

THE PERIODIC TABLE

Period 1 2 3 4 5 6 7 0 Group

1																	4 He Helium 2															
2	7 Li Lithium 3	8 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10													
3	11 Na Sodium 11	12 Mg Magnesium 12											19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36		
4	19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36														
5	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54														
6	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	58 Ce Cerium 58	59 Pr Praseodymium 59	60 Nd Neodymium 60	61 Pm Promethium 61	62 Sm Samarium 62	63 Eu Europium 63	64 Gd Gadolinium 64	65 Tb Terbium 65	66 Dy Dysprosium 66	67 Ho Holmium 67	68 Er Erbium 68	69 Tm Thulium 69	70 Yb Ytterbium 70	71 Lu Lutetium 71	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86
7	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89																													

Key

Relative atomic mass
Symbol
Name
Atomic number



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SECTION A

1. The starting material in the manufacture of sulphuric acid is sulphur.

(a) Give **two** sources of sulphur.

1

2

(2)

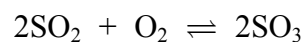
(b) Give **two** other raw materials used in the process.

1

2

(2)

(c) The equation for one of the reactions involved in the contact process is



(i) What is the name of the product of this reaction?

.....

(1)

(ii) State **two** conditions used in this reaction.

1

2

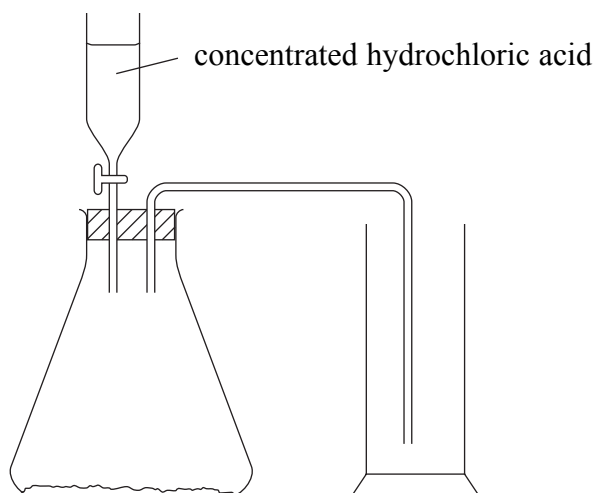
(2)

Q1

(Total 7 marks)



2. The diagram shows the apparatus used to prepare chlorine gas in the laboratory.



(a) At the start of the experiment the conical flask contains a manganese compound. Identify this compound and give its colour.

Compound

Colour

(2)

(b) The diagram shows the gas being collected by downward delivery. On what property of chlorine does this method depend?

.....

(1)

(c) What colour is seen in the gas jar as it fills with chlorine?

.....

(1)

(d) Describe a test for chlorine gas.

Test

Result

(2)



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blank

(e) In industry, chlorine is manufactured from brine.

(i) Name the compound in brine that is the source of chlorine.

.....
(1)

(ii) What method is used to obtain chlorine from brine?

.....
(1)

(iii) State **one** large-scale use of chlorine.

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

Q2

(Total 9 marks)



Leave
blank

3. The formulae CH_4 and C_4H_{10} represent two organic compounds.

(a) State why these compounds are described as

(i) saturated.....
.....
(1)

(ii) hydrocarbons.....
.....
(1)

(b) CH_4 and C_4H_{10} are members of the same homologous series. All members of the same homologous series can be represented by a general formula.

(i) What is the general formula of this homologous series?
.....
(1)

(ii) To which homologous series do CH_4 and C_4H_{10} belong?
.....
(1)

(iii) Give **two** other features of members of the same homologous series.
1
2
(2)

(c) The compound C_4H_{10} exists as isomers. What is meant by the term **isomers**?

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

(Total 8 marks)

Q3



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4. The Periodic Table on page 2 may be useful in answering parts of this question. The symbols of some atoms and ions are shown below.

Al Cl⁻ Mg Mg²⁺ Na⁺ O²⁻

(a) Which **one** of these is formed by the loss of one electron from an atom?

.....
(1)

(b) Which **one** of these is formed by the gain of two electrons by an atom?

.....
(1)

(c) Which **one** of these has the same electronic configuration as an atom of argon?

.....
(1)

(d) Which **one** of these has an electronic configuration of 2.8.2?

.....
(1)

(e) Which **three** of these have the same electronic configuration?

.....
(1)

(f) Compounds containing the ions listed include MgO and NaCl. Which of these compounds has the higher melting point? Give a reason.

Compound with higher melting point

Reason

.....
(2)

(Total 7 marks)

Q4



5. The equation shows the formation of hydrogen chloride.



(a) (i) What does the symbol ΔH represent?

.....
(1)

(ii) ΔH is negative for this reaction. What does this indicate?

.....
(1)

(b) Each substance in the equation contains the same type of bonding. Name this type of bonding and describe how it forms.

Name

Description

.....
(3)

(c) Draw a dot and cross diagram to show the bonding in H_2 .

(1)

(d) H_2 molecules contain strong bonds. Explain why the boiling point of H_2 is low.

.....

(2)

(e) Hydrogen chloride is soluble in both water and methylbenzene. What colour is phenolphthalein in each of these solutions?

Hydrogen chloride dissolved in water

Hydrogen chloride dissolved in methylbenzene

(2)



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blank

(f) A student carries out a test to show that a solution of hydrogen chloride contains chloride ions. First she adds dilute nitric acid.

(i) Name the other solution she adds.

.....
(1)

(ii) Describe what she observes.

.....
(1)

(iii) Complete the equation to show the reaction that occurs.

..... + HCl → +
(2)

(Total 14 marks)

Q5

TOTAL FOR SECTION A: 45 MARKS



SECTION B

6. The table gives some information about the elements in Group 7 of the Periodic Table.

Name of element	Melting point (°C)	Boiling point (°C)
fluorine	-220	-188
chlorine	-101	-35
bromine	-7	
iodine	+114	+184
astatine		+337

(a) (i) Use the information in the table to predict the physical state of astatine at room temperature.

.....
(1)

(ii) Use the information in the table to predict a value for the boiling point of bromine.

.....
(1)

(b) All atoms of elements in Group 7 have seven electrons in their outer shell. When they react they can form ions.

(i) What is the charge on the ions formed?

.....
(1)

(ii) Explain why the atoms form ions with this charge.

.....

(2)

(c) Which element in Group 7 is the **most** reactive?

.....
(1)



Leave
blank

(d) When chlorine gas is bubbled through potassium bromide solution a reaction takes place.

(i) Write the chemical equation for the reaction.

.....
(2)

(ii) What is **seen** during the reaction?

.....
(1)

(e) A compound contains 16.4% potassium, 30.0% chlorine and 53.6% iodine by mass. Calculate the empirical formula of the compound.

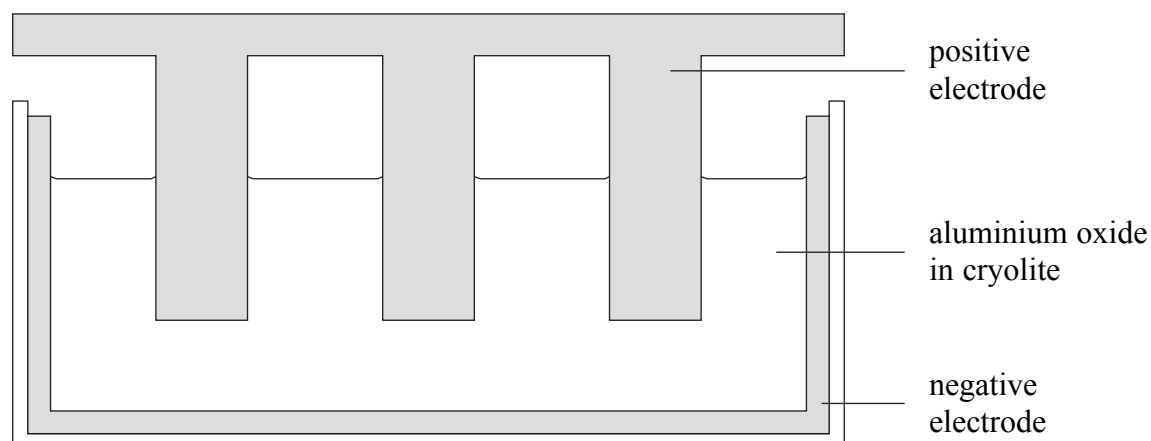
(3)

Q6

(Total 12 marks)



7. Aluminium is extracted from aluminium oxide by electrolysis. The diagram shows a cross-section through an electrolysis cell.



(a) Aluminium oxide has a melting point of over 2000°C.

(i) Explain why obtaining molten aluminium oxide is difficult.

.....

(1)

(ii) How does the use of cryolite help to overcome this difficulty?

.....

(2)

(b) The products of the electrolysis are oxygen and aluminium.

(i) Complete the ionic half-equation for the formation of oxygen at the positive electrode.



(ii) Write the ionic half-equation to show the formation of aluminium at the negative electrode.

.....
(2)



Leave blank

(c) The electrolysis of aluminium oxide is a redox process. Use the equations in (b) to help you identify what has been oxidised. Explain your answer.

Oxidised

Explanation

(2)

(d) Explain why the positive electrodes need to be replaced regularly.

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

(3)

(e) Aluminium is used as the main conductor in overhead power cables.

(i) Describe the structure of aluminium metal.

.....
.....

(2)

(ii) Explain why it is a good conductor of electricity.

.....
.....

(1)

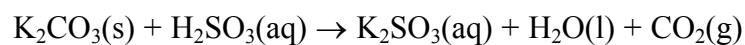
Q7

(Total 14 marks)

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8. Potassium carbonate, K_2CO_3 , reacts with sulphurous acid, H_2SO_3 .



(a) Sulphurous acid is a weak acid. Give **two** differences between strong and weak acids.

1

.....

2

.....

(2)

A 2.76 g sample of solid potassium carbonate was placed in a beaker.

(b) (i) Calculate the relative formula mass, M_r , of potassium carbonate.

(1)

(ii) Calculate the amount, in moles, of potassium carbonate in 2.76 g.

(1)

(iii) Sulphurous acid of concentration $0.200 \text{ mol dm}^{-3}$ was added to the beaker. Calculate the minimum volume, **in cm^3** , of sulphurous acid needed to react with 2.76 g of potassium carbonate.

(2)

(iv) Calculate the relative formula mass, M_r , of carbon dioxide.

(1)



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blank

(v) Calculate the mass of carbon dioxide formed.

(1)

(vi) Calculate the volume of this mass of carbon dioxide at room temperature and pressure (rtp).

The volume of one mole of any gas at rtp is 24 dm³.

(1)

(c) Describe simple tests that can be used to show that the solution produced in the reaction contains

(i) potassium ions

Test

Result

(2)

(ii) sulphite ions

Test

.....

Result

(3)

Q8

(Total 14 marks)

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9. Crude oil is a complex mixture of different hydrocarbons. It is separated into useful fractions by fractional distillation. Short-chain hydrocarbons are used as fuels.

(a) Name the fraction that contains methane.

.....
(1)

(b) How does the release of methane into the atmosphere affect the environment?

.....
(1)

(c) Long-chain hydrocarbons are cracked to produce hydrocarbons with shorter chains.

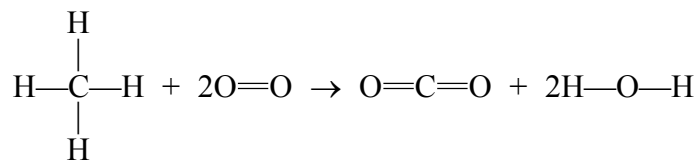
(i) State **one** condition needed for cracking to occur.

.....
(1)

(ii) Why are long-chain hydrocarbons available for cracking?

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

(d) Methane is used as a fuel. The combustion of methane is shown by the equation



The table gives some average bond dissociation energies.

Bond	Average bond dissociation energy (kJ/mol)
O=O	496
C=O	743
C—H	412
O—H	463



Use the data in the table opposite to answer the following questions.

(i) Calculate the total energy taken in when all the bonds in the reactants are broken.

(2)

(ii) Calculate the total energy given out when all the bonds in the products are formed.

(2)

(iii) Calculate the value of ΔH for this reaction.

(1)

(e) When a hydrocarbon burns in a limited supply of oxygen, incomplete combustion occurs. One of the products is carbon monoxide.

(i) Write a chemical equation for the incomplete combustion of methane.

.....
(2)

(ii) Why can incomplete combustion be dangerous?

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

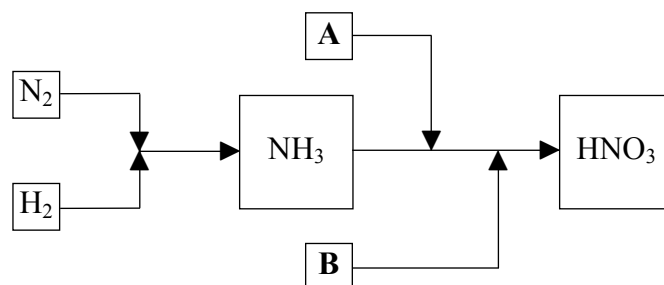
(Total 13 marks)

Q9

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10. The flow chart shows the steps in the industrial production of ammonia, NH₃, and nitric acid, HNO₃.



(a) (i) Name the raw material from which hydrogen is obtained.

..... (1)

(ii) Write a chemical equation to show how hydrogen is obtained from this raw material.

..... (2)

(iii) Name the catalyst used in the production of ammonia.

..... (1)

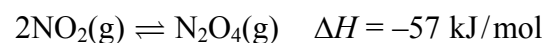
(b) Substance **A** in the flow chart is an element. Substance **B** is a compound. Identify **A** and **B**.

A

B

(2)

(c) During the conversion of ammonia into nitric acid, nitrogen dioxide, NO₂, is made. Nitrogen dioxide can undergo the following reaction.



This reaction is reversible. A dynamic equilibrium is established.

(i) How can you tell from the equation that the reaction is reversible?

..... (1)



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(ii) What is meant by the term **dynamic equilibrium**?

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

(iii) What happens to the amount of $\text{N}_2\text{O}_4(\text{g})$ in the mixture at equilibrium when the pressure is increased?

.....
(1)

(iv) What happens to the amount of $\text{N}_2\text{O}_4(\text{g})$ in the mixture at equilibrium when the temperature is increased?

.....
(1)

(d) (i) Why is it important that oxides of nitrogen are not allowed to escape into the atmosphere?

.....
(1)

(ii) Describe **two** problems that can result.

1
.....
2
.....
(2)

(Total 14 marks)

Q10

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TURN OVER FOR QUESTION 11



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11. Diamond and graphite are allotropes of carbon. They both have giant molecular covalent structures.

Both diamond and graphite have high sublimation points.

Diamond can be used for cutting.

Graphite can be used as a lubricant.

(a) Describe, without drawing a diagram, the structure of diamond.

Include the number of atoms to which each carbon atom is bonded and how the atoms are arranged. Explain how this structure relates to the use of diamond in cutting.

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

(3)

(b) Describe, without drawing a diagram, the structure of graphite.

Include the number of atoms to which each carbon atom is bonded and how the atoms are arranged. Explain how this structure relates to the use of graphite as a lubricant.

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

(3)

(c) Explain why both diamond and graphite have high sublimation points.

.....
.....

(2)

Q11

(Total 8 marks)

TOTAL FOR SECTION B: 75 MARKS

TOTAL FOR PAPER: 120 MARKS

END

