

THE PERIODIC TABLE

Period 1 2 3 4 5 6 7 0

Group

1	1	2	3	4	5	6	7	0													
1								<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 1 H Hydrogen 1 </div>													
2	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 7 Li Lithium 3 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 9 Be Beryllium 4 </div>					<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 11 B Boron 5 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 12 C Carbon 6 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 14 N Nitrogen 7 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 16 O Oxygen 8 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 19 F Fluorine 9 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 20 Ne Neon 10 </div>									
3	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 23 Na Sodium 11 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 24 Mg Magnesium 12 </div>					<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 27 Al Aluminium 13 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 28 Si Silicon 14 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 31 P Phosphorus 15 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 32 S Sulphur 16 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 35.5 Cl Chlorine 17 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 40 Ar Argon 18 </div>									
4	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 39 K Potassium 19 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 40 Ca Calcium 20 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 45 Sc Scandium 21 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 48 Ti Titanium 22 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 51 V Vanadium 23 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 52 Cr Chromium 24 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 55 Mn Manganese 25 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 56 Fe Iron 26 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 59 Co Cobalt 27 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 59 Ni Nickel 28 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 63.5 Cu Copper 29 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 65 Zn Zinc 30 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 70 Ga Gallium 31 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 73 Ge Germanium 32 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 75 As Arsenic 33 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 79 Se Selenium 34 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 80 Br Bromine 35 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 84 Kr Krypton 36 </div>			
5	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 86 Rb Rubidium 37 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 88 Sr Strontium 38 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 89 Y Yttrium 39 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 91 Zr Zirconium 40 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 93 Nb Niobium 41 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 96 Mo Molybdenum 42 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 99 Tc Technetium 43 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 101 Ru Ruthenium 44 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 103 Rh Rhodium 45 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 106 Pd Palladium 46 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 108 Ag Silver 47 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 112 Cd Cadmium 48 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 115 In Indium 49 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 119 Sn Tin 50 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 122 Sb Antimony 51 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 128 Te Tellurium 52 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 127 I Iodine 53 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 131 Xe Xenon 54 </div>			
6	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 133 Cs Caesium 55 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 137 Ba Barium 56 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 139 La Lanthanum 57 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 179 Hf Hafnium 72 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 181 Ta Tantalum 73 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 184 W Tungsten 74 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 186 Re Rhenium 75 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 190 Os Osmium 76 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 192 Ir Iridium 77 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 195 Pt Platinum 78 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 197 Au Gold 79 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 201 Hg Mercury 80 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 204 Tl Thallium 81 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 207 Pb Lead 82 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 209 Bi Bismuth 83 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 210 Po Polonium 84 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 210 At Astatine 85 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 222 Rn Radon 86 </div>			
7	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 223 Fr Francium 87 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 226 Ra Radium 88 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 227 Ac Actinium 89 </div>						<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 270 U Uranium 92 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 271 Pa Protactinium 93 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 272 Th Thorium 94 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 274 Pu Plutonium 96 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 276 Am Americium 98 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 278 Cm Curium 100 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 280 Bk Berkelium 102 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 282 Cf Californium 104 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 285 Es Einsteinium 106 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 287 Fm Fermium 108 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 289 Md Mendelevium 110 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 291 No Nobelium 112 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 293 Lr Lawrencium 114 </div>

Key

Relative atomic mass
Symbol
Name
Atomic number



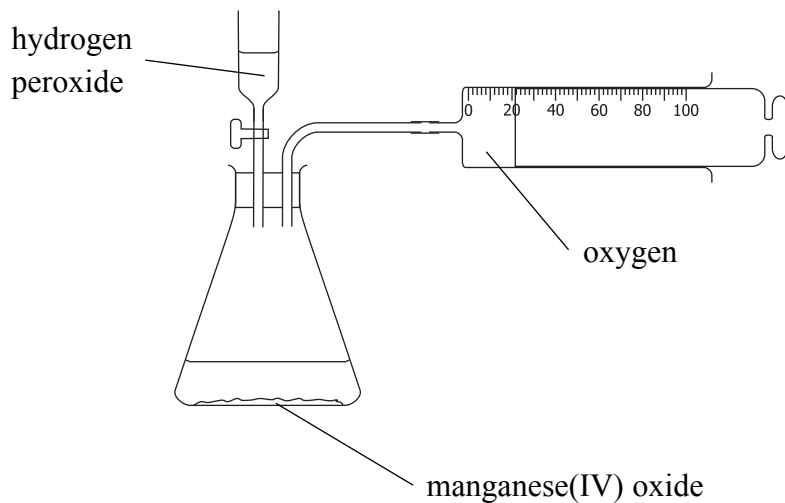
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TURN OVER FOR QUESTION 1



SECTION A

1. Oxygen gas can be prepared and collected in the laboratory using the apparatus shown in the diagram.



(a) Hydrogen peroxide decomposes very slowly to form water and oxygen.

(i) Write a word equation for this reaction.

.....
.....
(1)

(ii) The reaction is much faster if a small amount of manganese(IV) oxide is added. What type of substance is manganese(IV) oxide in this reaction?

.....
(1)

(b) The diagram shows oxygen gas being collected in a syringe. Suggest one other way to collect the gas.

.....
.....
(1)

(c) Describe the test for oxygen.

.....
.....
(1)

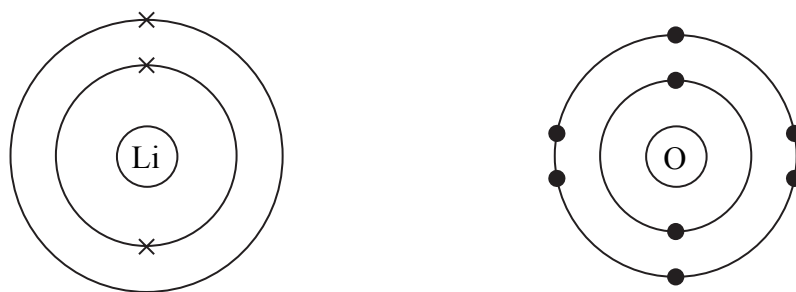


(d) Lithium burns in oxygen to form the ionic compound lithium oxide.

(i) State the colour of the flame when lithium burns.

..... (1)

(ii) The diagrams show the electron configurations of an atom of lithium and an atom of oxygen.



Describe what happens, in terms of electrons, when lithium reacts with oxygen.

.....
.....
.....
..... (3)

(iii) Write the formula of each of the ions in lithium oxide.

Lithium ion
Oxide ion (2)

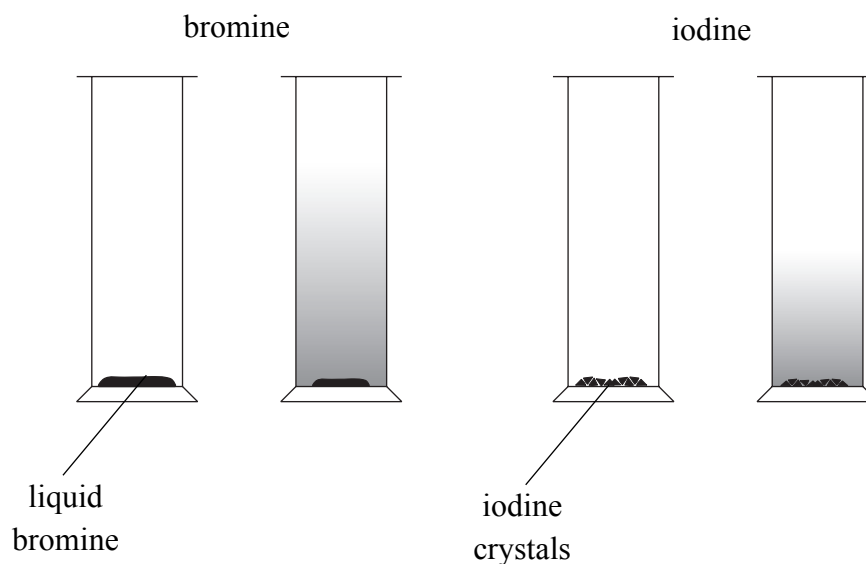
(Total 10 marks)

Q1



2. A few drops of liquid bromine and a few crystals of solid iodine are placed in the bottom of separate gas jars and the open ends covered with lids. The jars are left for some time under the same conditions.

The diagrams show the jars just after the bromine and iodine are added, and after some time.



- (a) State the colour of
 liquid bromine
- solid iodine
- (2)**

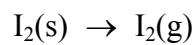
- (b) The diagrams show that the particles of bromine and iodine spread out in the jars.

- (i) What is the name of this process?

.....

(1)

- (ii) The iodine changes into a gas before this process occurs.
 The chemical equation for this change is



The change involving bromine is called evaporation.
 Write a chemical equation, including state symbols, for this change.

.....

(2)



(iii) Describe how the movement and spacing of the particles in $I_2(g)$ is different from that in $I_2(s)$.

Movement

Spacing

(2)

(c) The gases chlorine and hydrogen react together to form hydrogen chloride gas. Hydrogen chloride gas dissolves in water to form hydrochloric acid.

Bromine reacts in a similar way to chlorine.

(i) Write a word equation for the reaction between bromine and hydrogen.

.....
.....

(1)

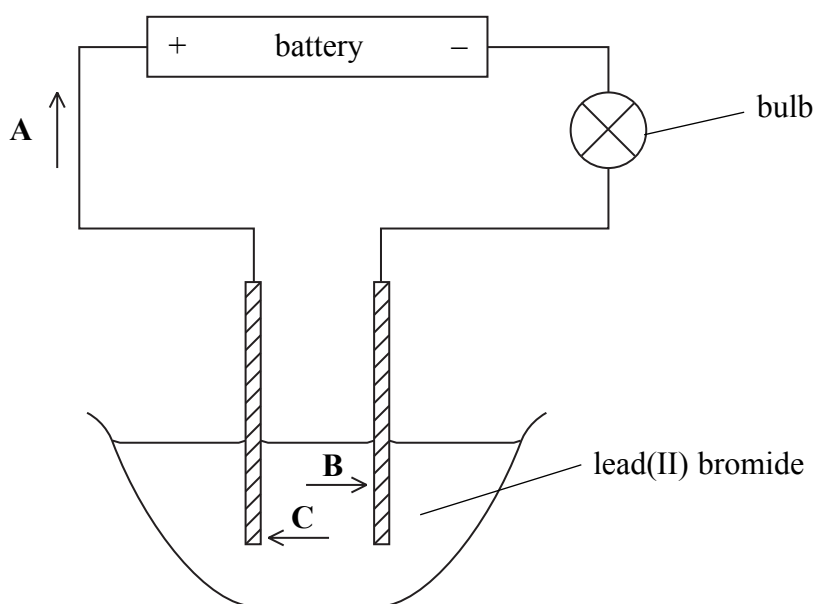
(ii) Suggest the name of the acid formed when the product in (c)(i) dissolves in water.

.....

(1)



(d) The diagram shows apparatus for electrolysis of lead(II) bromide.



(i) When the apparatus is set up as shown, electrolysis does not occur. State what must be done before electrolysis can occur.

.....

(1)

(ii) When electrolysis occurs, particles **A**, **B** and **C** move in the directions shown by the arrows in the diagram. Identify each of these particles.

A

B

C

(3)

(e) Explain why the reaction at the negative electrode is described as reduction.

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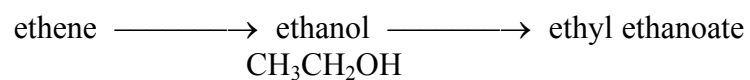
(1)

(Total 14 marks)

Q2



4. Ethene can be converted to ethyl ethanoate as follows:



(a) In industry, ethene is converted to ethanol by reacting it with steam in the presence of a catalyst.

(i) Write the chemical equation for this reaction.

.....

 (1)

(ii) Name the catalyst used.

.....
 (1)

(b) Ethanol can also be made by fermentation. Describe how this is done.

.....

 (4)



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blank

(c) Ethanol is converted to ethyl ethanoate by warming it with ethanoic acid in the presence of a catalyst.

(i) Write the chemical equation, including state symbols, for this reaction.

.....
.....

(3)

(ii) How can a student detect the formation of ethyl ethanoate in this reaction?

.....
.....

(1)

Q4

(Total 10 marks)

TOTAL FOR SECTION A: 45 MARKS



SECTION B

5. (a) The table shows the electronic configurations of atoms of the elements in Period 3 of the Periodic Table.

Element	Na	Mg	Al	Si	P	S	Cl	Ar
Electronic configuration	2.8.1	2.8.2	2.8.3	2.8.4	2.8.5	2.8.6	2.8.7	2.8.8

- (i) How is the electronic configuration of an atom of an element related to its position in the Periodic Table?

.....

 (1)

- (ii) Give the electronic configuration of an atom of the element directly below magnesium in the Periodic Table.

.....
 (1)

- (b) Explain the meaning of the term **isotopes**.

.....

 (2)



(c) An element exists as three isotopes. The table gives some information about them.

Number of neutrons	Number of protons	Atomic number of isotope	Mass number of isotope	Percentage of each isotope in the element
		12	24	79
13	12	12		
14	12		26	11

(i) Complete the table for the isotopes of the element. (5)

(ii) Use the information in the table and the Periodic Table on page 2 to identify the element.

..... (1)

(iii) Use the information in the table to calculate the relative atomic mass of the element. Give your answer to **three** significant figures.

(3)

(iv) When a sample of the element containing only atoms with a mass number of 24 was added to dilute sulphuric acid, effervescence was seen.

What would be seen if a sample of the element containing only atoms with a mass number of 26 was added to dilute sulphuric acid? Explain your answer.

Observation

.....

Explanation

.....

(2)

(Total 15 marks)

Q5

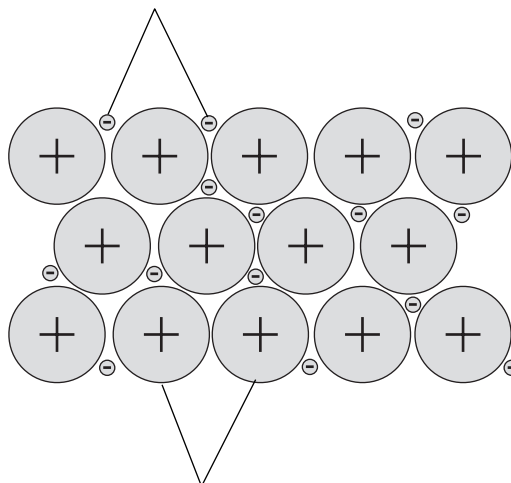


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6. (a) The diagram represents the structure of a metal.

electrons from outer shell of metal atoms



metal ions

Use the diagram to help you explain

(i) why a metal conducts electricity

.....
.....
.....

(2)

(ii) why a metal is malleable.

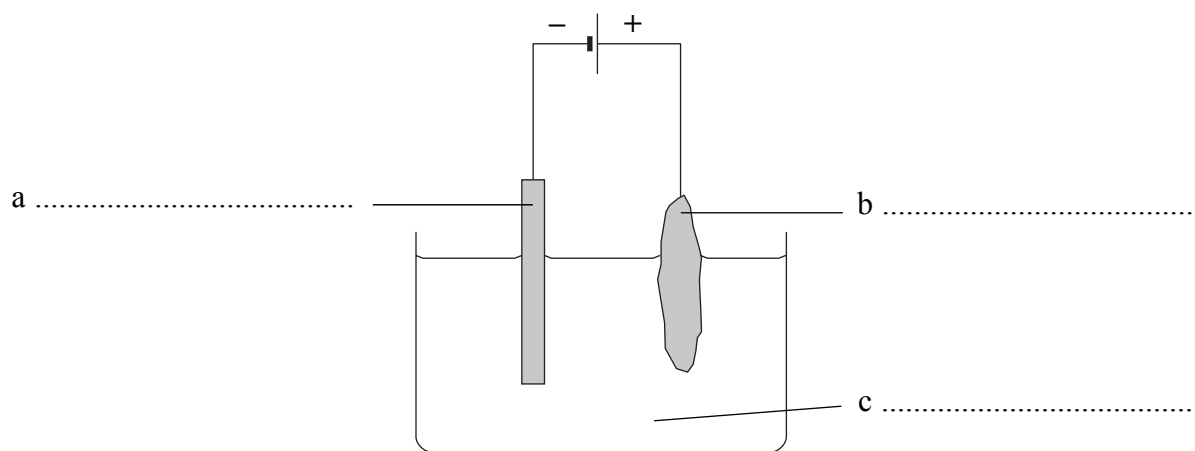
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(2)



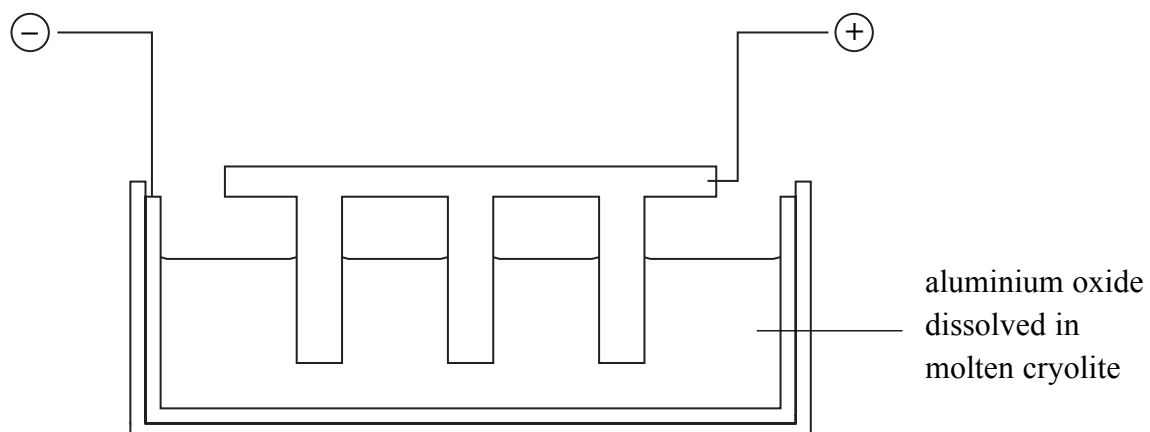
(b) Copper is purified by electrolysis.

Label the diagram of the apparatus used.



(3)

(c) Aluminium is obtained from aluminium oxide using electrolysis.



(i) Explain why the aluminium oxide is dissolved in molten cryolite.

.....

(1)

(ii) Name the element used for both the positive and negative electrodes.

.....

(1)



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(d) Both copper and aluminium have many uses. Give a different use for each of these metals and give a property of the metal on which that use depends.

Use of copper

Property on which use depends

Use of aluminium

Property on which use depends

(4)

(e) Titanium is a metal that has a similar reactivity to aluminium. Rutile is an ore that contains titanium dioxide, TiO_2 .

Suggest how titanium could be obtained from this ore and explain your answer.

.....

.....

.....

.....

(2)

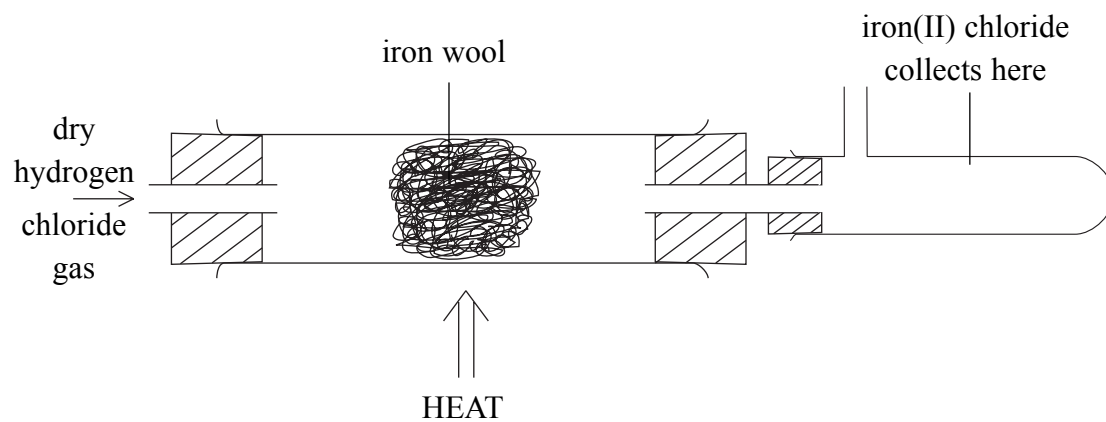
Q6

(Total 15 marks)

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7. (a) The apparatus shown can be used to react iron with dry hydrogen chloride gas.



One of the products is iron(II) chloride.

Write a chemical equation for the reaction.

..... (3)

(b) When hot iron wool is plunged into a gas jar containing dry chlorine gas, a rapid reaction occurs. The iron wool glows brightly and a dense smoke of iron(III) chloride is seen.

What does the fact that the iron wool glows brightly tell you about the reaction?

..... (1)



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(c) Sodium hydroxide reacts with both iron(II) chloride and with iron(III) chloride.

Describe how you could use sodium hydroxide solution to distinguish between solid samples of iron(II) chloride and iron(III) chloride. Give brief details of what you would do and what you would observe in each case.

.....

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.....

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.....

.....

.....

(4)

Q7

(Total 8 marks)



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8. (a) The table shows the displayed formulae of some organic compounds.

Compound	Displayed formula
A	<pre> H H H-C-C-H H H </pre>
B	<pre> H H H-C-C-O H H H </pre>
C	<pre> H H \ / C=C / \ H H </pre>
D	<pre> H H H H-C-C-C-H H H H </pre>
E	<pre> H H \ / C / \ H C=C H \ / \ / H H </pre>

(i) Give one reason why compound **B** is not a hydrocarbon.

.....
(1)

(ii) State the empirical formula of compound **A**.

.....
(1)

(iii) Both **A** and **D** are members of the same homologous series.
What is a homologous series?

.....
.....
.....
(2)



(iv) Draw a dot and cross diagram to show the bonding in compound A.

(2)

(v) What is the name of the addition polymer formed by compound E?

.....
(1)

(vi) Draw the repeat unit of the addition polymer of compound E.

(2)

(vii) Compound E reacts rapidly with bromine water but the addition polymer of compound E does not. Explain this difference in behaviour.

.....
.....
.....
(2)



(b) Draw the displayed formulae of three isomers with molecular formula C_4H_8 .

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(3)

Q8

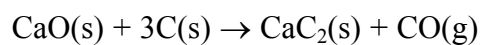
(Total 14 marks)

23

Turn over



9. At a high temperature, calcium oxide reacts with carbon to form calcium carbide, CaC_2 .



- (a) Calcium oxide reacts with carbon to make 128 g of calcium carbide. Calculate

(i) the relative formula mass of calcium carbide.

(1)

(ii) the amount, in moles, of calcium carbide made in the reaction.

(1)

(iii) the minimum amount, in moles, of carbon that is required to make this amount of calcium carbide.

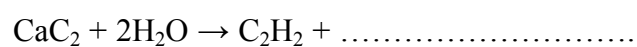
(1)

(iv) the minimum mass, in g, of carbon required.

(1)

- (b) Calcium carbide reacts with water to make the gas ethyne, C_2H_2 , and a compound of calcium.

(i) Complete the chemical equation for this reaction:



(1)

(ii) Ethyne, C_2H_2 , is highly flammable.

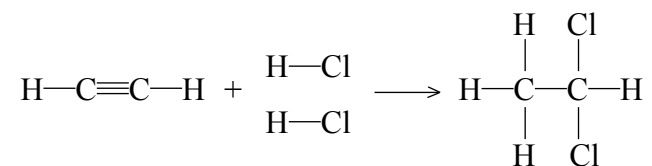
Predict the products of the complete combustion of ethyne.

.....

(2)



(c) Ethyne reacts with hydrogen chloride gas.



The table shows some average bond dissociation energies.

Bond	Average bond dissociation energy (kJ / mol)
H—C	412
C≡C	837
H—Cl	431
C—C	348
C—Cl	338

(i) Calculate the energy, in kJ, required to break all of the bonds in the reactants.

(2)

(ii) Calculate the energy, in kJ, given out when all of the bonds in the product are formed.

(2)

(iii) Calculate the value of ΔH , in kJ / mol, for the reaction.

(1)

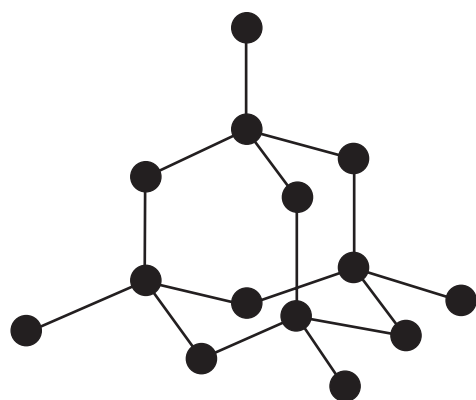
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Q9

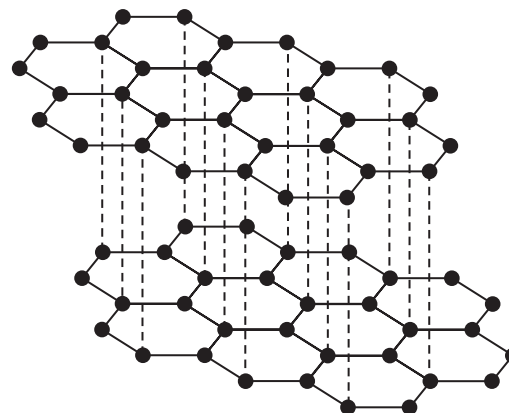
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10. The diagrams show the structures of diamond and graphite. They are different structural forms of the element carbon.



diamond



graphite

(a) What type of structure are both diamond and graphite?

..... (1)

(b) Diamond has a high sublimation temperature. Explain why.

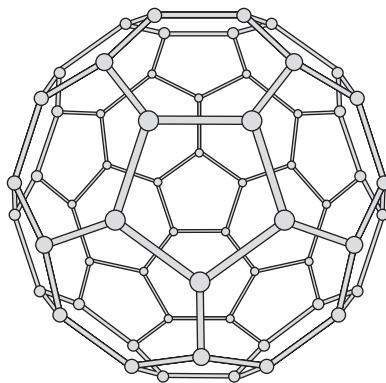
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.....
..... (3)

(c) Graphite can be used as a lubricant. Explain why.

.....
.....
..... (2)



(d) During the twentieth century another structural form of carbon was discovered. In this structural form the molecules have the formula C_{60} and are shaped like footballs.



(i) C_{60} has a much lower sublimation temperature than diamond. Suggest why.

.....
.....
.....
.....

(3)

(ii) Would you expect C_{60} to act as a lubricant? Explain your answer.

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.....
.....
.....

(2)

Q10

(Total 11 marks)

TOTAL FOR SECTION B: 75 MARKS

TOTAL FOR PAPER: 120 MARKS

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