

Name: _____

Bonding, Structure & Properties part 4 AQA Triple Chemistry

Date: _____

Time: **67 minutes**

Marks: **67 marks**

Comments:

1.

Kelp is a seaweed.

Kelp can be used in foods and as a renewable energy source.



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(a) Scientific experiments, on their own, **cannot** fully answer one of the following questions. Which one?

Tick (✓) **one** box.

Questions	Tick (✓)
How much carbon dioxide is produced when 100 g of kelp is burned?	
Does kelp give out more heat energy than coal?	
Will kelp last longer than coal as an energy source?	
Which fuel, kelp or coal, produces the most ash when burned?	

(1)

(b) Scientists cannot answer the question ‘should people use kelp instead of coal as an energy source?’

Give **two** reasons why.

(2)

(c) Sodium iodide can be produced from kelp.

(i) How many electrons are in the outer shell of an iodine atom?

(1)

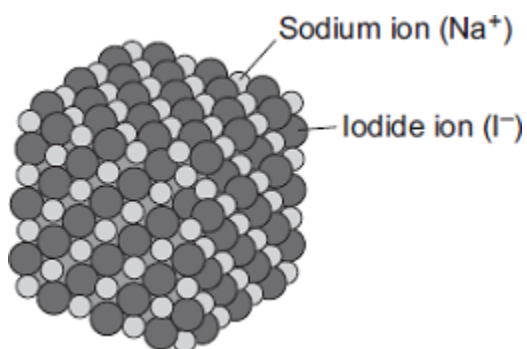
(ii) Sodium iodide contains sodium ions (Na^+) and iodide ions (I^-).

Describe, as fully as you can, what happens when sodium atoms react with iodine atoms to produce sodium iodide.

You may use a diagram in your answer

(3)

(iii) The diagram shows the structure of sodium iodide.



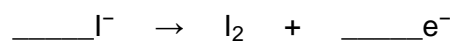
Solid sodium iodide does not conduct electricity.

Why does sodium iodide solution conduct electricity?

(1)

(iv) When sodium iodide solution is electrolysed, iodine is formed at the positive electrode.

Complete and balance the half equation for the formation of iodine.



(1)

(v) What is formed at the negative electrode when sodium iodide solution is electrolysed?

Explain why.

(2)

(Total 11 marks)

2.

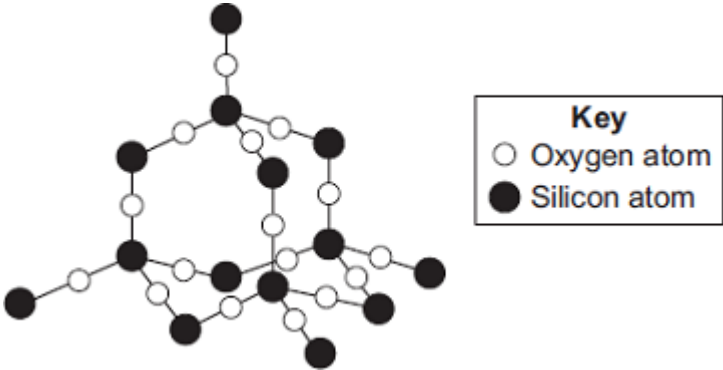
Silicon dioxide is used as a lining for furnaces.

Furnaces can be used to melt iron for recycling.



© Oleksiy Mark/iStock

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)

3.

Read the article and then answer the questions.

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.



© Feng Yu/iStock

'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) Tick (✓) the best description of a 'nanosize' layer.

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

(1)

(b) Suggest **two** ways in which using 'nanocoated' tennis balls would be good for the environment.

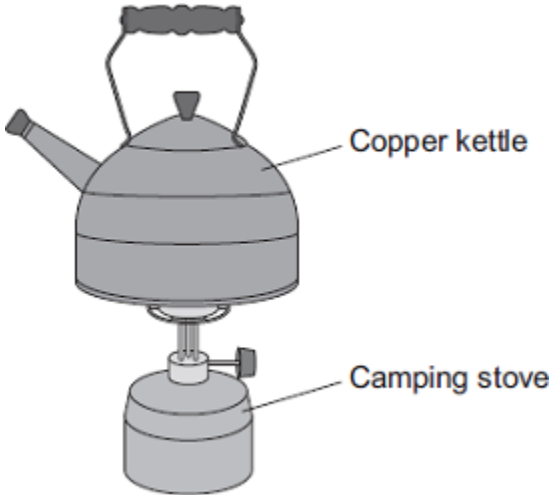
(2)
(Total 3 marks)

4.

The picture shows a copper kettle being heated on a camping stove.

Copper is a good material for making a kettle because:

- it has a high melting point
- it is a very good conductor of heat.



(a) Explain why copper, like many other metals, has a high melting point.

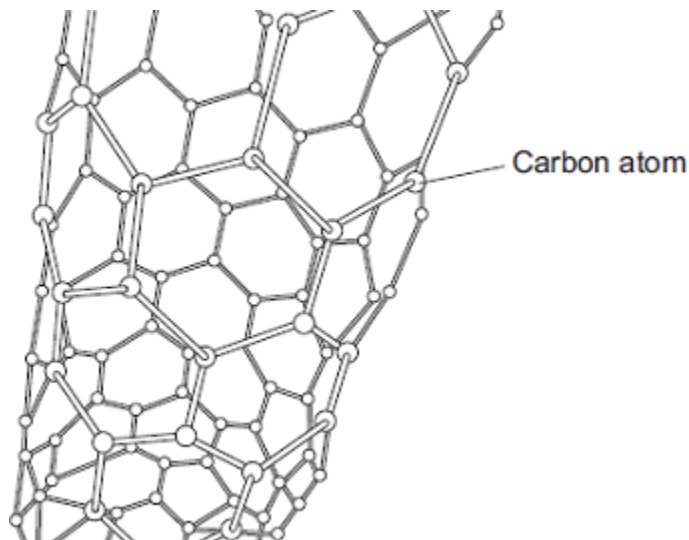
Your answer should describe the structure and bonding of a metal.

(4)

- (b) Aeroplanes contain many miles of electrical wiring made from copper. This adds to the mass of the aeroplane.

It has been suggested that the electrical wiring made from copper could be replaced by carbon nanotubes which are less dense than copper.

The diagram shows the structure of a carbon nanotube.



- (i) What does the term 'nano' tell you about the carbon nanotubes?

(1)

- (ii) Like graphite, each carbon atom in the carbon nanotube is joined to three other carbon atoms.

Explain why the carbon nanotube can conduct electricity.

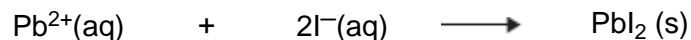
(2)

(Total 7 marks)

5.

This question is about some compounds made from iodine.

- (a) Lead iodide can be made by mixing a solution containing lead ions with a solution containing iodide ions. Lead iodide is formed as a precipitate.



The table below gives information about the solubility of some compounds.

Soluble compounds	Insoluble compounds
All sodium and potassium salts	
All nitrates	
Most chlorides, bromides and iodides	Silver and lead chlorides, bromides and iodides

Use the table to help you to name:

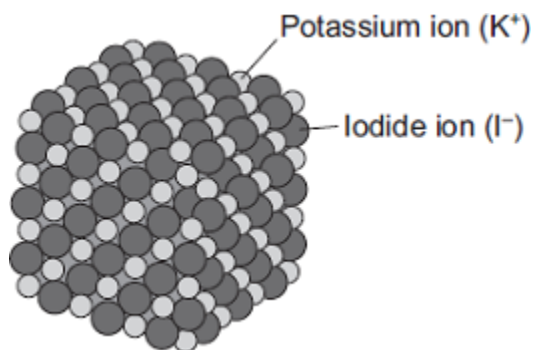
- (i) A soluble compound which contains lead ions _____

(1)

- (ii) A soluble compound which contains iodide ions

(1)

(c) The diagram shows the structure of potassium iodide.

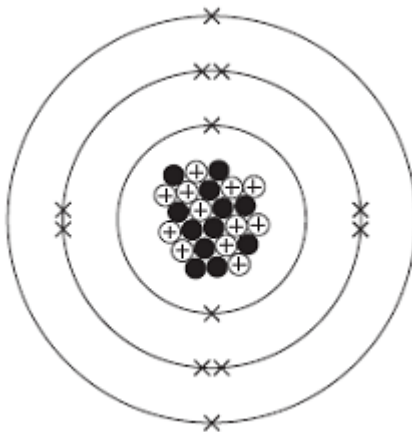


Explain why a high temperature is needed to melt potassium iodide.

(3)
(Total 9 marks)

6.

The diagram represents a magnesium atom.



(a) Use words from the box to answer these questions.

electron	neutron	nucleus	proton
----------	---------	---------	--------

(i) What is the name of the central part of the atom? _____

(1)

(ii) What is the name of the particle with no charge? _____

(1)

(iii) What is the name of the particle with a negative charge? _____

(1)

(b) Use the diagram above to help you answer these questions.

(i) Draw a ring around the atomic (proton) number of this magnesium atom.

12

24

36

(1)

(ii) Draw a ring around the mass number of this magnesium atom.

12

24

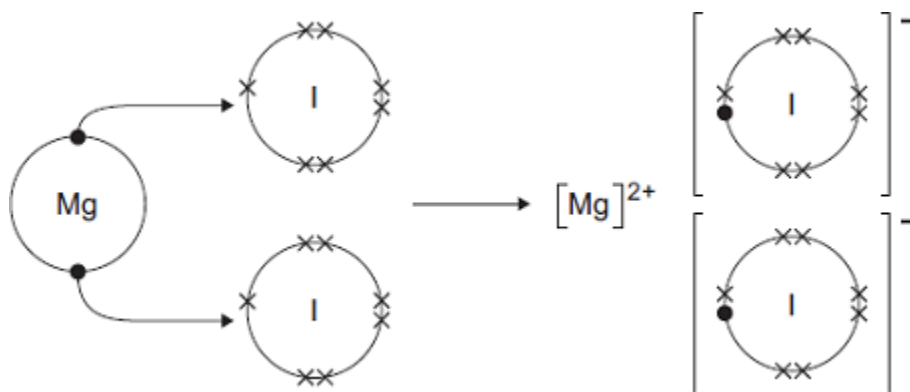
36

(1)

(c) The diagram shows how magnesium and iodine atoms form magnesium iodide.

Only the outer electrons are shown.

The dots (●) and crosses (×) are used to represent electrons.



Use the diagram to help you to answer this question.

Describe, as fully as you can, what happens when magnesium reacts with iodine to make magnesium iodide.

To gain full marks you should use the words atom, electron and ion in your answer.

(4)
(Total 9 marks)

7. This question is about alloys.

Bronze and brass are both alloys which contain copper.

(a) Bronze is an alloy of copper and one other metal.

What is the other metal in bronze?

Tick (✓) **one** box.

Aluminium

Tin

Zinc

(1)

(b) Give **one** use of brass.

(1)

Alloys of gold are used to make jewellery.

(c) The proportion of gold in an alloy is measured in carats:

- pure gold is 24 carat
- 50% gold is 12 carat.

The table below shows information about two gold rings, **A** and **B**.

A and **B** contain only gold and silver.

Complete below the table below.

Gold ring	Carat	Mass of metal in grams	
		gold	silver
A		7	7
B	18	9	

(2)

(d) Suggest **two** reasons why alloys of gold are used instead of pure gold to make jewellery.

1 _____

2 _____

(2)

Steels are alloys of iron.

(e) Spoons are made of stainless steel.

Spoons:

- are washed after use
- must not wear away quickly.

Suggest **one** reason why stainless steel is suitable for making spoons.

(1)

(f) Steel horseshoes are shaped to fit the feet of horses.

Which type of steel is most easily shaped into horseshoes?

Tick (✓) **one** box.

High carbon steel

Low carbon steel

Stainless steel

(1)

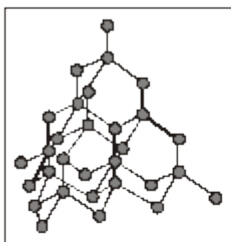
(Total 8 marks)

8.

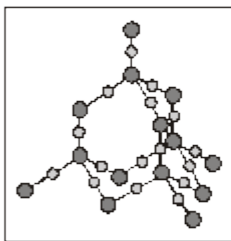
This question is about giant structures. Diamond, graphite and silicon dioxide all have giant structures.

(a) The diagrams show the structures of these three substances.

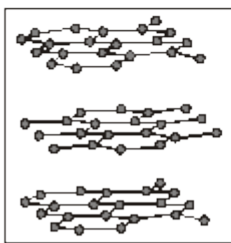
Draw a line from each structure to its name.



Silicon dioxide



Graphite



Diamond

(2)

(b) Complete the sentences using words from the box.

covalent

four

hard

ionic

shiny

soft

three

two

(i) Diamond, graphite and silicon dioxide have high melting points because all the atoms in their structures are joined by strong _____ bonds.

(1)

(ii) In diamond each atom is joined to _____ other atoms.

(1)

(iii) Diamond can be used to make cutting tools because it has a rigid structure which makes it very _____ (1)

(iv) In graphite each atom is joined to _____ other atoms. (1)

(v) Graphite can be used to make pencils because it has a structure which makes it _____ (1)

(c) When a diamond is heated to a high temperature and then placed in pure oxygen it burns. Carbon dioxide is the only product.

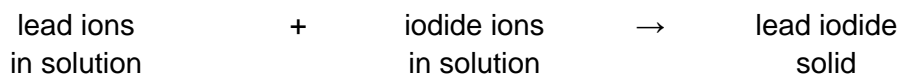
Name the element in diamond. _____ (1)

(Total 8 marks)

9. This question is about lead iodide and magnesium iodide.

(a) Lead iodide can be made by mixing a solution containing lead ions with a solution containing iodide ions.

Lead iodide is formed as a solid.



(i) Draw a ring around the name given to this type of reaction.

electrolysis

neutralisation

precipitation

(1)

(ii) Tick (✓) the method used to separate solid lead iodide from the solution.

Method	Tick (✓)
distillation	
evaporation	
filtration	

(1)

(iii) The table below gives information about the solubility of some compounds.

Soluble compounds	Insoluble compounds
all sodium and potassium salts	
all nitrates	
most chlorides, bromides and iodides	silver and lead chlorides, bromides and iodides

Use the table to help you to:

draw a ring around a soluble compound which contains lead ions

lead bromide

lead chloride

lead nitrate

draw a ring around a soluble compound which contains iodide ions.

lead iodide

silver iodide

sodium iodide

(2)

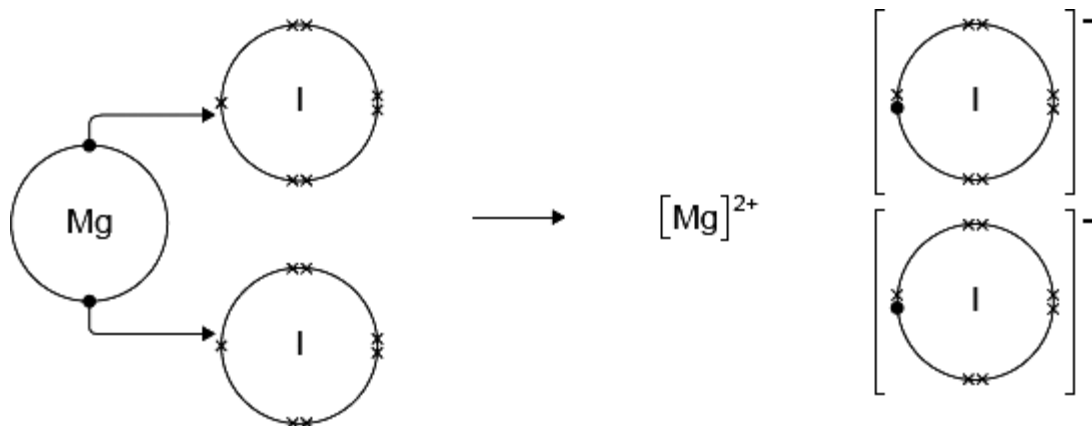
(b) Magnesium iodide can be made by reacting magnesium with iodine.



The diagram shows how this takes place.

Only the outer electrons are shown.

The dots (●) and crosses(x) are used to represent electrons.



Use the diagram to help you to answer this question.

Describe, as fully as you can, what happens when magnesium reacts with iodine to make magnesium iodide.

To gain full marks you should use the words atom, electron and ion in your answer.

(4)
(Total 8 marks)

Mark schemes

- 1.** (a) Will kelp last longer than coal as an energy source? 1
- (b) any **two** from:
- cannot be determined by experiment
allow can't predict how long kelp / coal will last
allow more testing needed
 - based on opinion
 - ethical **or** environmental **or** economic reason
allow could damage ecosystem allow reference to cost
- 2
- (c) (i) 7 1
- (ii) sodium (atom) loses (electron) **and** iodine (atom) gains (an electron)
*reference to incorrect bonding **or** incorrectly named particle*
= max 2
any or all marks can be obtained from a labelled diagram
ignore inner shell electrons if shown
- 1
- 1 electron 1
- (electrostatic) attraction **or** forms ionic bond(s) 1
- (iii) ions can move (in the solution) 1
- (iv) $2 I^{-} \rightarrow I_2 + 2 e^{-}$ 1
- (v) hydrogen is formed 1
- because sodium is more reactive (than hydrogen) 1
- [11]**
- 2.** 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]

3.

(a) a layer a few hundred atoms thick

1

(b) any **two** from:

*any **two** ideas*

- less materials or save resources
- less energy
- less fuel
- less pollution / greenhouse effect / global warming
- less waste

ignore references to cost / recycling

2

[3]

4.

(a) *reference to incorrect bonding **or** incorrect structure
or incorrect particles = max 3*

giant structure / lattice

ignore many bonds

1

made up of positive ions surrounded by delocalized / free electrons

allow positive ions surrounded by a sea of electrons

1

with strong bonds / attractions

allow hard to break for strong

1

so a lot of energy is needed to break these bonds / attractions / forces

ignore high temperature

ignore heat

1

(b) (i) that they are very small

or

1-100 nanometres **or** a few(hundred) atoms

accept tiny / really small / a lot smaller / any indication of very small

eg. microscopic, smaller than the eye can see

ignore incorrect numerical values if very small is given

1

(ii) delocalised / free electrons

allow sea of electrons

1

one non-bonded electron from each atom

accept electron(s) moving through the structure / nanotube

allow electron(s) carry / form / pass current / charge

1

[7]

5.

(a) (i) lead nitrate

accept $Pb(NO_3)_2$

do not accept nitride

ignore (all) nitrate(s)

1

(ii) sodium iodide / potassium iodide

accept NaI / KI

accept other correct soluble iodides eg HI , MgI_2

do not accept sodium iodine / potassium iodine

1

(b) *metallic / sharing / covalent **or** molecule = max 3*

magnesium loses 2 electrons

all three underlined ideas must be present

two underlined ideas = 1 mark eg magnesium loses electrons

or

magnesium gains 2 electrons

or

magnesium loses 2 ions

*nb magnesium **ion** loses 2 electrons = 1 mark*

2 errors = 0 marks eg magnesium gains electrons

2

iodine gains 1 / an electron

all four underlined ideas must be present

three underlined ideas = 1 mark eg iodine gains electron(s)

or

iodine loses 1 / an electron

or

iodide gains 1 / an ion

or

iodide (ion) gains 1 / an electron

2 errors = 0 marks

2

- (c) attractions / forces (of attraction) / bonds are strong **or** lot of energy needed to break bonds / forces / attractions

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

1

because oppositely charged ions attract **or** electrostatic attraction between ions

1

in giant structure **or** lattice

ignore many bonds

ignore ionic bonding unqualified

1

[9]

6.

- (a) (i) nucleus

1

- (ii) neutron

1

- (iii) electron

1

- (b) (i) 12

1

- (ii) 24

1

(c) any **four** from:

sharing / covalent / metallic = max 3

- magnesium (atom) reacts with **two** iodine (atoms)
- magnesium (atom) loses electrons
- **2** electrons (from each atom)
- Iodine (atom) gains electron(s)
- **1** electron or an electron (to each atom)
- iodide ion formed
allow iodine ion
- iodide has negative charge / is a negative ion / particle
allow iodine
ignore I²⁻
- magnesium ion formed
- magnesium has positive charge
- oppositely charged ions attract
- a giant structure / lattice is formed
allow 1 mark for unqualified reference to ion formation or ionic bonding

4

[9]

7.

(a) tin

1

(b) any **one** from:

- ornaments
 - musical instruments
 - hinges / knobs / screws
- allow any correct use of brass*

1

(c) **(A)** 12 (carat)

1

(B) 3 (grams)

1

(d) any **two** from:

- (alloy of gold is) harder
- (alloy of gold is) cheaper
- aesthetic reasons

allow converse statements about pure gold

2

(e) any **one** from:

- does not corrode
- does not react with water
- is hard

allow will not rust

1

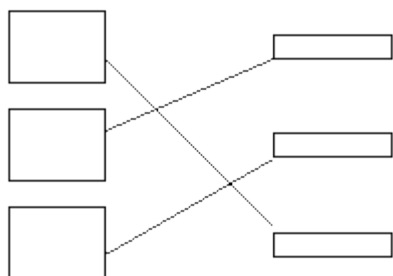
(f) low carbon steel

1

[8]

8.

(a)



all three lines correct gains 2 marks

one or two correct gains 1 mark

if there are more than 3 lines then lose mark for each extra line

2

(b) (i) covalent

1

(ii) four

1

(iii) hard

1

(iv) three

1

(v) soft

1

(c) carbon

accept C

1

- 9.** (a) (i) precipitation 1
- (ii) filtration 1
- (iii) lead nitrate 1
- sodium iodide 1
- (b) *sharing / covalent / metallic = max 3*

any **four** from:

- magnesium (atom) reacts with two iodine (atoms)
- magnesium (atom) loses
- **2** electrons
- iodine (atom) gains
- **1** electron **or** an electron
- iodide ion formed
 - allow iodine ion*
 - allow iodine*
 - ignore I²⁻*
- iodide has negative charge / is a negative ion / particle
- magnesium ion formed
- magnesium has positive charge
- oppositely charged ions attract
- a giant structure / lattice is formed
 - if reference to ions being formed is made unqualified, allow 1 mark*

4

[8]