Week 2 Learning Check
Chemistry Higher

Name: _____

Class: _____

Date: _____

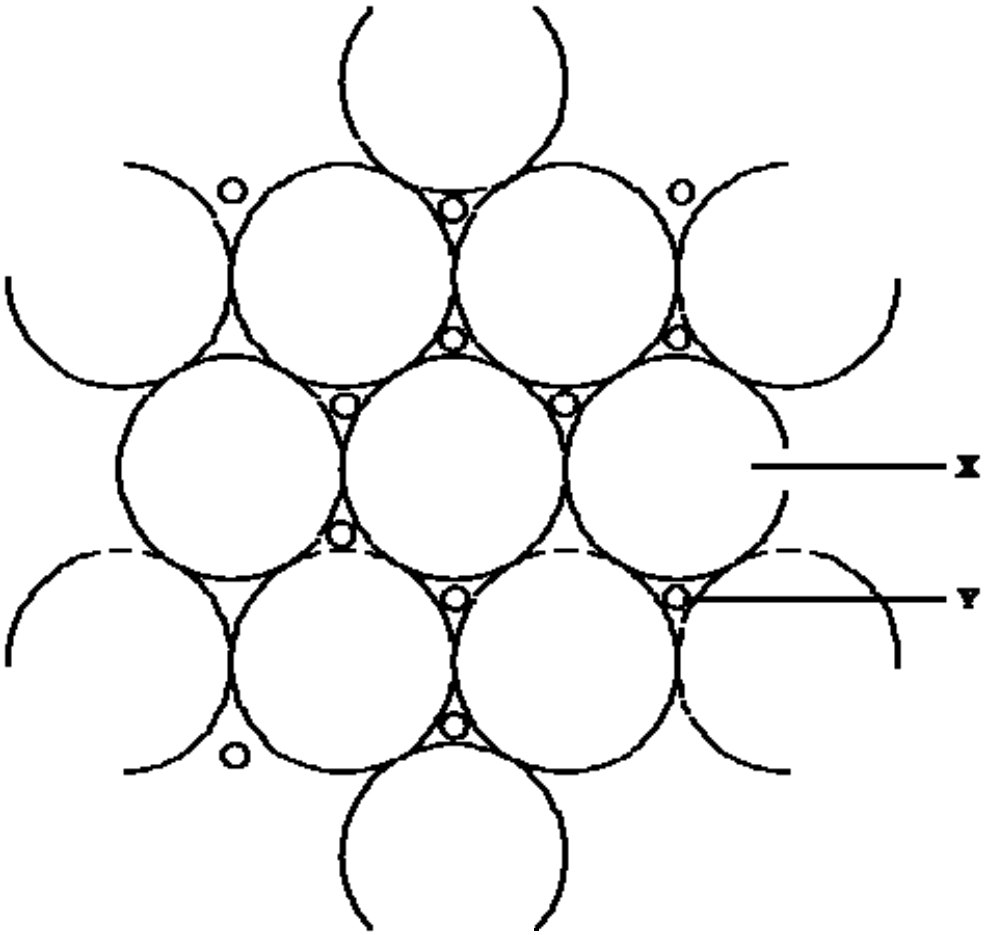
Time: **30 minutes**

Marks: **32 marks**

Comments:

Q1.

The diagram shows a model of part of the giant lattice of a metal.



(a) Name particles **X** and **Y**.

X _____

Y _____

(2)

(b) Explain, in terms of the giant structure above, why is it possible to bend a piece of metal.

_____

_____

_____

_____

(2)

(Total 4 marks)

Q2.

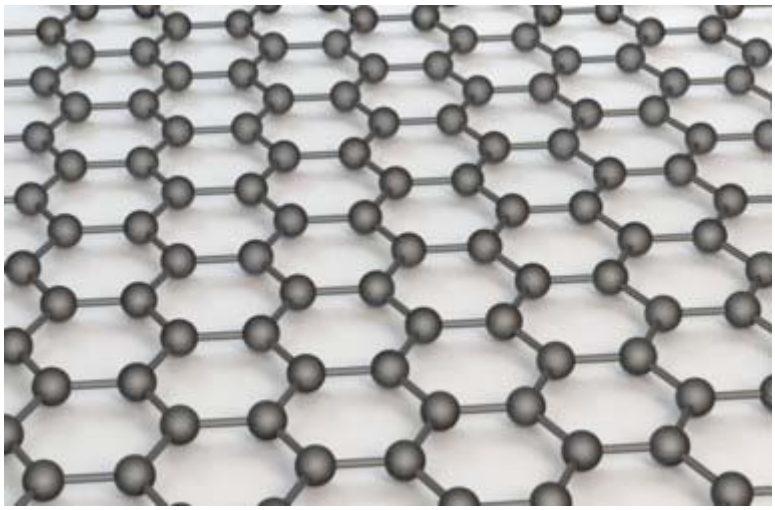
Scientists have recently developed a method to produce large sheets of a substance called graphene.
Graphene is made from carbon and is a single layer of graphite just one atom thick.

The properties of graphene include:

- it conducts electricity
- it is transparent since it is only one atom thick
- it is strong and durable.

These properties make it suitable to overlay a monitor screen to make it a touchscreen.

The photograph below shows the structure of graphene.



Photographs supplied by iStockphoto/Thinkstock

Use your knowledge of the bonding in graphite and the photograph of the structure to help you to explain, as fully as you can:

(a) (i) why graphene is strong;

_____

_____

_____

_____

_____

_____

(3)

(ii) why graphene conducts electricity.

_____

_____

_____

_____

_____

(2)

(b) Suggest why a sheet of graphite which has a large number of carbon layers would not be suitable for the touchscreen.

_____

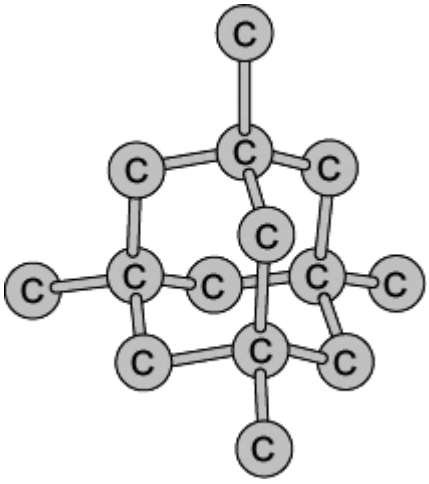
_____

(1)

(Total 6 marks)

Q3.

Diamonds are used as abrasives.



Model of part of the diamond structure

Diamonds are very hard.
Explain why.

A good answer will include information on the structure and bonding in diamonds.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 3 marks)

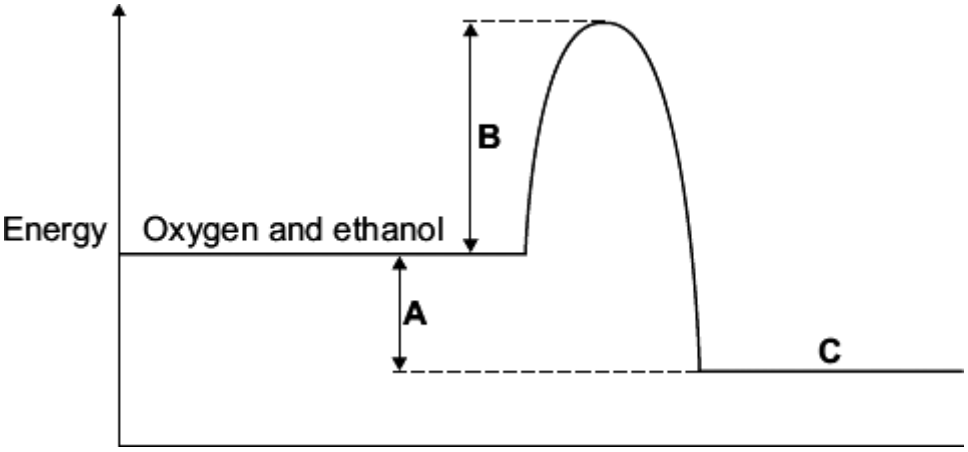
Q4.

V2 rockets were used during the Second World War.

By aronsson [CC BY-SA 2.0], via Flickr

V2 rockets were powered by liquid oxygen and ethanol. Oxygen and ethanol react to produce carbon dioxide and water.

The energy level diagram represents the energy changes during this reaction.



(a) On the energy level diagram what is represented by the letter:

A _____

B _____

C _____

(3)

(b) What type of reaction is represented by this energy level diagram?

_____

_____

(1)

(Total 4 marks)

Q5.

Cassiterite is an ore of the metal tin.

(a) What is an ore?

_____

_____

(2)

(b) Some metals are obtained by removing oxygen from the metal oxide.

What name do we give to this chemical reaction?

_____

(1)

(c) Name **one** metal which must be extracted from its melted ore by electrolysis rather than by using carbon.

_____

(1)

(Total 4 marks)

Q6.

The *electrolysis* of sodium chloride solution produces useful substances.

(a) Explain the meaning of *electrolysis*.

_____

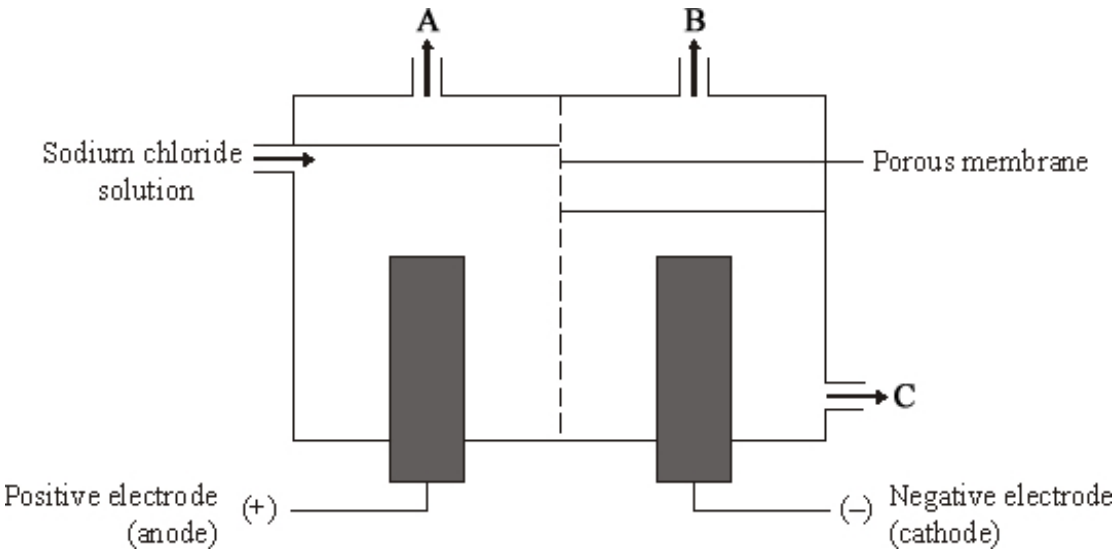
_____

_____

_____

(2)

(b) The diagram shows an apparatus used for the electrolysis of sodium chloride solution.



Reproduced with the permission of Nelson Thornes Ltd from PATRICK FULLICK et al, ISBN 0-7487-9644- 4. First published in 2006

The electrolysis produces two gases, chlorine and Gas **A.**

Name Gas **A** _____

(1)

(c) The electrodes used in this process can be made of graphite. Explain why graphite conducts electricity.

_____

_____

_____

_____

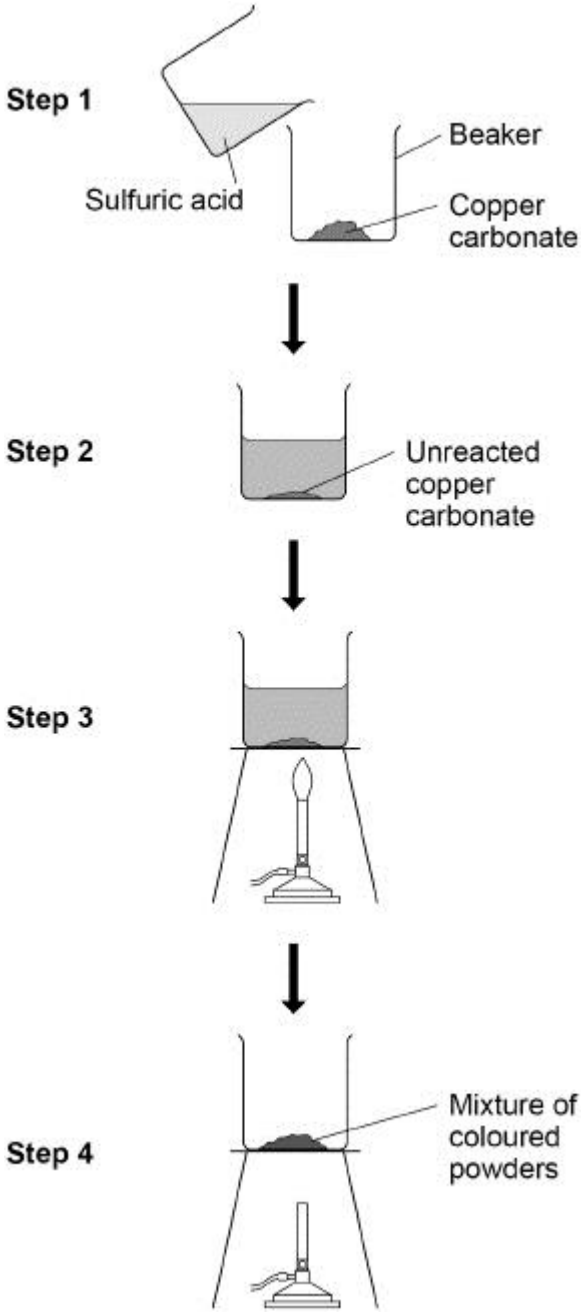
(2)

(Total 5 marks)

Q7.

A student wanted to make blue copper sulfate crystals from green copper carbonate powder and sulfuric acid.

The diagram below shows the method the student used.



The student obtained a mixture of coloured powders **not** blue crystals.

Describe how the method could be improved so that blue copper sulfate crystals are produced.

_____

_____

_____

(Total 6 marks)

Mark schemes

Q1.

(a) **X** – (metal) atom / ion

1

Y – electron

1

(b) free electrons or electrons move

1

(allow metal) atoms / ions to slide over each other

OR

bonding non - directional for 2 marks

1

[4]

Q2.

(a) (i) *ionic / molecules / metallic / (inter)molecular = max **2***

because graphene / it has a giant structure / lattice / macromolecular
accept <u>all</u> / <u>every</u> / <u>each</u> atom is <u>bonded to</u> 3 other atoms

1

because graphene / it has covalent bonds / is covalent

1

because in graphene / the bonds are strong **or**
a lot of energy needed / hard to break the bonds

1

(ii) there are delocalised / free electrons

1

because one (delocalised / free) electron <u>per atom</u> linked to first marking point
accept because three <u>electrons per atom</u> used (in bonding)
accept because one electron <u>per atom</u> not used (in bonding)

1

(b) opaque (owtte)
eg could not see through them

or layers slide
or layers not aligned
ignore thick

1

[6]

Q3.

any **three** from:

any reference to incorrect bonding = max 2

- giant structure / lattice / macromolecule
- covalent (bonds)
- bonds are (very) strong
  allow bonds difficult to break
  ***or** takes a lot of energy to break bonds*
- each atom / carbon joined to <u>four</u> others
  accept each atom / carbon forms <u>four</u> bonds

3

[3]

Q4.

(a) A = <u>energy</u> / <u>enthalpy</u> change / difference
*allow heat change **or** ΔH*
allow energy released

1

B = activation energy / EA
allow definition of activation energy

1

C = carbon dioxide and water
accept products

1

(b) exothermic
allow combustion / redox / oxidation
ignore reduction / burning

1

[4]

Q5.

(a) *ideas that it is a*

- compound of metal/metal oxide/combined (NOT mixed) cpd/ named cpd O^{2-}/S^{2-}/CO_3^{2-} etc
- found naturally/in rocks/in Earth's Crust
  for 1 mark each

2

(b) reduction (accept smelting/refining but <u>not</u> electrolysis)
for 1 mark

1

(c) One example. Al or above in Reactivity Series
ie Group I or II metals NOT Pb/Cu or compounds

for 1 mark

1

[4]

Q6.

(a) electric current / electricity

1

plus **one** from:

- is passed through <u>ionic</u> compound / substance / electrolyte
- passed through molten/aqueous <u>compound</u> / <u>substance</u>
  must be linked to electricity
  allow liquid compound / substance
  *do **not** allow solution / liquid alone*
- causing decomposition
  accept split up / breakdown / breaking up owtte
  ignore separated
  accept elements are formed
  ignore new substances form

1

(b) hydrogen

accept H_2
*do **not** accept H / H^2*

1

(c) one electron from each atom

accept each carbon is bonded to three other carbon atoms leaving one (unbonded) electron owtte

1

is delocalised / free (to move)

must be linked to electrons
*answers of delocalised / free electrons only, gains **1** mark*
*accept each carbon is bonded to three other carbon atoms leaving delocalised / free electrons = **2** marks*
***maximum 1** mark if graphite described as a metal / giant ionic lattice*

1

[5]

Q7.

(a) **Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

4–6

Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.

1–3

No relevant content

0

Indicative content

- place sulfuric acid in beaker
- add copper carbonate one spatula at a time
- until no longer dissolves
  or
  no effervescence seen

- filter mixture
- to remove excess copper carbonate

- add solution to an evaporating basin
- heat to crystallisation point
  or
  heat till half water gone
  or
  heat till crystals just start to form
- using water bath or electric heater
- leave to cool (until crystals form)

[6]

Q1.

Giant structures continue to provide problems for all but the most able candidates.

(a) **X** was frequently given as metal or even nucleus. Rather more candidates correctly identified **Y** as an electron.

(b) The role of free electrons in the structural properties of a metal remains a mystery to all but the most able.

Q2.

(a) (i) This proved to be a very discriminating question. Of the students who gained less than three marks, many mentioned other types of bonding, including ionic bonding and intermolecular forces. Some students even included all 3 types of bonding for good measure – no doubt hoping that one would be right and pick up some marks! In this and 4ai, some students wrote about bonds being joined together strongly – muddling bonds with particles being bonded together, eg “bonds are held together by strong forces of attraction.” Many students gained credit for “giant covalent structure”, but then went on to mention intermolecular forces.

(ii) The majority of students recognised that the presence of delocalised or free electrons enables graphene to conduct electricity. However, only the most complete responses (a minority) clearly explained that each atom provided one delocalised electron. As in (a)(i), examiners had difficulty interpreting some students’ answers due to imprecise language eg rather than each atom having one electron not used in bonding, some students wrote that each molecule has one spare atom,“only 3 bonds are connected, so one bond is free to move around”, free atoms. Some students only scoring one mark said that there was one free electron, but omitted to say per atom. In high demand questions, students are expected to be able to express their understanding of chemical concepts clearly, and in such a way that examiners can readily interpret their answers, even on quite complex topics such as why graphene is strong or conducts electricity. Where answers are difficult to interpret, or are ambiguous due to imprecise use of language, credit cannot be awarded.

(b) A majority of students realised that a screen with a large number of carbon layers would not be transparent. A significant number of students also gained credit for recognising that with multiple layers, the layers could slide. However of those who gained no credit, many stated that the screen would be too thick, without specifying a problem which would arise from this. Others felt that the multiple layered screen would not be strong enough, or be too thick and rigid to respond to touch.

Q3.

The hardness of diamond was generally well explained in terms of its structure and bonding, with some excellent, comprehensive answers seen.
Some students made references to incorrect types of bonding, especially “intermolecular”. “Each carbon is joined to three others” was also stated by a significant minority of students. This type of error limited their mark to a maximum of two.

Q4.

(a) Almost half of the candidates scored no marks here. A large number wrote about the rocket taking off, landing or accelerating. B was often given as ‘energy increase’ and C as ‘energy of the products’ or ‘final energy’.

(b) About one third of the candidates did not gain this mark. Many wrote ‘chemical’, ‘endothermic ‘or ‘burning’.

Q5.

Paper I4

This question was poorly answered. Most candidates found it difficult to describe an ore. The few good answers noted that it was a compound of a metal found naturally in rocks. Many candidates incorrectly thought that the removal of oxygen was oxidation rather than reduction. Whilst in (c) most candidates gave either lead or iron rather than a reactive metal like aluminium or sodium.

Paper H6

(a) Full marks were surprisingly seldom gained for this seemingly simple item. Relatively few candidates referred to the metals in ores being combined with other elements as compounds.

(b) “Reduction” was the response of a disappointingly small proportion of candidates; “oxidation” or “de-oxidation” were common responses.

(c) Many candidates suggested copper or iron as metals which could not be extracted from their ores using carbon.

Q6.

Many candidates found difficulty in explaining the meaning of the term electrolysis in part (a). These candidates knew that it was something to do with electricity but could not give any further information. Other candidates did not mention electricity but simply talked about the movement of ions.

The majority of candidates gave the correct response which was hydrogen in part (b). A variety of incorrect responses were seen including oxygen, chlorine and sodium oxide. In part (c) many of the candidates gained one mark for the idea of delocalised electrons. Fewer candidates were able to give a more detailed answer which explained that each carbon atom has one free electron. Some candidates thought that graphite must be a metal.