances are added to silicon dioxide to make glass. Glass melts at a lower temperature than silicon dioxide.

Suggest why.

_____

_____

(1)

(b) Sodium oxide is one of the substances added to silicon dioxide to make glass.

(i) Sodium oxide contains Na^+ ions and O^{2-} ions.

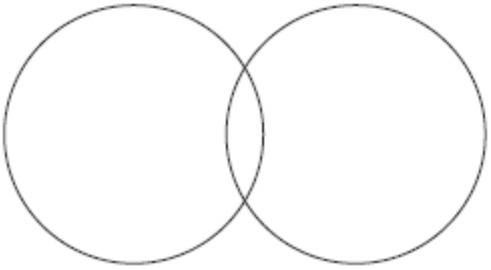
Give the formula of sodium oxide.

_____

(1)

(ii) Sodium oxide is made by heating sodium metal in oxygen gas.

Complete the diagram to show the outer electrons in an oxygen molecule (O_2).



(2)

(c) Glass can be coloured using tiny particles of gold. Gold is a metal.

Describe the structure of a metal.

_____

_____

_____

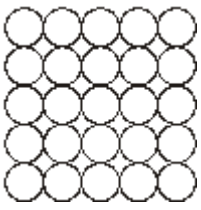
_____

(3)

(Total 7 marks)

Q10. Iron is the main structural metal used in the world.

(a) The diagram represents the particles in iron, Fe.



Draw a ring around the correct word in the box to complete the sentence.

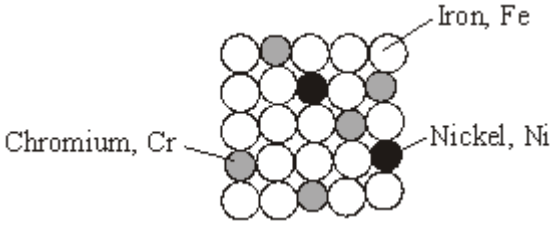
Iron is described as an element because all the | atoms / compounds | are the same.

metals

(1)

(b) Stainless steel is mostly iron.

The diagram represents the particles in stainless steel.



Use the correct words from the box to complete the sentences about alloys.

metal	**mixture**	**molecule**	**polymer**	**smart**	**structure**

Stainless steel is an alloy because it is a _____ of iron, chromium and nickel.

An alloy is made up of more than one type of _____ .

Stainless steel alloys are harder than iron because the different sized atoms added

change the _____ .

An alloy that can return to its original shape after being deformed is called a

_____ alloy.

(4)

(c) In the UK, we use about 1.8 billion steel cans every year but only 25% are recycled. Used steel cans are worth about £100 per tonne.

Recycling saves raw materials and reduces waste that would end up in landfill. Producing steel by recycling used cans saves 75% of the energy that would be needed to produce steel from iron ore. This also reduces carbon dioxide emissions.

(i) Give **two** reasons, from the information above, to explain why recycling used steel cans is a good idea.

1. _____

_____

2. _____

_____

(2)

(ii) Suggest how the local council could increase the percentage of used steel cans that are recycled.

_____

_____

(1)
(Total 8 marks)

Q11. The picture shows a wooden bowl.
The pieces of wood used for this bowl were dyed different colours.

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

The artist who made the bowl explained why he dissolved the coloured dyes in methanol.

> I use different coloured dyes dissolved in methanol.
> I use methanol because with dyes dissolved in water the wood needs to be soaked for a longer time.
> The bowl dries more quickly if I use methanol instead of water.

a) The artist uses methanol instead of water.

Give **two** reasons why.

1. _____

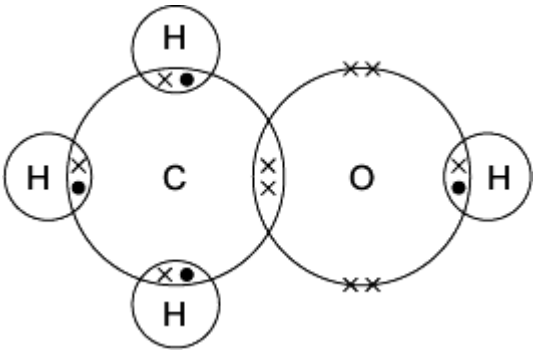
_____

2. _____

_____

(2)

(b) The diagram shows how the atoms are bonded in methanol.



Draw a ring around:

(i) the formula of methanol

CH_4O **CH^4O** **CHO_4**

(1)

(ii) the type of bonding in methanol.

covalent **ionic** **metallic**

(1)

(c) Methanol has a low boiling point.

Tick (✓) the reason why.

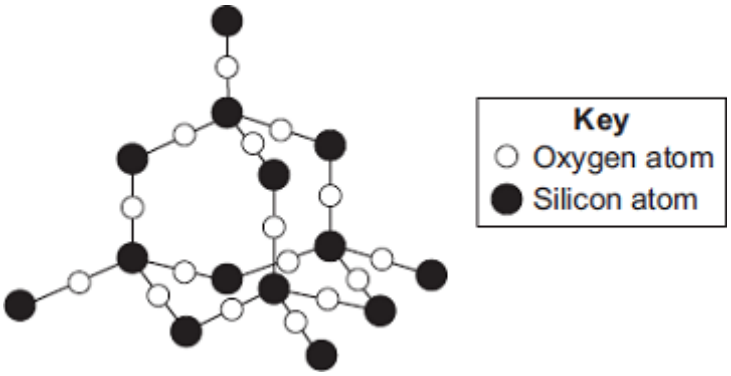
Reason why	**Tick (✓)**
It has a giant covalent structure.	
It is made of small molecules.	
It has a giant metallic structure.	

(1)
(Total 5 marks)

Q12. Silicon dioxide is used as a lining for furnaces.

Furnaces can be used to melt iron for recycling.

The diagram shows a small part of the structure of silicon dioxide.



Explain why silicon dioxide is a suitable material for lining furnaces.

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Q13. This question is about the properties and uses of materials.

Use your knowledge of structure and bonding to answer the questions.

(a) Explain how copper conducts electricity.

_____

_____

_____

_____

_____

(2)

(b) Explain why diamond is hard.

_____

_____

_____

_____

_____

(2)

(c) Explain why thermosetting polymers are better than thermosoftening polymers for saucepan handles.

_____

_____

_____

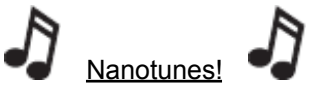
_____

_____

(2)

(Total 6 marks)

Q14. The article gives some information about graphene.



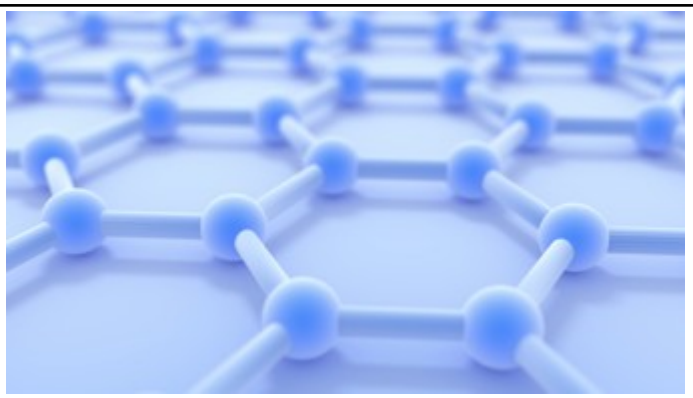
Nanotunes!

Carbon can be made into nano-thin, strong sheets called graphene.

A graphene sheet is a single layer of graphite.

Graphene conducts electricity and is used in loudspeakers.

The picture shows the structure of graphene.



© 7immy/iStock

(a) Use the picture and your knowledge of bonding in graphite to:

(i) explain why graphene is strong;

_____

_____

_____

_____

_____

_____

(3)

(ii) explain why graphene can conduct electricity.

_____

_____

_____

_____

_____

_____

(2)

(b) Graphite is made up of layers of graphene.

Explain why graphite is a lubricant.

_____

_____

_____

_____

(2)

(Total 7 marks)

Mark schemes

Q1.

(a) (i) 7 / seven

1

(ii) 1

*do **not** accept –1*

1

Electron

1

(iii) isotopes

1

(b) (i) (sodium +) fluorine → sodium fluoride

1

(ii) compounds

1

(iii) mole

1

(iv) sodium (atom) loses

1

fluorine (atom) gains

1

one electron

1

ions formed

1

*allow sodium forms positive (ion) **or** fluorine forms negative (ion)*

allow form ionic bond

allow to gain a full outer shell of electrons

allow forms noble gas structure

***max 3** if reference to incorrect particle / bonding*

(v) Dissolve in water

1

High melting point

1

[13]

Q2.

(a) (i) neutrons

this order only

1

electrons

1

protons

1

(ii) box on the left ticked

1

(b) (i) effervescence / bubbling / fizzing / bubbles of gas

*do **not** accept just gas alone*

1

magnesium gets smaller / disappears

allow magnesium dissolves

*allow gets hotter **or** steam produced*

ignore references to magnesium moving and floating / sinking and incorrectly named gases.

1

(ii) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best–fit' approach to the marking.

0 marks
No relevant content

Level 1 (1−2 marks)
There are simple statements of some of the steps in a procedure for obtaining magnesium chloride.

Level 2 (3−4 marks)
There is a description of a laboratory procedure for obtaining magnesium chloride from dilute hydrochloric acid and magnesium.

The answer must include a way of ensuring the hydrochloric acid is fully reacted **or** a method of obtaining magnesium chloride crystals.

Level 3 (5−6 marks)
There is a well organised description of a laboratory procedure for obtaining magnesium chloride that can be followed by another person.

The answer must include a way of ensuring the hydrochloric acid is fully reacted **and** a method of obtaining magnesium chloride crystals.

examples of the points made in the response:

- hydrochloric acid in beaker (or similar)
- add small pieces of magnesium ribbon
- until magnesium is in excess or until no more effervescence occurs *
- filter using filter paper and funnel
- filter excess magnesium
- pour solution into evaporating basin / dish
- heat using Bunsen burner
- leave to crystallise / leave for water to evaporate / boil off water
- decant solution
- pat dry (using filter paper).

*Student may choose to use a named indicator until it turns a neutral colour, record the number of pieces of magnesium added then repeat without the indicator.

6

[12]

Q3.

(a) gives out (heat)

1

(b) D

1

(c) L

1

(d) magnesium chloride

1

[4]

Q4.

(a) (i) C

1

(ii) B

1

(iii) A

1

(iv) D

1

(b) (i) SO_2

1

(ii) shared

1

(iii) covalent

1

[7]

Q5.

(a) CH_4

4 should be below halfway up H / tail of 4 below the dotted line

1

(b) molecule

1

(c) covalent

1

[3]

Q6.

(a) carbon

1

(b) all

1

(c) covalent

1

(d) four

1

(e) hard

1

[5]

Q7.

(a) C_3H_8

capital letters for symbols numbers must be halfway or lower down the element symbol

allow H_8C_3

*do **not** allow 3:8 **or** C_3 and H_8*

1

(b) (i) electron

1

(ii) covalent

1

(c) low **and** small

*both for **1** mark*

1

[4]

Q8.

(a) Stops / reduces air from escaping (owtte)

*allow keeping shape **or** keeping it hard*

1

(b) a layer a few hundred atoms thick

1

(c) any **two** from:

- last longer
- use fewer balls
- less materials **or** save resources
- less manufactured

  accept less factories
- less energy

- less fuel
- less pollution / greenhouse effect / global warming
- less waste

ignore references to cost / recycling
*any **two** ideas*

2

[4]

Q9.

(a) *weaker bonds*

allow (other substances) react with the silicon dioxide

or

fewer bonds

ignore weaker / fewer forces

or

disruption to lattice

*do **not** accept reference to intermolecular forces / bonds*

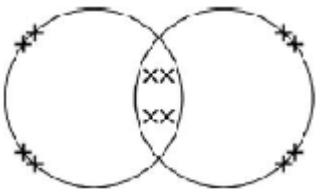
1

(b) (i) Na_2O

*do **not** accept brackets or charges in the formula*

1

(ii)



electrons can be shown as dots, crosses, e or any combination

2 bonding pairs

accept 4 electrons within the overlap

1

2 lone pairs on each oxygen

accept 4 non-bonding electrons on each oxygen

1

(c) *lattice / regular pattern / layers / giant structure / close-packed arrangement*

1

(of) positive ions **or** (of) atoms

1

(with) delocalised / free electrons

*reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max **2***

1

[7]

Q10.

(a) atoms

1

(b) mixture

1

metal

1

structure

1

smart

1

(c) (i) any **two** from:

- saves raw materials / iron ore
- saves energy / fuels
  accept cheaper / saves money
- make new / useful items
- make money / it is economic
- <u>reduces</u> pollution
  allow less harmful for the environment
- decreases cost of steel cans
- reduces carbon dioxide emissions
- decreases waste materials / use of landfill

2

(ii) any **one** from:

- provide information / education of the need to recycle
- legislate against / charge for waste
- reward / pay people to recycle
  accept fine people for not recycling
- put labels on the cans
- provide recycling bags / bins / areas

1

[8]

Q11.

(a) any **two** from

assume it = methanol

allow converse for water

- shorter / quicker soaking time

  allow it is quicker

- takes less time / quicker to dry

  or faster evaporation

- dissolves quicker / better in methanol

2

(b) (i) CH_4O

1

(ii) covalent

1

(c) it is made of small molecules

1

[5]

Q12.

high melting point

*reference to incorrect bonding **or** incorrect particles **or** incorrect structure = max **3***

accept will not melt (at high temperatures)
ignore withstand high temperatures

1

because a lot of energy needed to break bonds

1

because it is covalent **or** has strong bonds

accept bonds are hard to break

1

and because it is a giant structure **or** a macromolecule **or** a lattice

ignore many bonds

1

[4]

Q13.

(a) has delocalised electrons

accept free (moving) electrons

1

(so electrons) can move through the structure/metal

accept (so electrons) can carry charge through the structure/metal

accept (so electrons) can form a current

1

reference to incorrect particles ***or*** *incorrect bonding* ***or*** *incorrect structure* = ***max 1***

(b) giant structure

accept lattice

accept each atom forms four bonds (with other carbon atoms)

ignore macromolecular

1

strong bonds

accept covalent

do ***not*** *accept ionic*

1

reference to intermolecular forces/bonds ***or*** *incorrect particles* = ***max 1***

(c) thermosetting polymers do not melt (when heated)

accept thermosetting polymers do not change shape (when heated)

accept thermosetting polymers have high(er) melting points

ignore thermosetting polymers do not soften (when heated)

1

due to cross-links (between chains)

accept due to bonds between chains

1

reference to smart polymers = ***max 1***

accept converse argument

[6]

Q14.

(a) (i) giant lattice

allow each carbon atom is joined to three others

1

atoms in graphene are covalently bonded

max. ***2*** *marks if any reference to wrong type of bonding*

1

and covalent bonds are strong **or** need a lot of energy to be broken

allow difficult to break

1

(ii) because graphene has delocalised electrons

allow each carbon atom has one free electron

1

which can move throughout the structure

do ***not*** *accept just electrons can move.*

1

(b) because there are weak forces between molecules

allow no <u>bonds</u> between the layers

1

so layers / molecules can slip / slide.

1

[7]