GREENDALE SECONDARY SCHOOL
Preliminary Examination 2024

STUDENT NAME	

CLASS	4		TEACHING GROUP						REG. NO		

CHEMISTRY **6092/02**
Paper 2 **1 hour 45 minutes**

Student answer on the Question Paper.
No Additional Materials are Required.

READ THESE INSTRUCTIONS FIRST

Write your name, class, teaching group and register number in the spaces provided above.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section **A**
Answer **all** questions.
Write your answers in the spaces provided.

Section **B**
Answer **one** question.
Write your answers in the spaces provided.

The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 32.

The use of an approved scientific calculator is expected, where appropriate.

Section A

Answer **all** questions.

1 Two chloride salts, iron(II) chloride and lead(II) chloride are made from the same acid but different preparation methods.

(a) Complete Table 1.1, in identifying the reactants to prepare iron(II) chloride and lead(II) chloride salts.

Table 1.1

<table>
<tr><td rowspan="2">salt</td><td colspan="2">reactants</td></tr>
<tr><td>acid</td><td>other reactant</td></tr>
<tr><td>iron(II) chloride</td><td rowspan="2">hydrochloric acid</td><td>iron(II) carbonate</td></tr>
<tr><td>lead(II) chloride</td><td>lead(II) nitrate</td></tr>
</table>

[2]

(b) Use Table 1.1 to name the resulting solution formed during the preparation of lead(II) chloride salt.

solution formed: ………………………………………………………………………… [1]

(c) While preparing iron(II) chloride, a student added one of the reactants in excess.

Use Table 1.1 to identify which reactant must be added in excess for the preparation of iron(II) chloride.

Explain your reasoning.

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…………………………………………………………………………………………………[1]

[Total: 4]

2 **(a)** Fig. 2.1 shows the structure of compound **A**.

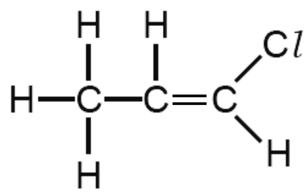

Fig. 2.1

Compound **A** can be polymerised.

Draw **two** repeating units of the polymer formed when compound **A** is polymerised.

[1]

(b) Poly(ethene) is an example of a polymer that can be recycled.

Describe one physical method and one chemical method used to recycle this polymer.

physical method ....

....

chemical method ....

.... [2]

(c) **(i)** Fig. 2.2 shows two monomers that react together to produce a polymer.

monomer 1 monomer 2

Fig. 2.2

Draw the structure of the repeating unit of the polymer produced from monomers 1 and 2.

[1]

(ii) The repeating unit for a different polymer is shown in Fig. 2.3.

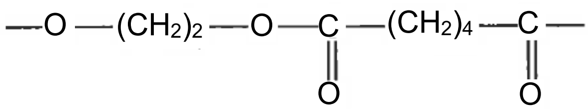

Fig. 2.3

Suggest **one** similarity and **one** difference between the monomers used to make this polymer and those used to make the polymer in **(c)(i)**.

....

....

....

....[2]

(iii) Name the type of linkage found in the polymer formed in **(c)(i)** and the polymer shown in Fig. 2.3.

polymer formed in **(c)(i)**: ....

polymer shown in Fig. 2.3: ....

[1]

[Total: 7]

3 Compounds **A** and **B** are isomers.

Table 3.1 shows some information about the isomers **A** and **B**.

Table 3.1

isomer	description of isomer			empirical formula	M_r	pH of 0.1 mol/dm^3 of solution
	$\mathrm{H-\overset{\displaystyle H \atop |}{\underset{\displaystyle | \atop H}{C}}-}$	$\mathrm{-\overset{\displaystyle H \atop |}{\underset{\displaystyle | \atop H}{C}}-}$	$\mathrm{-\overset{\displaystyle O \atop \|}{C}-O-}$			
A	✓	✓	✓	C_2H_4O	88	3
B	✓	×	✓	C_2H_4O	88	3

✓ − presence of unit
× − absence of unit

(a) Which data in Table 3.1 supports the statement that **A** and **B** are isomers?

....

....[1]

(b) Use the information in Table 3.1 to deduce and draw the structural formula for isomers **A** and **B**.

Show all atoms and bonds.

isomer **A**
isomer **B**

[2]

(c) The structure of another isomer of **A** and **B** is shown in Fig. 3.1.

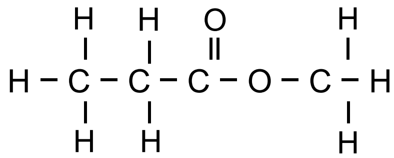

Fig. 3.1

Draw the displayed formula of the carboxylic acid and the alcohol that react to form the isomer in Fig. 3.1.

alcohol	carboxylic acid

[2]

(d) Another compound **R** is from the same homologous series as isomers **A** and **B**.

Compound **R** contains of 62.1% carbon, 10.3% hydrogen and 27.6% oxygen.

Deduce the **empirical formula** of compound **R**.
Show your working.

[2]

[Total: 7]

4 Fig. 4.1 shows some elements in the Periodic Table.

	1	2	13	14	15	16	17	18
Period 2	**Li**			**C**		**O**	**F**	
Period 3	**Na**						**C*l***	
Period 4	**K**						**Br**	
Period 5	**Rb**						**I**	

Fig. 4.1

(a) Put a tick (✓) in **one** box for each row to show whether the following statements about the trends of some of these elements in Fig. 4.1 are true or false.

	true	false
Atoms lose electrons more easily down group 1.		
Melting point decreases from fluorine to iodine.		
The strongest non-metal oxidising agent is at the top of a group.		
Metallic character increases across Period 3.		

[2]

(b) Table 4.1 shows information about some of the elements in Period 2.

Table 4.1

element	melting point /°C	electrical conductivity
lithium	180.5	good
carbon (graphite)	3600	good
oxygen	–218.8	poor

Use ideas about **bonding** and **structure** to explain the differences in properties of the elements shown in Table 4.1.

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[Total: 7]

5 Table 5.1 shows some information about the hydrides of elements in Period 3 of the Periodic Table. Read the information and answer the questions that follow.

Table 5.1

element	metal / non-metal	formula of hydride	M_r of hydride	effect of adding hydride to water
Na	metal	NaH	24	reacts to form $H_2(g)$ and an alkaline solution
Mg	metal	MgH_2	26	reacts to form $H_2(g)$ and an alkaline solution
A*l*	metal	AlH_3	30	reacts to form $H_2(g)$ and an alkaline solution
Si	non-metal	SiH_4	32	does not react
P	non-metal	PH_3	34	reacts to form $H_2(g)$ and a slightly alkaline solution
S	non-metal	H_2S	34	reacts to form a slightly acidic solution
C*l*	non-metal	HCl	36.5	reacts to form an acidic solution

(a) Write a balanced chemical equation for the reaction between NaH and water.

.... [1]

(b) A student performs an experiment to test whether some hydrides react with water.

He adds each hydride to water and tests the pH of the mixture.

Explain how the result shows whether a hydride is a metal hydride or a non-metal hydride.

....

....

.... [1]

(c) Draw a 'dot-and-cross' diagram to show the bonding in NaH.

Show only outer electrons.

[2]

(d) Explain why sodium hydride can conduct electricity in molten state but not in solid state.

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……………………………………………………………………………………………..[2]

(e) Two students make these statements about the percentage by mass of hydrogen in the hydrides.

Student 1: 'The greater the number of hydrogen atoms in the hydride, the greater the percentage by mass of hydrogen.'

Student 2: 'The percentage by mass of hydrogen is the same for the same number of hydrogen atoms in the hydride.'

Does the information in Table 5.1 support the statements made by students 1 and 2?

Explain your reasoning.

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……………………………………………………………………………………………..[2]

[Total: 8]

6 A student investigates the progress of the reaction between 20 cm^3 of 0.1 mol/dm^3 dilute hydrochloric acid, HCl, and an excess of large pieces of marble, $CaCO_3$, using the apparatus shown in Fig. 6.1.

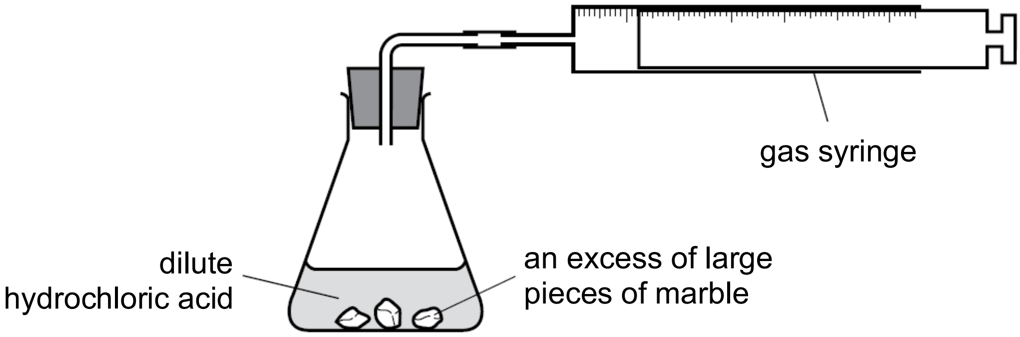

Fig. 6.1

(a) A graph of the volume of gas produced against time is shown in Fig. 6.2.

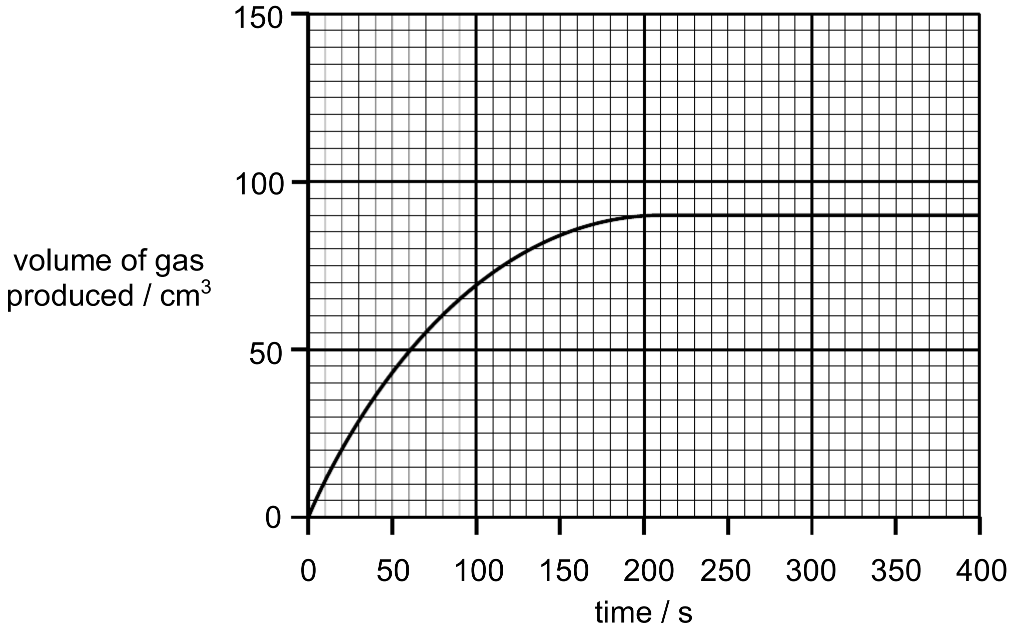

Fig. 6.2

(i) Deduce the time at which the reaction finishes.

time = ... s [1]

(ii) Calculate the average rate of the reaction for the first 90 seconds.

State the unit for the rate of reaction.

average rate of reaction = ...[1]

(b) The experiment is repeated using the

- same mass of smaller pieces of marble,
- half the volume of 0.1 mol/dm^3 of HCl.

All other conditions are kept the same.

Draw a line **on the grid** in Fig. 6.2 to show the progress of the reaction with the changes in conditions.

[1]

(c) The original experiment is repeated at a higher temperature.

All other conditions are kept the same.

Explain why the rate of a reaction increases when temperature increases, in terms of activation energy and collisions between particles.

....

....

....

....

....[2]

[Total: 5]

7 Peroxodisulfate ions, $S_2O_8^{2-}$, react with iodide ions in aqueous solution.

$$S_2O_8^{2-}(aq) + 2I^-(aq) \rightarrow 2SO_4^{2-}(aq) + I_2(aq)$$

Table 7.1 shows how the relative rate of this reaction changes when different concentrations of peroxodisulfate ions and iodide ions are used.

Table 7.1

experiment	concentration of $S_2O_8^{2-}$ / mol dm^{-3}	concentration of I^- / mol dm^{-3}	relative rate of reaction
1	0.008	0.02	1.7
2	0.016	0.02	3.4
3	0.032	0.02	6.8
4	0.008	0.04	3.4
5	0.008	0.08	

(a) Use information in Table 7.1 to deduce the relative rate of experiment 5.

Explain your reasoning.

....

....

....[1]

(b) In experiments 4 and 5, the volume of aqueous peroxodisulfate ions used is 20 cm^3 each.

In experiments 4 and 5, the volume of aqueous iodide ions used is 10 cm^3 each.

Which is the limiting reactant at the start of experiments 4 and 5?

Show your working.

[2]

[Total: 3]

8 **(a)** Emissions from power stations contain the pollutant gas, sulfur dioxide.

(i) Describe one harmful effect on marble statues and metal bridges caused by sulfur dioxide.

……………………………………………………………………………………….

……………………………………………………………………………………....[1]

(ii) One way to remove sulfur dioxide is to use a 'scrubber' containing wet calcium carbonate.

The reaction of sulfur dioxide with wet calcium carbonate happens in several stages.

In the first stage, sulfur dioxide reacts with water to make an acid, H_2SO_3.

In the second stage, this acid reacts with calcium carbonate to make calcium sulfite, $CaSO_3$.

Write a chemical equation for the reaction in each stage.

equation in stage 1:

……………………………………………………………………………………….

equation in stage 2:

……………………………………………………………………………………….

[2]

(b) Car engines are adjusted to work at a particular air: fuel ratio.

The amount of air that is mixed with the fuel affects the temperature of the engine, the amount of pollutant gases that form and how efficiently the catalytic converter works.

The major pollutant gases are carbon monoxide and nitrogen monoxide.

(i) A 'lean burn' engine runs with a higher ratio of air to fuel than a normal car engine.

This means that the mixture contains a higher amount of air compared to fuel.

One effect of this is a lower running temperature of the engine.

How will a lean burn engine affect the amount of **carbon monoxide** and **nitrogen monoxide** formed compared to a normal car engine?

Explain your reasoning.

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……………………………………………………………………………………[3]

(ii) The catalytic converter removes pollutant gases.

The converter removes carbon monoxide and nitrogen monoxide by oxidation and reduction.

from oxidising agent	to reducing agent
$CO + \overset{\downarrow}{[O]} \rightarrow CO_2$	$2NO \rightarrow N_2 + 2\overset{\downarrow}{[O]}$

Write an overall equation to show how carbon monoxide and nitrogen monoxide react together in the converter.

....[1]

(iii) Explain in terms of oxidation states, why the reactions in the catalytic converter are described as redox.

....

....

....

....[2]

[Total: 9]

9 Alkynes are a homologous series of organic compounds.

Alkynes contain the C≡C group. They react in a similar way to alkenes.

Table 9.1 shows some information about the first four alkynes.

Table 9.1

alkyne	molecular formula	boiling point / °C
ethyne	C_2H_2	–84
	C_3H_4	–23
butyne	C_4H_6	8
pentyne	C_5H_8	40

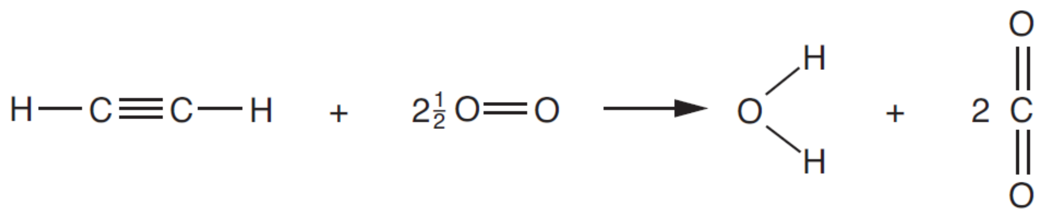
(a) Suggest the name of the alkyne with the molecular formula C_3H_4.

....[1]

(b) Deduce the general formula of the alkyne homologous series.

....[1]

(c) Ethyne reacts with oxygen in an exothermic reaction.



(i) Explain why the combustion of ethyne is an exothermic reaction.

Use ideas about the energy changes that take place during bond breaking and bond making.

....

....

....

.... [2]

(ii) The complete combustion of one mole of ethyne releases 1410 kJ of energy.

Calculate the energy released when 1000 dm^3 of ethyne, measured at room temperature and pressure, is completely combusted.

energy released = ... kJ [2]

(d) Ethyne is bubbled through aqueous bromine.

(i) Suggest a possible molecular formula of the product of this reaction.

.... [1]

(ii) What is observed during the reaction?

.... [1]

[Total: 8]

10 Dynamic equilibrium

Reversible reactions often have a product yield much lower than 100%, and always result in a mixture of products and reactants after no further chemical change occurs.

A reversible reaction comprises of a forward reaction and a backward reaction, as shown in Fig. 10.1.

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

forward reaction

$N_2O_4(g) \rightarrow 2NO_2(g)$

backward reaction

$2NO_2(g) \rightarrow N_2O_4(g)$

Fig. 10.1

A unique feature about reversible reactions is that both forward and backward reactions occur simultaneously.

Eventually, a state of **dynamic equilibrium** is achieved, whereby any new amount of products formed is converted back into the reactants, and the reactants are converted into products, as time passes. Hence, the system is in a state of balance, known as equilibrium. The concentration of reactants and products remain constant.

Fig. 10.2 shows a graph of forward and backward reaction rates as time passes, based on the decomposition of N_2O_4, dinitrogen tetroxide, shown in Fig. 10.1.

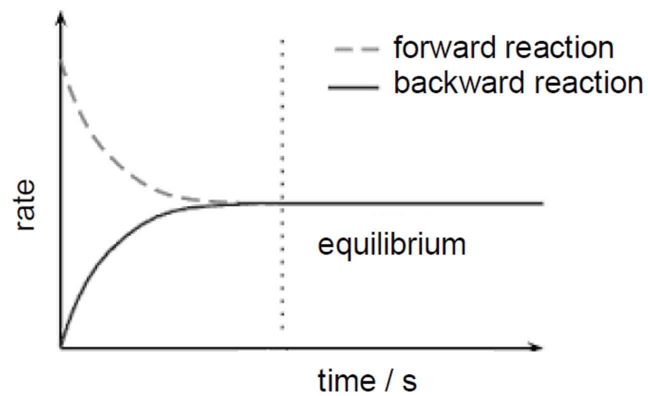


Fig. 10.2

Le Chatelier's principle

In the late 1800s, Henri Louis Le Chatelier, devised an important principle. It states that **if a dynamic equilibrium is disturbed by changing the conditions, the position of equilibrium shifts to counteract and remove the change to re-establish a new equilibrium of reactants and products.**

One way in which the equilibrium can be disturbed is by adding reactants or products to, or removing reactants or products from the mixture.

The composition of an equilibrium mixture in a reversible reaction can be affected by changes in concentration, temperature and pressure.

Factors affecting equilibrium

Changing concentration

An example is the formation of a white precipitate of bismuth oxychloride, $BiOCl$, when colourless bismuth(III) chloride, $BiCl_3$, is added to water.

$$BiCl_3(aq) + H_2O(l) \rightleftharpoons BiOCl(s) + 2HCl(aq)$$

Read Table 10.1 which describes the changes when excess $HCl(aq)$ is added to the equilibrium mixture. This addition of excess $HCl(aq)$ is a ‘disturbance’.

Table 10.1

substances present at **initial** equilibrium	$BiCl_3(aq)$, $H_2O(l)$, $BiOCl(s)$ and $HCl(aq)$
disturbance: adding excess HCl at equilibrium	increase in concentration of $H^+(aq)$ and $Cl^-(aq)$
to counteract and remove the disturbance	shift towards the backward reaction to remove excess $HCl(aq)$
new equilibrium obtained	more $BiCl_3(aq)$ and $H_2O(l)$; less $BiOCl(s)$

Changing temperature

An example is the industrial manufacture of ammonia.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Read Table 10.2 which describes the changes when temperature is increased.

Table 10.2

substances present at **initial** equilibrium	$N_2(g)$, $H_2(g)$ and $NH_3(g)$
energy change for this reaction	forward reaction releases heat (exothermic); backward reaction absorbs heat (endothermic)
disturbance: increase in temperature at equilibrium	excess heat added to the reaction
to counteract and remove the disturbance	shift towards the backward reaction which absorbs the excess heat
new equilibrium obtained	more $N_2(g)$ and $H_2(g)$; less $NH_3(g)$

<u>Changing pressure</u>

The same example of the industrial manufacture of ammonia is used.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Read Table 10.3 which describes the changes when pressure is increased.

Table 10.3

moles of gas	moles of gaseous reactants: 1 mole of N_2 + 3 moles of H_2 = 4 moles moles of gaseous product: 2 moles of NH_3 = 2 moles
disturbance: increase in pressure at equilibrium	excess pressure in the reaction
to counteract and remove the disturbance	shift towards the forward reaction (fewer number of moles of gas) to decrease the number of moles of gas present
new equilibrium obtained	less $N_2(g)$ and $H_2(g)$; more $NH_3(g)$

(a) Use information from Fig. 10.2 to describe how the forward and backward reaction rates change over time.

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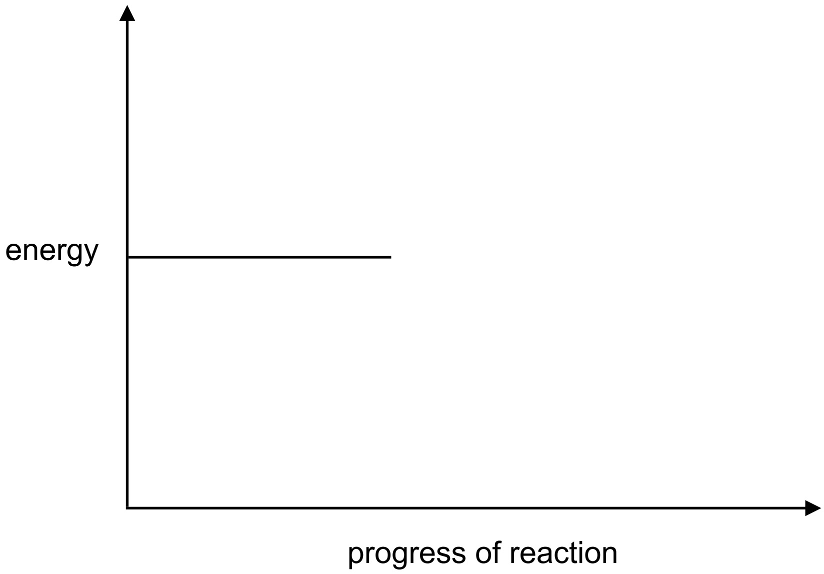
…………………………………………………………………………………………[2]

(b) Complete the energy profile diagram for the manufacture of ammonia.

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) \qquad \Delta H = \text{ negative}$$

Your diagram should show:

- the reactants and products of the reaction,
- the energy profile and activation energy, E_a,
- the enthalpy change of reaction, ΔH.



[3]

(c) When hydrogen ions are added to methyl orange (Meor), a red coloured complex (H-Meor) is formed.

An equilibrium mixture between the two forms of methyl orange will be established.

$$\underset{\text{red}}{\text{H-Meor(aq)}} \rightleftharpoons H^+(aq) + \underset{\text{yellow}}{Meor^-(aq)}$$

$Meor^-$ is yellow in colour.

Using Le Chatelier's Principle, suggest what you would observe when hydroxide ions are added to this equilibrium mixture.

Explain your reasoning.

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…………………………………………………………………………………………[2]

(d) An equilibrium mixture for the formation of methanol from carbon monoxide and hydrogen is shown.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

Using Le Chatelier's Principle, predict and explain the effect of decreasing the pressure on the amount of methanol in the equilibrium mixture.

The temperature remains constant.

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………………………………………………………………………………………… [2]

(e) At 200 °C and 200 atmospheric pressure, phosphorus(V) chloride, PCl_5, forms an equilibrium mixture with phosphorus(III) chloride, PCl_3, and chlorine, Cl_2.

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

The table shows the percentage of phosphorus(III) chloride in the equilibrium mixture at different temperatures.

The pressure is the same in each case.

temperature / °C	% of PCl_3 in the mixture
200	48
300	95
400	99

(i) Describe how the composition of this equilibrium mixture changes with temperature.

.... [1]

(ii) Use your answer from **(e)(i)** and Le Chatelier's Principle to predict whether the forward reaction is endothermic or exothermic.

Explain your reasoning.

....

....

....

....

....

....[2]

[Total: 12]

Section B

Answer **one** question from this section.

11 **(a)** Electrolysis of dilute aqueous potassium chloride and concentrated aqueous potassium chloride were carried out separately using inert electrodes.

A few drops of Universal Indicator were added to each of the electrolyte.

The set-up is shown in Fig. 11.1 and Fig. 11.2.

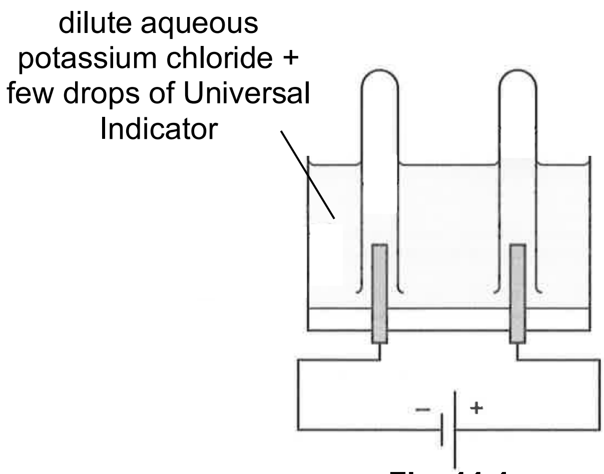

Fig. 11.1

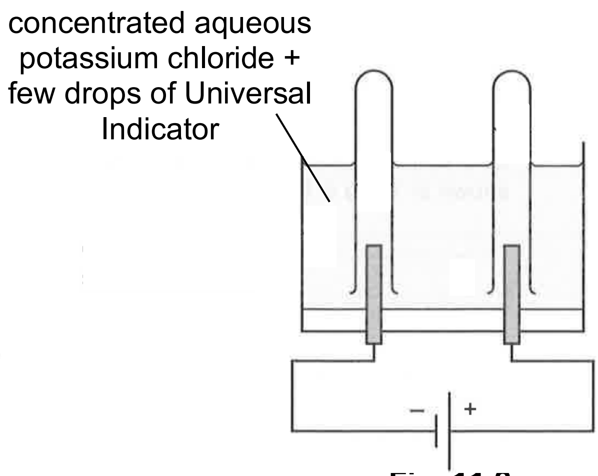

Fig. 11.2

A student made this conclusion regarding both the electrolysis.

For both of the electrolysis,
- the gaseous product at the negative electrode is the same but
- the gaseous product at the positive electrode is different.

Explain the student's conclusion and the changes to the electrolyte.

Your answer should:
- explain why the products form,
- describe and explain the changes to the Universal Indicator added to each electrolyte,
- give half-equations for the reaction at each electrode.

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[5]

(b) A new type of electroplating is known as brush electroplating. It can be used to electroplate copper onto very large iron structures.

During the electroplating process, a metal brush spreads a layer of aqueous copper(II) sulfate over the surface of the iron structure. A layer of copper metal forms on the surface of the iron support.

Fig. 11.3 shows the set-up.

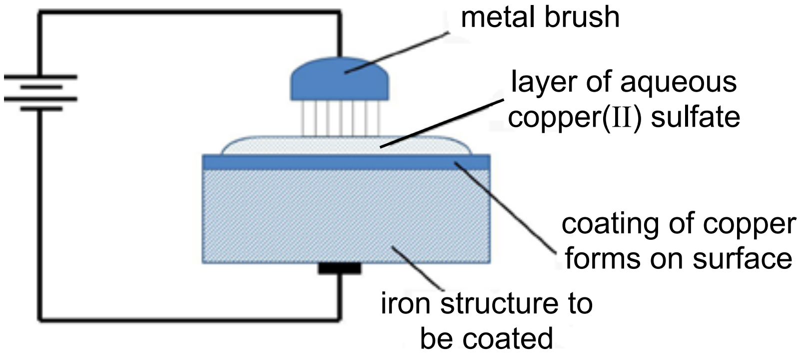

Fig. 11.3

(i) Identify each electrode in the electroplating process in Fig. 11.3.

negative electrode: ....

positive electrode: ....

[1]

(ii) Write an ionic half-equation for the formation of copper metal on the iron structure.

State symbols are **not** required.

....[1]

(iii) Two different designs of metal brush are available.
One type of brush is made of copper while the other is made of platinum.

As the electroplating takes place, each brush has a different effect on the concentration of copper(II) ions in aqueous copper(II) sulfate.

State the effect on the concentration of copper(II) ions during the electrolysis when each brush is used.

brush made of copper:

effect: .... [1]

brush made of platinum:

effect: .... [1]

(iv) Platinum brushes are much more expensive than copper brushes.

However, copper brushes need replacing regularly but platinum brushes do not.

Explain why.

....

....

.... [1]

[Total: 10]

12 **(a)** Fig. 12.1 shows an experiment, where rods of copper and zinc are dipped into dilute sulfuric acid.

The top of each rod is touching.

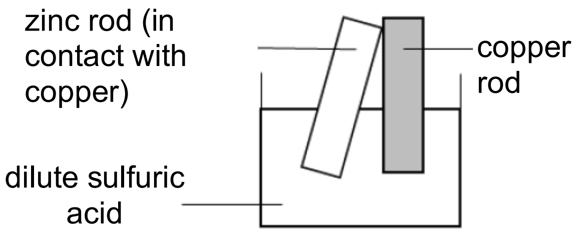

Fig. 12.1

Predict and explain the expected observations.

Your answer should:

- describe the expected observations at each piece of metal rod,
- explain why each change occurs,
- give half-equations for the reaction at each metal rod.

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[4]

(b) Table 12.1 gives some data about two fuels, hydrogen and ethanol.

Table 12.1

fuel	boiling point/ °C	density at r.t.p / g dm^{-3}	volume of 1 mol of fuel at r.t.p / dm^3	enthalpy change of combustion / kJ mol^{-1}	enthalpy change of combustion / kJ g^{-1}
hydrogen, H_2	–252	0.083	24		−143
ethanol, C_2H_5OH	78.4	789		−1367	

(i) Complete Table 12.1 by calculating the volume of 1 mol of ethanol, and the enthalpy change of combustion of hydrogen in kJ / mol and the enthalpy change of combustion of ethanol in kJ / g.

Use the space below to show your working.

[3]

(ii) Use the information in Table 12.1 to evaluate the use of hydrogen and ethanol as fuels.

Your answer should consider:

- the ease of storage,
- the energy content of the fuels.

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.... [2]

(iii) Ethanol can be manufactured from ethene and from glucose.

State which source of ethanol makes it a renewable fuel and explain your answer.

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………………………………………………………………………………………[1]

[Total: 10]

END OF PAPER

The Periodic Table of Elements

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

Group

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

The Avogadro constant, $L = 6.02 \times 10^{23}$ mol^{-1}