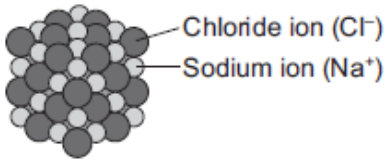
Q1. **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Explain why chlorine (Cl_2) is a gas at room temperature, but sodium chloride (NaCl) is a solid at room temperature.

Chlorine

Cl — Cl

Sodium chloride



Include a description of the bonding and structure of chlorine and sodium chloride in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Extra space .....

.....

.....

.....

.....

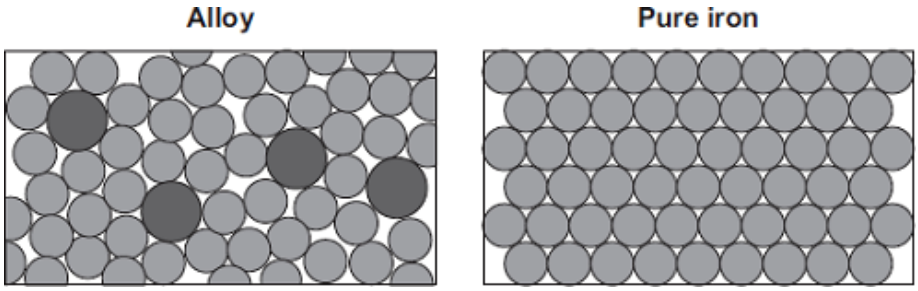
(Total 6 marks)

Q2. Oil rigs are used to drill for crude oil.

© Digital Vision/Photodisc

(a) Drills are made from an alloy of iron.

The diagrams show the particles in the alloy and in pure iron.



Use the diagrams to explain why the alloy is harder than pure iron.

.....

.....

.....

.....

(2)

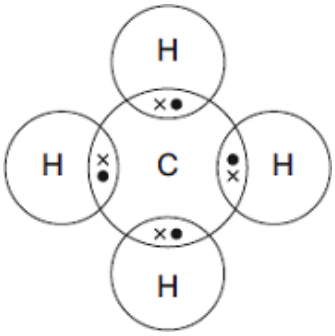
(b) Drill heads contain diamonds.

Tick (✓) **two** reasons why diamonds are hard.

Reason	Tick (✓)
Diamonds have a giant covalent structure.	
Diamonds have high melting points.	
Diamonds are unreactive.	
Diamonds have strong bonds between carbon atoms.	

(2)

(c) Methane gas is often found where crude oil is found.
The diagram shows how atoms bond in methane.
Only the outer electrons are shown.



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

Methane is

a compound.
an element.
a mixture.

(1)

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

The formula of methane is

C_4H_4
C_4H
CH_4

(1)

(iii) Name the type of bond between the carbon and hydrogen atoms in methane.

.....

(1)

(d) Explain why methane is a gas at 20°C.

.....

.....

.....

.....

(2)
(Total 9 marks)

Q3. (a) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The salt called potassium chloride is made when potassium hydroxide solution reacts with hydrochloric acid.

potassium hydroxide solution + hydrochloric acid → potassium chloride solution + water

Describe a method for making **crystals** of potassium chloride from potassium hydroxide solution and hydrochloric acid.

In this method you should:

- describe how you will add the correct amount of the hydrochloric acid to neutralise the potassium hydroxide solution
- describe how you will get crystals of potassium chloride.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)

(b) Ammonium nitrate is another salt.
Ammonium nitrate is made when ammonia solution is neutralised with an acid.

Name the acid to complete the word equation.

ammonia + ... acid → ammonium nitrate

(1)

(c) Read the information.

Ammonium nitrate – good or bad?

Some farmers put a lot of ammonium nitrate on their farmland.

Many people are worried about this use of ammonium nitrate.

Rain water can wash the ammonium nitrate off the farmland and into rivers and lakes. The ammonium nitrate may get into drinking water supplies and could be harmful to health.

(i) Why do some farmers put ammonium nitrate on their farmland?

.....

.....

(1)

(ii) Which **one** of the questions in the table cannot be answered by science alone?

Tick (✓) **one** question.

Question	Tick (✓)
How much ammonium nitrate is in drinking water?	
Should farmers stop using ammonium nitrate on their farmland?	
Is ammonium nitrate soluble in rain water?	

Give **two** reasons why this question **cannot** be answered by science alone.

.....

.....

.....

.....

(3)

(Total 11 marks)

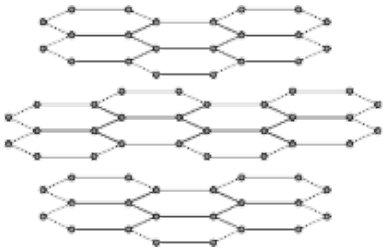
Q4. Read the information

Graphene

Scientists have made a new substance called graphene.
The bonding and structure of graphene are similar to graphite.

Graphene is made of a single layer of the same atoms as graphite.

Graphene



Graphite

Use the information above and your knowledge of graphite to answer the questions.

(a) This part of the question is about graphene.

Choose the correct answer to complete each sentence.

(i)

ionic	**covalent**	**metallic**

The bonds between the atoms in graphene are .....

(1)

(ii)

chromium	**carbon**	**chlorine**

Graphene is made of ..... atoms.

(1)

(iii)

2	**3**	**4**

In graphene each atom bonds to ..... other atoms.

(1)

(b) This part of the question is about graphite.

Graphite is used in pencils.

Explain why. Use the diagrams to help you.

.....

.....

.....

.....

(2)
(Total 5 marks)

Q5. Gold and gold ions are used as catalysts.

(a) An atom of gold is represented as:

$$^{197}_{79}Au$$

Complete the sentences.

The atomic number of gold is .....

The number of electrons in an atom of gold is .....

(2)

(b) Scientists have found that gold nanoparticles are very good catalysts.

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

A gold nanoparticle contains a few | hundred / thousand / million | atoms.

(1)

(c) The formation of a gold ion (Au^{3+}) from a gold atom (Au) is shown in the symbol equation.

$$Au \rightarrow Au^{3+} + 3e^-$$

(i) Complete the sentence.

The particles lost when a gold atom becomes a gold ion

are called .....

(1)

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

The number of these particles lost when a gold atom becomes a gold ion is

one.
two.
three.

(1)

(d) Gold ions are used as a catalyst in the reaction to make chloroethene.

How does a catalyst help a reaction?

.....

(1)

(e) Chloroethene can react to make a thermosoftening polymer.

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

When heated, a thermosoftening polymer will

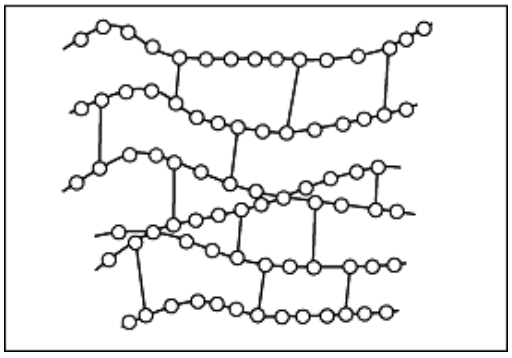
dissolve.
melt.
solidify.

(1)

(ii) Polymer **B** is a different type of polymer.

The diagram shows the structure of polymer **B**.

Polymer B



How can you tell from the diagram that polymer **B** is **not** thermosoftening?

.....

.....

(1)

(Total 8 marks)

Q6. (a) The symbol equation for the decomposition of hydrogen peroxide is:

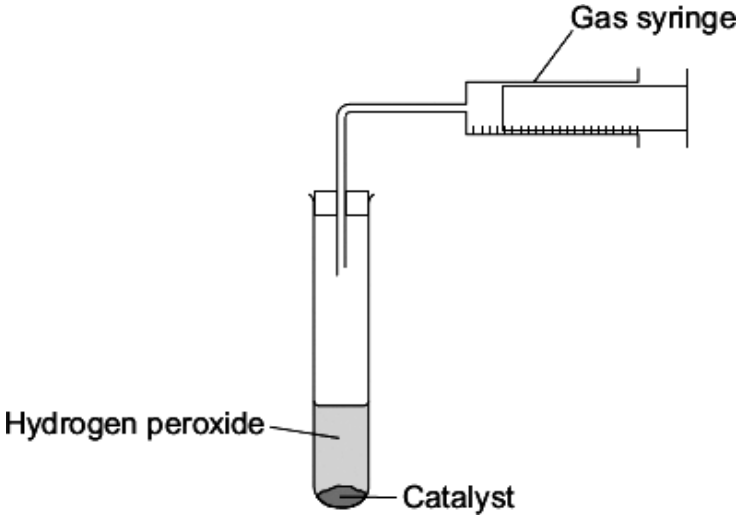
$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Complete the word equation for the decomposition of hydrogen peroxide.

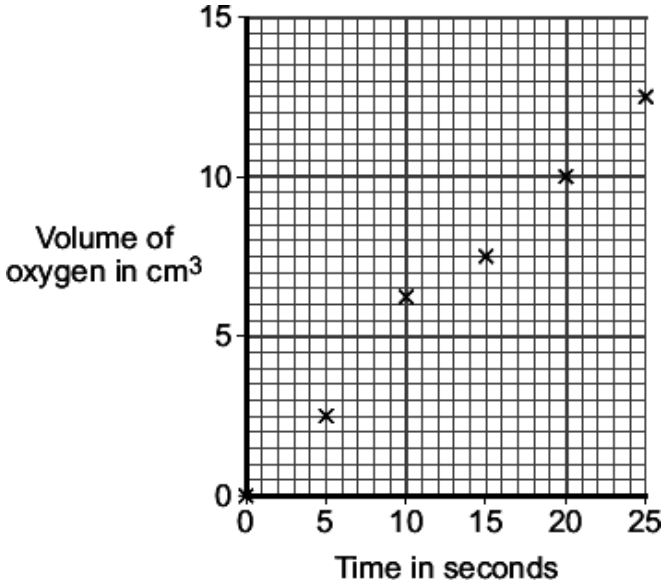
Hydrogen peroxide → ..... + ...

(1)

(b) A student did an experiment to see how quickly hydrogen peroxide decomposes. The student used the apparatus shown below to measure the volume of oxygen.



(i) Draw a straight line of best fit to complete the graph.



(1)

(ii) Draw a circle around the anomalous point on the graph.

(1)

(iii) What is the volume of oxygen given off after 15 seconds?

..... cm^3

(1)

(iv) How did the volume of oxygen change between 0 and 25 seconds?

.....

(1)

(c) The student wanted to make the reaction faster.

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

(i) To make the reaction faster, the temperature should be

higher.

lower.

the same.

(1)

(ii) To make the reaction faster, the hydrogen peroxide should be

more dilute.

more concentrated.

the same.

(1)

(d) The diagram represents the bonding in oxygen.

O=O

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

(i) When two oxygen atoms bond, the atoms

share

transfer

delocalise

electrons.

(1)

(ii) The oxygen atoms are joined by

ionic

metallic

covalent

bonds.

(1)

(iii) Oxygen is made of

simple molecules.

a giant lattice.

macromolecules.

(1)

(e) When hydrogen peroxide decomposes water is produced.
Which **two** statements in the table explain why water is a liquid at room temperature?

Tick (✓) the **two** statements.

Statement	Tick (✓)
Water has a boiling point of 100 °C.	
Water is made of ions.	
Water has a melting point lower than room temperature.	
Water has a giant covalent structure.	

(2)
(Total 12 marks)

Q7. This question is about the planet Mars.

© Tristan3D/Shutterstock

(a) Mars is a red colour in the sky at night.

The red colour of Mars is because of iron oxide.

Iron oxide is an ionic compound.

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

Ionic compounds are made of

giant lattices.

polymer chains.

simple molecules.

(1)

(b) Many spacecraft have been sent to Mars. Parts of these spacecraft are made from polymers.

(i) Polymers that behave like shape memory alloys are used in spacecraft.

The shape memory polymers are cooled and compressed. These polymers are stored on the spacecraft until needed.

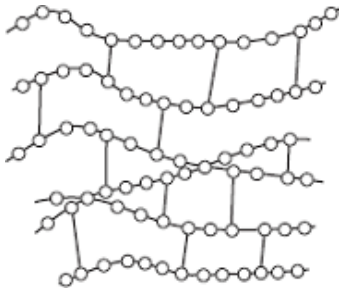
Suggest how the polymers could be made to return to their original shape.

.....

(1)

(ii) Thermosetting polymers are used for the tiles on the outside of spacecraft.

The diagram shows the structure of a thermosetting polymer.



Explain, in terms of structure, why some polymers are thermosetting.

.....

.....

.....

.....

(2)

(c) Instrumental methods such as GC−MS are used to analyse substances found on Mars.

In GC−MS, gas chromatography columns are linked to mass spectrometers.

(i) What does gas chromatography do to the substances?

.....

.....

(1)

(ii) Give **two** reasons for using instrumental methods for analysis.

1 .....

.....

2 .....

.....

(2)

(Total 7 marks)

M1. Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.

0 marks
No relevant content

Level 1 (1–2 marks)
*There is a statement about the bonding and / or structure **or** melting / boiling point of chlorine **or** sodium chloride.*

Level 2 (3–4 marks)
*There are statements about the bonding and / or structure of chlorine **or** sodium chloride.*

Level 3 (5–6 marks)
*There are statements about the bonding and / or structure of chlorine **and** sodium chloride.*

*There is an explanation of why chlorine is a gas **or** sodium chloride is a solid.*

Examples of chemistry points made in response:

Chlorine:

covalent bonds between atoms

forming (simple) molecules

no / weak attraction / bonds between molecules

low boiling point

Sodium chloride:

*ionic bonds **or** electrostatic attraction*

strong bonds

in all directions

between oppositely charged ions

forming giant lattice

large amounts of energy needed to break bonds

high melting point

[6]

M2. (a) (alloy) atoms / ions / particles not in layers
accept layers are distorted
accept different (size) particles / atoms

1

so, (alloy) layers / atoms / ions / particles can't slide
*if no other mark awarded allow (an alloy) is a mixture of metals for **1** mark*

1

(b) diamonds have a giant covalent structure

1

diamonds have strong bonds between carbon atoms

1

(c) (i) a compound

1

(ii) CH_4

1

(iii) covalent

1

(d) methane has a low boiling point
or boiling point less than 20°C molecules

1

because it has small molecules

accept it has forces between molecules

*accept weak forces between molecules for **2** marks*

1

[9]

M3. (a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)
There is a simple description of a laboratory procedure for obtaining potassium chloride.

Level 2 (3-4 marks)
There is a clear description of a laboratory procedure for obtaining potassium chloride from potassium hydroxide solution and hydrochloric acid that does not necessarily allow the procedure to be completed successfully by another person. The answer must include the use of an indicator or a method of obtaining crystals.

Level 3 (5-6 marks)
There is a detailed description of a laboratory procedure for obtaining potassium chloride from potassium hydroxide solution and hydrochloric acid that can be followed by another person. The answer must include the use of an indicator and a method of obtaining crystals.

examples of the chemistry/social points made in the response:

- One reagent in beaker (or similar)
- Add (any named) indicator
- Add other reagent
- Swirl or mix
- Add dropwise near end point
- Stop addition at change of indicator colour
- Note volume of reagent added
- Repeat without indicator, adding same volume of reagent **or** remove indicator using charcoal
- Pour solution into basin / dish
- Heat (using Bunsen burner)
- Leave to crystallise / leave for water to evaporate / boil off water

Accept any answers based on titration

6

(b) nitric (acid)

allow HNO_3

ignore incorrect formula

1

(c) (i) because it is a fertiliser / helps plants grow

allow plant food

*do **not** accept pesticide / herbicide / neutralising soil*

1

(ii) tick by: 'Should farmers stop using ammonium nitrate on their land?'

1

any **two** from:

- cannot be done by experiment
  accept difficult to get / not enough evidence
- based on opinion / view
  allow must be done by survey
- ethical **or** economic issue
  *if top box ticked allow **1** mark for drinking water varies from place to place*

2

[11]

M4. (a) (i) covalent

*two different answers indicated gains **0** marks*

1

(ii) carbon

*two different answers indicated gains **0** marks*

1

(iii) 3

*two different answers indicated gains **0** marks*

1

(b) layers can slide / slip

1

because there are no bonds between layers

accept because weak forces / bonds between layers

or so (pieces of) graphite rubs / breaks off

or graphite left on the paper

1

[5]

M5. (a) 79

1

79

1

(b) hundred

1

(c) (i) electron(s)

1

(ii) three

1

(d) changes rate of reaction

accept lowers activation energy

or

speeds up / slows down reaction

accept reduces costs

1

(e) (i) melt

1

(ii) crosslinking

allow answers on diagram

or

(covalent) bonds between polymers / chains

allow bonds between layers
*do **not** allow intermolecular*

1

[8]

M6. (a) oxygen **and** water

both needed for mark
allow hydrogen oxide for water
in any order
ignore formulae

1

(b) (i) best fit line, omitting point at 10s

straight line drawn through all correct points

1

(ii) circle around point at 10 s

allow any indication

1

(iii) 7.5

allow ecf from candidate's line

1

(iv) increases (with time)

accept goes from 0 to 12.5

1

(c) (i) higher

1

(ii) more concentrated

1

(d) (i) share

1

(ii) covalent

1

(iii) simple molecules

1

(e) Water has a boiling point of 100°C

1

Water has a melting point lower than room temperature

1

[12]

M7. (a) giant lattices

1

(b) (i) heat / warm / increase the temperature

allow reduce pressure

do not accept melt

1

(ii) (polymer) chains cannot slide

1

because they have cross-links

if no other mark awarded allow

*polymers do not melt for **1** mark*

1

(c) (i) separates (substances)

1

(ii) any **two** from:

ignore reliable / precise / efficient

ignore references to cost

- quick / rapid
- accurate
- can detect small quantities / sensitive

2

[7]