Geylang Methodist School (Secondary)
Preliminary Examination 2019

CHEMISTRY **6092/01**

Paper 1 Multiple Choice **Sec 4 Express**

Additional materials : OAS **1 hour**

Setter : Mr Jeryl Goh **16 September 2019**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class and register number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions in this paper. Answer **all** questions.
For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark.
A mark will not be deducted for a wrong answer.
Any rough working should be done in this paper.
A copy of the Periodic Table is printed on page 14.

This document consists of **14** printed pages.

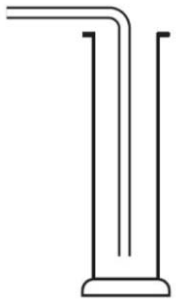
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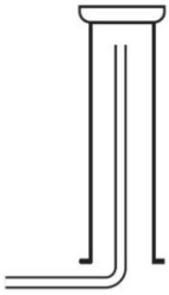
1 In an experiment, a student reacts hydrochloric acid with magnesium ribbons and wants to collect and measure the amount of gas produced at 30-second intervals.

Which apparatus is most suitable for collecting the gas produced?

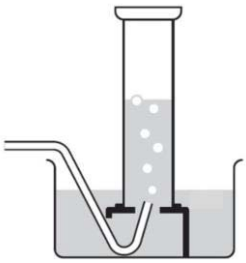
A



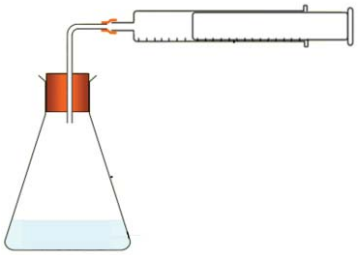
B



C



D



2 Mary performed paper chromatography on a dye and obtained only one spot with an R_f value of 0.68.

Which of the following statements is true about her chromatogram?

A Changing the solvent will not affect the R_f value.
B Using a more concentrated dye solution will increase the R_f value.
C The dye is likely to be a pure substance.
D The spot is closer to the starting line than it is to the solvent front.

3 In which of the following solid mixtures can the underlined substance be obtained by adding water, stirring and filtering?

A mixture of iron and <u>iron(II) chloride</u>
B mixture of <u>lithium</u> and copper(II) sulfate
C mixture of sand and <u>iron</u>
D mixture of <u>sodium chloride</u> and sodium hydroxide

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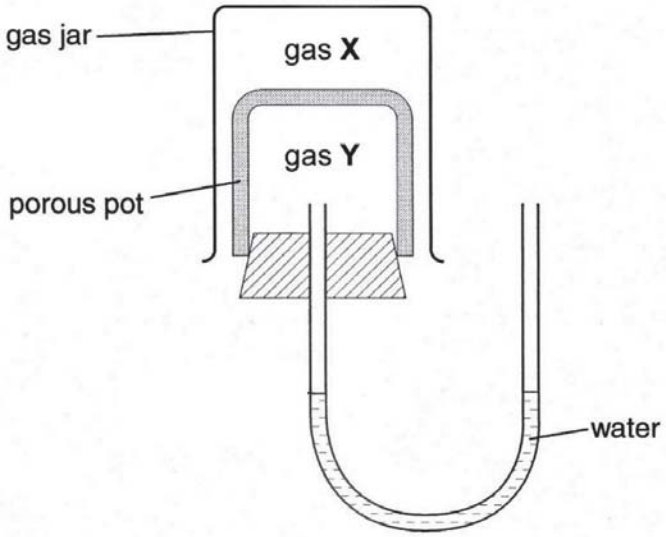
4 A series of chemical tests performed on an unknown solution produced the following results.

test	observation
add aqueous sodium hydroxide, warm gently	effervescence produced
add acidified barium nitrate	white precipitate formed, no effervescence produced

Which of the following substance could be present in the solution?

A ammonium carbonate
B ammonium sulfate
C calcium sulfate
D sodium hydrogencarbonate

5 The following apparatus was set up as shown below.



Which of the following pair of gases X and Y will result in no movement of the water in the U-shaped tube?

	gas X	gas Y
A	H_2	He
B	N_2	CO
C	O_2	CH_4
D	SO_2	NO_2

6 Which of the following groups of substances contain an element, a compound and a mixture?

A brass, rust, haematite
B diamond, graphite, air
C ozone, cast iron, slag
D silica, diamond, petrol

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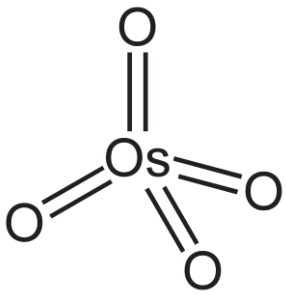
7 The following table lists the atomic structure of three particles W, X, Y and Z.

particle	proton	electron	neutron
W	7	10	7
X	7	7	8
Y	7	10	8
Z	8	8	8

Which two particles are isotopes of each other?

A W and Y
B X and Y
C X and Z
D Y and Z

8 Osmium tetroxide has the structural formula as shown.



What is the valency of osmium?

A 4
B 8
C 12
D 16

9 Which of the following statements explains why copper conducts electricity?

A Copper atoms are held together by weak intermolecular forces.
B Copper has free moving atoms.
C Copper has free moving electrons.
D Copper has free moving ions.

10 How many oxygen atoms are there in 0.05 moles of ozone gas?

A 3×10^{22}
B 3×10^{23}
C 9×10^{22}
D 9×10^{23}

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11 In a titration, 26.4 cm^3 of 0.2 mol/dm^3 calcium hydroxide was required to completely neutralize 19.0 cm^3 of hydrochloric acid.

What is the concentration of the acid used?

A 0.28 mol/dm^3
B 0.36 mol/dm^3
C 0.56 mol/dm^3
D 0.84 mol/dm^3

12 A 5.0 g sample of a mixture of sand and calcium carbonate was heated strongly in an open flask until there was no further change in mass.

Determine the percentage calcium carbonate in the mixture if the final recorded mass was 4.2 g.

A 36%
B 52%
C 72%
D 84%

13 Which of the following properties increases down the group in Group I?

A ease of losing an electron
B ionic charge
C melting point
D non-metallic character

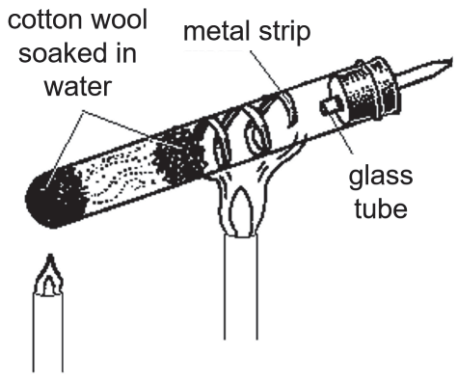
14 A new halogen discovered, X, forms a compound with potassium with the formula KX. A solution of KX was found to be displaced by iodine.

Which of the following most likely describes the appearance and physical state of X_2?

A a dark coloured liquid
B a dark coloured solid
C a pale coloured liquid
D a pale coloured solid

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15 In the experiment shown below, a strip of metal was heated in a test-tube. When a spark was created at the outlet of the glass tube, no flame was observed.



Which of the following metal could be in the test-tube?

A calcium
B magnesium
C tin
D zinc

16 When nickel is placed in copper(II) nitrate solution, the solution gradually turns green.

Which statement is true about the reaction?

A Copper atoms gain electrons.
B Copper ions gain electrons.
C Nickel atoms gain electrons.
D Nickel ions gain electrons.

17 Which of the following reactions does **not** occur in the extraction of iron in the blast furnace?

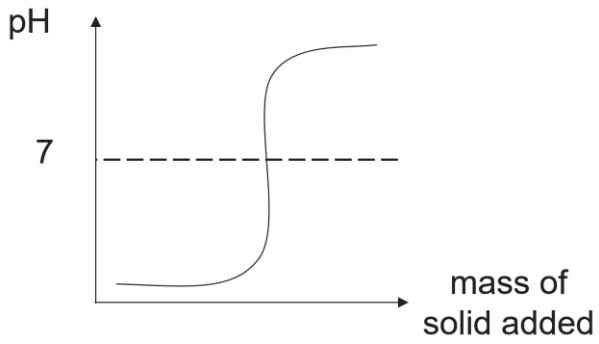
A $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
B $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$
C $CaCO_3 + 2NO_2 \rightarrow Ca(NO_3)_2 + CO_2$
D $C + CO_2 \rightarrow 2CO$

18 What ions are present in dilute aqueous ammonia?

A H^+ and OH^-
B NH_4^+, H^+, Cl^-, OH^-
C NH_4^+, H^+, OH^-
D NH_4^+, OH^-

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19 A solid was added, bit by bit, to a solution of hydrochloric acid. The graph below shows the change in pH.



What could the solid be?

A Li_2O
B MgO
C P_4O_{10}
D SiO_2

20 A student wants to prepare crystals of zinc chloride.

Which method is most suitable for this preparation?

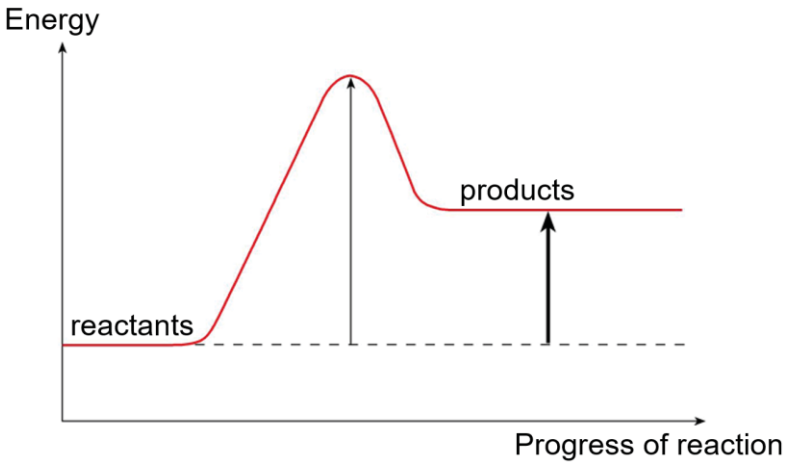
A displacement of magnesium chloride by zinc
B neutralization between zinc oxide and hydrochloric acid
C precipitation from zinc nitrate and sodium chloride
D titration of zinc hydroxide and hydrochloric acid

21 Which compound will likely be the best plant fertilizer?

A aluminium nitrate
B ammonium nitrate
C ammonium chloride
D sodium nitrate

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22



Which of the following reactions could have the above energy profile?

A $CuCO_3$ (s) → CuO (s) + CO_2 (g)
B $2NaOH$ (aq) + H_2SO_4 (aq) → Na_2SO_4 (aq) + $2H_2O$ (*l*)
C CH_4 (g) + $2O_2$ (g) → CO_2 (g) + $2H_2O$ (g)
D H_2O (g) → H_2O (*l*)

23 Which of the following statements best explains why sodium reacts spontaneously with water?

A Plenty of heat energy is given out during the reaction.
B Sodium atoms are exceptionally energetic.
C The activation energy of the reaction is small.
D The bonds in the products are very strong.

24 How will the addition of a catalyst affect the energy of particles and the activation energy of the reaction?

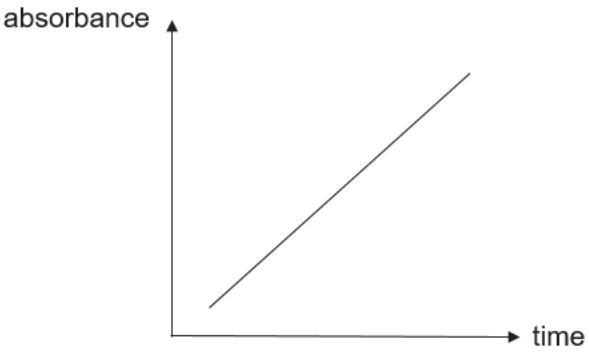
	energy of particles	activation energy
A	increases	decreases
B	increases	remains the same
C	remains the same	decreases
D	remains the same	remains the same

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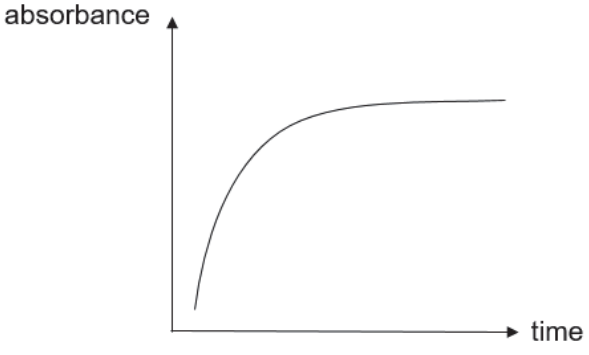
25 Octene (C_8H_{16}) is able to absorb UV light. The Beer-Lambert Law states that the amount of UV light absorbed is proportional to the concentration of the compound present. In one experiment, bromine water was added dropwise until in excess to a solution of octene and the absorbance of UV light by the mixture was tracked over time.

Which of the following graphs represents how the absorbance of UV light changes over time?

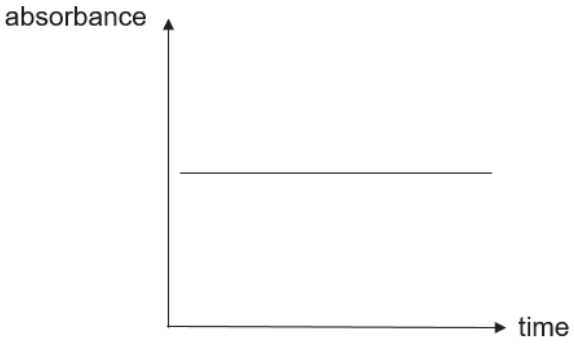
A



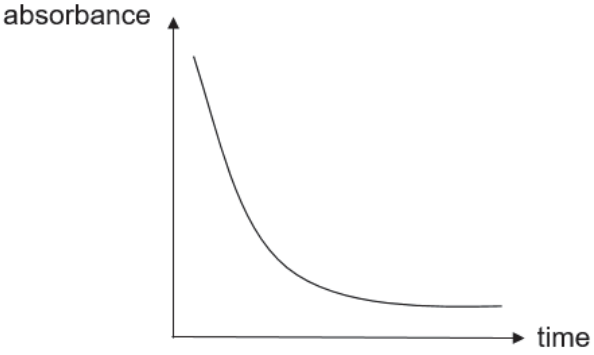
B



C



D



26 Which of the following correctly identifies the oxidation state of the underlined element?

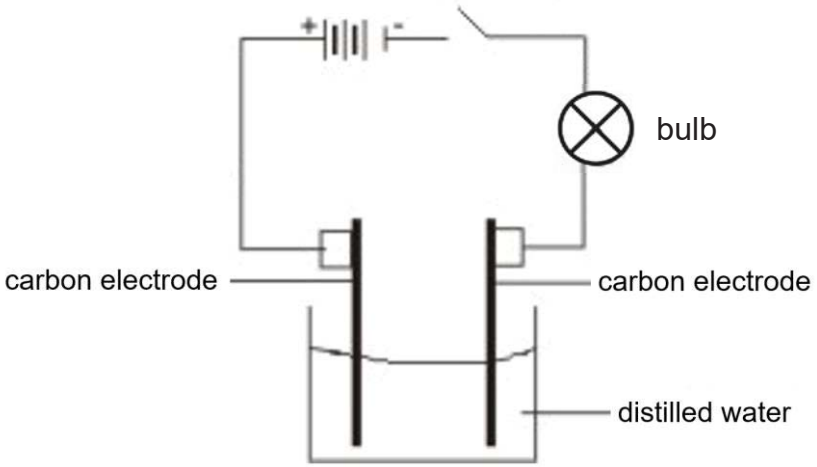
	substance	oxidation state
A	$\underline{Cu}_2O$	+2
B	$H_2\underline{S}O_3$	+4
C	$K\underline{Br}O_3$	+6
D	$P_4\underline{O}_{10}$	+5

27 Which of the following does **not** show a redox reaction?

A $C + CO_2 \rightarrow 2CO$
B $Fe + H_2O \rightarrow FeO + H_2$
C $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$
D $Zn + FeSO_4 \rightarrow ZnSO_4 + Fe$

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28 The diagram below shows an electrolytic cell. Initially, the bulb does not light up when the switch is closed.



Which of the following substances, when added, will cause the bulb to be the brightest?

A ethanoic acid
B magnesium carbonate
C sodium hydroxide
D sugar

29 Concentrated hydrochloric acid was electrolysed using inert electrodes.

Which of the following best describes how the pH of the electrolyte changes in the first five minutes?

A increases
B decreases
C remains constant at pH 1
D remains constant at pH 7

30 Three electric cells are set up using zinc metal and three unknown metals, U, V and W as electrodes.

The potential differences between the metals are given in the table below.

electric cell	metals used	voltage / V	positive electrode
1	Zn, U	–0.45	Zn
2	Zn, V	+2.71	V
3	Zn, W	+1.11	W

From these results, deduce which arrangement correctly lists the metals in the order of **decreasing** reactivity.

A U, Zn, V, W
B U, Zn, W, V
C V, W, Zn, U
D V, Zn, W, U

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31 Which statement best explains why carbon monoxide is harmful?

A It causes acid rain.
B It combines strongly with haemoglobin.
C It contributes to global warming.
D It irritates the eyes and lungs.

32 Which molecule has the greatest ozone-depleting potential?

A $CFClBr$
B $CFCl_3$
C CF_3Cl
D CH_2F_2

33 Which of the following is true about kerosene?

A Kerosene has a lower viscosity than petrol.
B Molecules of kerosene are larger than those in naphtha.
C Molecules in kerosene are used to make petrochemicals.
D Molecules of kerosene burn with a smokier flame than those in diesel.

34 Which of the following fuel would produce the greatest mass of carbon dioxide per kilogram when burnt in an excess supply of air?

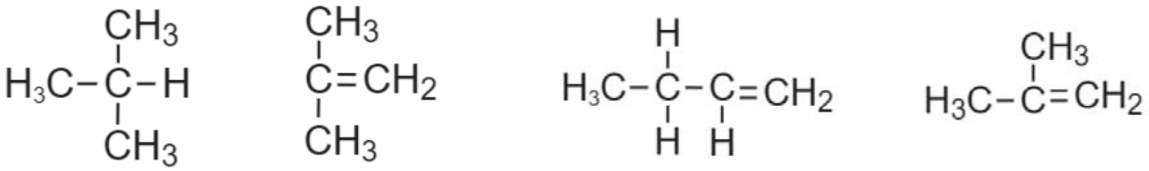
A $CH_2CHCOOCH_2CH_3$
B $(CH_3)_3COH$
C $CH_3CH_2C(CH_3)_2CH_2CH_3$
D $CH_3CH_2CH_2CH_2CH_2OH$

35 What catalyst is required for the addition of steam to an alkene?

A aluminium oxide
B concentrated sulfuric acid
C nickel
D phosphoric(V) acid

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36 The structures of four hydrocarbons are shown below.



How many isomers of butene are there?

A 1
B 2
C 3
D 4

37 Which of the following substances **cannot** be used to distinguish between ethanol and ethanoic acid?

A acidified potassium manganate(VII)
B aqueous bromine
C lithium carbonate
D moist blue litmus paper

38 Which bond is broken during esterification?

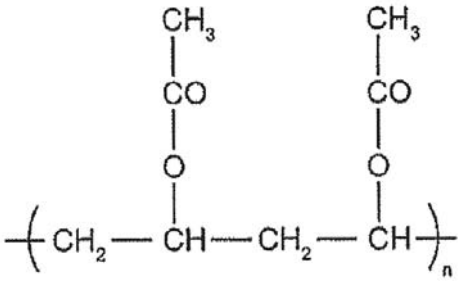
A C – C bond
B C – H bond
C C – O bond
D C = O bond

39 Which of the following statements is true about nylon and terylene?

A Both nylon and terylene have a carboxylic acid as one of their monomers.
B Nylon has ester linkages while terylene has amide linkages.
C Only one product is formed during their manufacturing processes.
D They are both made from addition polymerisation reactions.

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40 The diagram shows the formula of a polymer.



Which of the following could be used to make this polymer?

A $CH_3–COO–CH=CH_2$
B $HOOC–CH_2–COOH$ and $HO–CH_2CH_2–OH$
C $CH_3–CO–CH=CH_2$
D $CH_3–COO–CH_2=CH_2–OOC–CH_3$

End of Paper

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Geylang Methodist School (Secondary)
Preliminary Examination 2019

Candidate Name			
Class		Index Number	

CHEMISTRY

6092/02

Paper 2

Sec 4 Express

Additional materials: Nil

1 hour 45 minutes

Setter: Ms Ng Peck Suan

28 August 2019

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions in the spaces provided.

Section B
Answer **all three** questions in the spaces provided, the last question is in the form either/or.

At the end of the examination, **hand in Section A and Section B separately**.
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 17.

For Examiner's Use	
Section A	/50
B8	/10
B9	/10
B10	/10
Total	80

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Section A

Answer **all** questions in this section in the spaces provided.

A1 The equations **A**, **B**, **C**, **D** and **E** show some reactions involving compounds of Y.

A	**Y**CO_3 (s) → **Y**O (s) + CO_2 (g)
B	2**Y**O (s) + C (s) → 2**Y** (s) + CO_2 (g)
C	**Y**O (s) + H_2SO_4 (aq) → **Y**SO_4 (aq) + H_2O (*l*)
D	**Y**SO_4 (aq) + 2NaOH (aq) → **Y**$(OH)_2$ (s) + Na_2SO_4 (aq)
E	**Y**$(OH)_2$ (s) + 2HC*l* (aq) → **Y**Cl_2 (aq) + $2H_2O$ (*l*)

Use the letters **A**, **B**, **C**, **D** and **E** to answer parts **(a)** – **(c)** below.

(a) Which equation shows a change in the oxidation state of Y?

…… [1]

(b) Which three of the above equations are exothermic reactions?

…… [3]

(c) Which of these equations illustrates thermal decomposition?

……..... [1]

(d) When reaction D is carried out, a blue precipitate which is insoluble in excess aqueous sodium hydroxide is observed.

(i) State the expected observation when aqueous ammonia is added dropwise until in excess into a portion of aqueous **Y**SO_4.

.....

…… [2]

(ii) Write an ionic equation to represent reaction **D**.

…… [2]

[Total: 9]

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A2 The diagram shows part of the Periodic Table. Only some of the elements are shown.

							H										
													C	N	O		
Na												Al		P			
K	Ca						Fe			Cu	Zn						
Rb																	

Answer each of the following questions using only those elements shown in the diagram above. Each element may be used once, more than once or not at all.

(a) Give one element which

(i) has a giant molecular structure,

…….. [1]

(ii) combines with oxygen to form a gas which contributes to acid rain,

…….. [1]

(iii) forms an ion of type X^+ which has only three completely filled shells of electrons,

……. [1]

(iv) has a chloride of type XCl_2, whose aqueous solution forms a white precipitate with aqueous sodium hydroxide but insoluble in excess of it.

…….. [1]

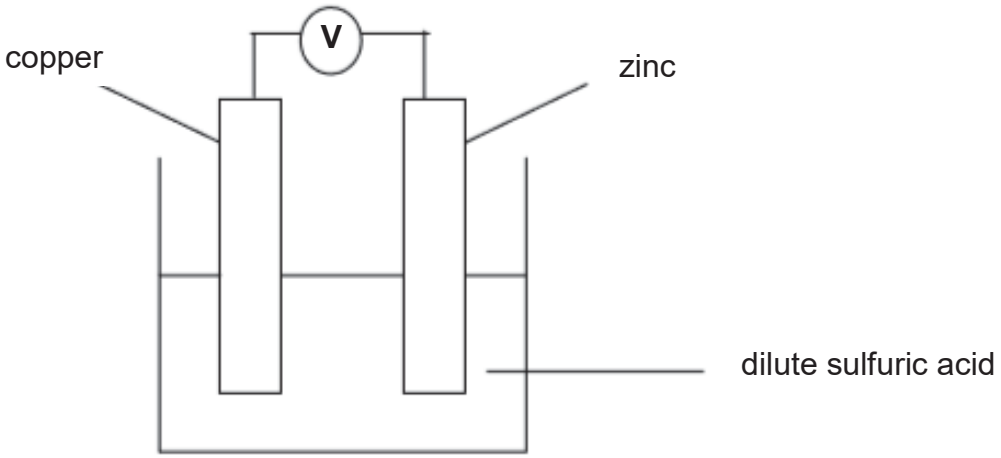
(b) Draw a 'dot and cross' diagram to show the chemical bonding in XCl_2.
Show only the outer shell electrons.

[2]

[Total: 6]

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A3 The diagram below shows an electric cell.



(a) **(i)** Indicate with arrows on the diagram to show the direction of the flow of electrons in the wire.

[1]

(ii) Write an ionic half equation for the reaction taking place at the negative electrode.

…….. [2]

(b) The experiment is repeated with the zinc electrode replaced by iron.

(i) State and explain the change in voltmeter reading obtained.

…….

…… [2]

(ii) State the colour change in the solution that will be different from that of copper with zinc.

…….

…….. [1]

[Total: 6]

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A4 Small pieces of different metals were added to different solutions of metal ions in water. The results are summarised in the following table.

Metal / Solution	**V**	**W**	**X**	**Y**	**Z**
V^{4+}	--------	displacement occurs	displacement occurs	displacement occurs	displacement occurs
W^{3+}	no reaction	--------	displacement occurs	displacement occurs	displacement occurs
X^{2+}	no reaction	no reaction	--------	displacement occurs	displacement occurs
Y^{3+}	no reaction	no reaction	no reaction	--------	no reaction
Z^{2+}	no reaction	no reaction	no reaction	displacement occurs	--------

(a) Place the five metals in order of chemical reactivity, with the most reactive first.

……..... [1]

(b) Magnesium is a more reactive metal than X but less reactive than Z,

(i) suggest the method of extraction for Z.

……..…… [1]

(ii) suggest the identity of metal Z.

…….. [1]

(iii) write a chemical equation for the reaction of metal Z with water.

……..…… [1]

(c) Iron is extracted in the blast furnace before it is made into alloys.
Draw the structure of the bonding present in iron. Label your diagram.

[2]

[Total: 6]

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A5 Barium is a metal found in Group II. Barium salts can be prepared using the various salt preparation methods. In an experiment, barium nitrate was prepared by adding 5 g of barium carbonate to 25.0 cm^3 of 0.400 mol/dm^3 dilute nitric acid.

(a) Identify the limiting reactant. Show your calculation clearly.

[3]

(b) A mass of 1.00 g of barium nitrate was obtained.

Calculate the percentage yield of barium nitrate.

[3]

(c) Calcium is another metal found in Group II.

State the two starting reagents for preparation of calcium sulfate.

…….. [2]

[Total: 8]

A6 Excess methane reacts with insufficient oxygen to give only two products – steam and a gaseous carbon-containing compound. The energy released from the reaction was 1080 kJ/mol. The table below shows some bond energies:

Covalent bond	**Bond energy (kJ/mol)**	**Covalent bond**	**Bond energy (kJ/mol)**
H – H	436	C – H	412
Cl – Cl	242	H – Cl	431
C – C	348	C = C	612
O – H	463	O = O	496

(a) Write a balanced chemical equation for the reaction. Include state symbols.

…….. [2]

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(b) Calculate the bond energy in the carbon-containing product in kJ/mol.

[2]

(c) Explain whether the reaction is exothermic or endothermic, in terms of bond-breaking and bond-forming.

……

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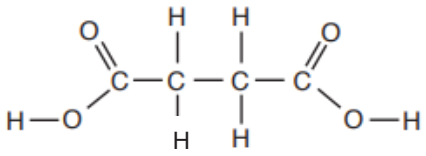
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…….... [3]

[Total: 7]

A7 Carboxylic acids contain the –COOH group. The following shows the full structural formula of carboxylic acid **W**.



(a) Magnesium was added to carboxylic acid **W** to form a salt and another product.

Describe your test and observations for another product obtained from the reaction between magnesium and carboxylic acid **W**.

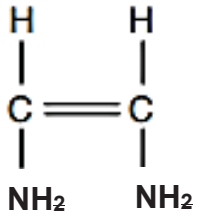
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…… [2]

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(b) The following compound **X** can undergo two types of polymerisation, one of which is condensation polymerisation when it reacts with acid **W**.

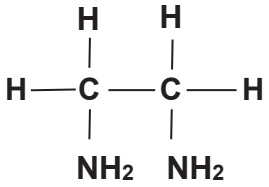


compound **X**

Draw two repeat units of the polymer formed when compound **X** and carboxylic acid **W** undergo condensation polymerisation. Circle the linkage.

[2]

(c) Compound **X** can then be converted into the following compound **Y**:



compound **Y**

State the reagent and conditions needed.

Reagent: …… [1]

Conditions: ……... [2]

(d) Predict your observation when compound **X** was added to bromine solution.

……

…… [1]

[Total: 8]

End of Section A

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Name:	Class:	Index No:	Marks:

Section B

Answer all **three** questions from this section.

The last question is in the form of an either/or and only **one** of the alternatives should be attempted.

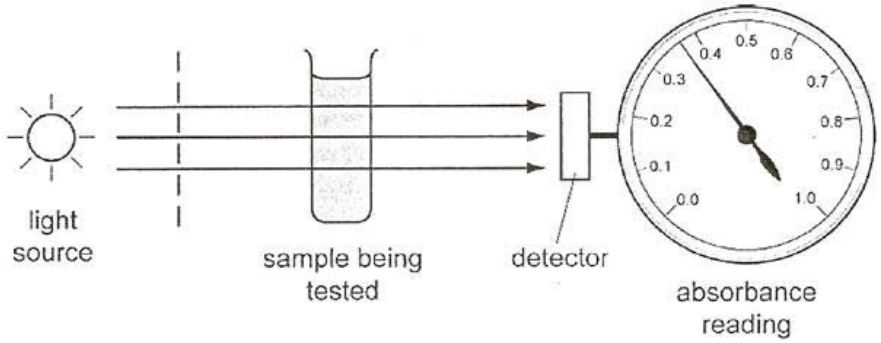
Write your answers in the spaces provided.

B8 Bromine is an important chemical used for making flame retardants. Bromine is extracted from seawater, which is naturally rich in bromide ions. Chlorine can be bubbled through seawater to convert bromide ions into bromine.

A student carried out an experiment in a laboratory to investigate the reaction between bromide ions and chlorine gas.

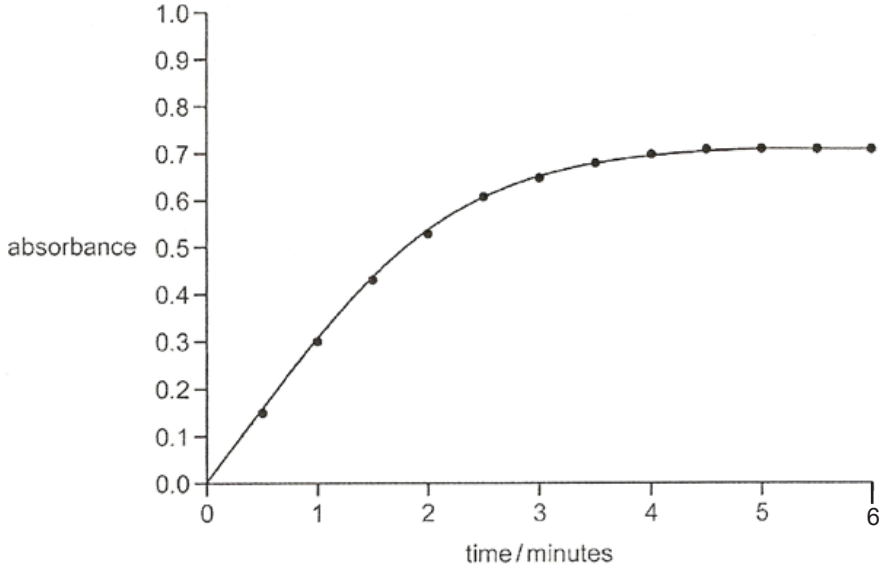
She bubbled chorine through aqueous potassium bromide for 6 minutes. She took samples of the reaction mixture every 30 s and measured the colour intensity of each sample using a colorimeter.

A colorimeter measures the amount of light absorbed by the solution when the light passes through a coloured solution.
The diagram shows how a colorimeter works.



The darker the colour of the solution, the greater the amount of light absorbed and the higher the absorbance reading on the colorimeter. Aqueous bromine absorbs more light than aqueous chlorine or aqueous potassium bromide.

The student plotted her results on a graph.



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(a) Write an ionic equation to represent the reaction between chlorine gas and aqueous potassium bromide.

…… [1]

(b) State and explain, with reference to the reaction, the relationship between absorbance and time in the **first minute** of the experiment.

……

……

…… [2]

(c) Describe and explain with the aid of the Collision Theory, the changes in speed of reaction shown by the graph.

……

……

……

……

……

……

……

…… [3]

(d) The student carried out **four** more experiments to determine the time taken for each reaction to finish. She used the same volume of aqueous potassium bromide each time and recorded the results as shown in the table below.

experiment	time taken for reaction to complete / min	absorbance reading at the end of reaction
1	5.00	0.8
2	6.00	0.4
3	2.50	0.8
4	2.50	0.9

(i) Which experiment uses potassium bromide of a lower concentration than that in experiment 1?

…… [1]

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(ii) How does the time taken for the reaction to complete relate to the rate of the reaction?

…… [1]

(iii) If the initial concentration of the reactants is the same, suggest explanations for the results obtained in experiments 1 and 3.

……

……

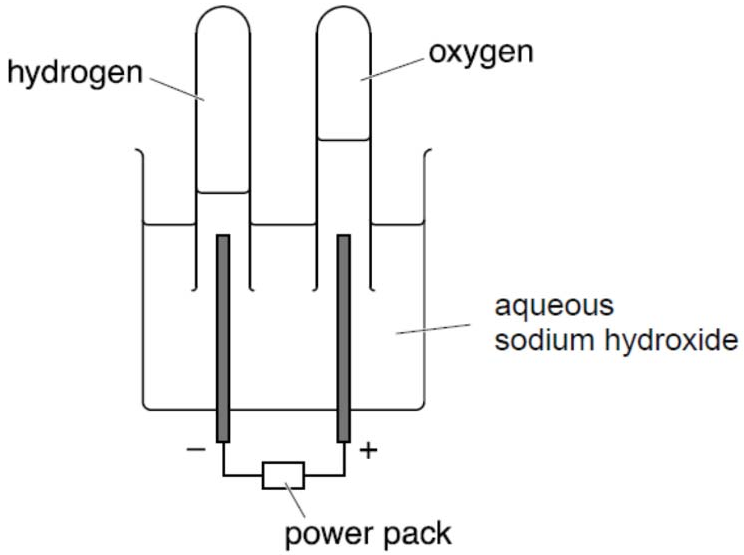
……

…… [2]

[Total: 10]

B9 Instead of carrying many tanks of oxygen and adding to the mass of the submarine, which makes it inefficient to move, naval forces sometimes make use of chemistry to constantly generate sufficient oxygen for the soldiers in the submarine to breathe.

One such method is the electrolysis of aqueous sodium hydroxide. The diagram below shows the schematic diagram of a set-up used for this purpose.



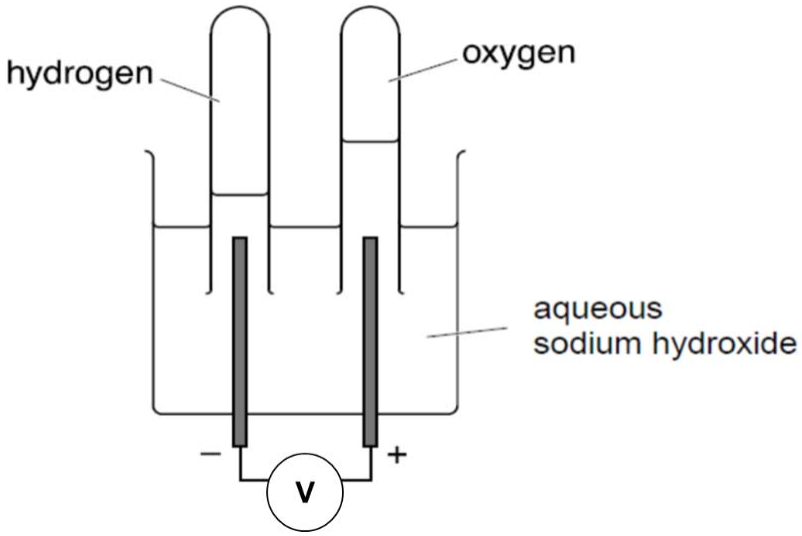
(a) State how the composition of the electrolyte changes after the electrolysis has been running for some time.

……

…… [1]

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(b) After some time, the power pack can be replaced by a voltmeter. This set-up as shown below then acts like a fuel cell to provide additional electricity to power the submarine.



The left hand electrode in the diagram becomes the negative terminal of the cell and the right hand electrode becomes the positive terminal.

(i) State the direction of the electron flow in the external circuit.

……. [1]

(ii) Construct an ionic equation to represent the reaction that occurs at the negative terminal in this fuel cell.

…….. [1]

(c) Other than submarines, cars can also be fitted with an engine powered by a hydrogen fuel cell or a conventional petrol engine.

One of the advantages of hydrogen fuel cells over the use of petrol in cars is that the only by-product is water, making it a clean fuel. A hydrogen fuel cell in operation, however, can sometimes achieve temperatures that are comparable to the conventional petrol engine.

(i) Suggest an environmental disadvantage of using petrol to power car engines.

……..

……..

…… [2]

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(ii) Suggest why hydrogen as a fuel (in the fuel cell) may not be that economically viable.

……..

……..

…….. [2]

(iii) Explain why it is possible for nitrogen oxides to be produced in both types of car engines.

……

……

..... [2]

(iv) Suggest why a catalytic converter installed in a car powered by a hydrogen fuel cell, will fail to reduce nitrogen oxide levels as compared to that in a car powered by petrol.

……

…… [1]

[Total: 10]

EITHER

B10 Long chain alkanes such as octane, C_8H_{18}, can be 'cracked' to produce shorter chain hydrocarbons which could then be separated by fractional distillation.

octane	→	**B** +	a mixture of **C**, **D** and **E**
C_8H_{18}		C_3H_6	(isomers of C_5H_{12})

(a) State the conditions necessary for this reaction to take place.

…… [1]

(b) Write the full structural formula of **B**.

[1]

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(c) Describe the process of separating mixtures **C**, **D** and **E** by fractional distillation.

……

……

……

……

……

……

…… [3]

(d) **C**, **D** and **E** exhibit structural isomerism. They are isomers of pentane, C_5H_{12}.

(i) Define the term *isomerism*.

……

…….. [1]

(ii) Complete the table below to show all possible isomers for pentane.

isomers of pentane		
C	**D**	**E**

[2]

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(e) In a separate experiment, one of the alkanes **C**, **D** or **E** reacted with bromine under ultraviolet light and produced **only one** bromoalkane compound **F**, with the formula, $C_5H_{11}Br$.

Suggest the structure of **F** and the structure of alkane used to form **F**.

structure of F	structure of alkane used, C_5H_{12}

[2]

[Total: 10]

OR

B10 Ammonia is a compound of nitrogen and hydrogen with the formula NH_3.
Ammonia exists in nature as a colourless gas with a characteristic pungent smell.
The undesirable smell is commonly associated with toilets as ammonia gas is given off from urine.

The nitrogen-containing substance in urine is urea, $CO(NH_2)_2$ which undergoes hydrolysis with water to form ammonia and a colourless acidic gas.

(a) Construct a chemical equation, including state symbols, for the hydrolysis of aqueous urea.

……..…… [2]

In the past, ammonia was obtained via the distillation of camel dung.
Nowadays, ammonia is obtained via the Haber Process.

(b) State the **three** operating conditions of the Haber Process.

……..……. [1]

(c) In addition, ammonia burns in **pure oxygen** according to the equation given below.

$$4NH_3\ (g) + 2O_2\ (g) \rightarrow 2N_2\ (g) + 6H_2O\ (l)$$

(i) Explain whether the reaction stated in **(c)** is a redox reaction in terms of oxidation numbers.

……...

……... [2]

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(ii) State the reducing agent in reaction **(c)**.

……. [1]

(iii) Given that 40 cm^3 of ammonia gas was completely reacted, calculate the minimum volume of **air** required.

[1]

(d) When ammonia dissolves in water, the water feels cold.

NH_3 (g) + H_2O (l) $\rightarrow$ NH_4OH (aq)

Draw an energy profile diagram, using the axes given below, for this reaction showing the activation energy and enthalpy change of the reaction. Label the axes.



[3]

[Total: 10]

End of paper

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DATA SHEET
The Periodic Table Of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							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 –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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 162	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 –	91 Pa protactinium –	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.).

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Geylang Methodist School (Secondary)
Prelim 2019
4Exp Chemistry 6092

Paper 1

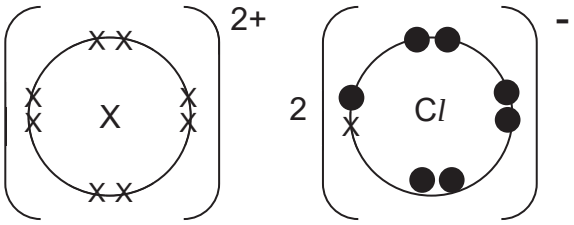
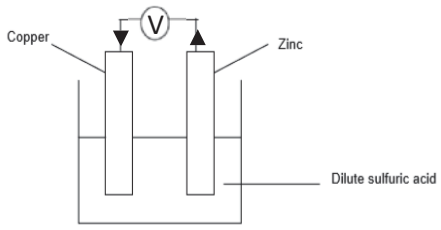
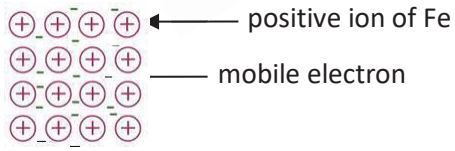
Paper 1							
1	D	11	C	21	B	31	B
2	C	12	A	22	A	32	B
3	A	13	A	23	C	33	B
4	B	14	B	24	C	34	C
5	B	15	C	25	D	35	D
6	D	16	B	26	B	36	B
7	A	17	C	27	C	37	B
8	B	18	C	28	C	38	C
9	C	19	A	29	A	39	A
10	C	20	B	30	B	40	A

Paper 2

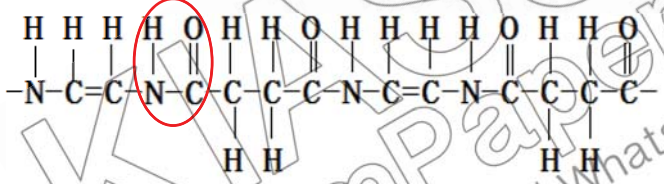
Section A (50 marks)		
A1		Marks allocation
(a)	B	1
(b)	C, D and E	3
(c)	A	1
(d)(i)	Blue precipitate forms. Blue precipitate dissolves in excess aqueous ammonia to form a dark blue solution.	1 1
(ii)	Y^{2+} (aq) + $2OH^-$ (aq) → $Y(OH)_2$ (s)	1 for correct ionic eqn 1 for correct state symbols
A2		
(a)(i)	C	1
(ii)	N	1
(iii)	K	1
(iv)	Ca	1

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(b)		1 for X^{2+} ion 1 for Cl^- ion
A3 **(i)**		1
(ii)	$Zn(s) \rightarrow Zn^{2+}(aq) + 2e$	1 for balanced ionic half equation 1 for correct state symbols
(b)(i)	The voltmeter reading will be **lower than that with zinc**. **Iron is below zinc** in the **reactivity series**. Hence, the **closer the metals are in the reactivity series**, the **smaller** the difference in voltage across the two electrodes.	1 1
(ii)	Colourless solution will turn pale green.	1
A4 **(a)**	Y, Z, X, W, V	1
(b)	**(i)** Electrolysis of molten ionic compound of Z. **(ii)** Calcium **(iii)** $Z + 2H_2O \rightarrow Z(OH)_2 + H_2$ or $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$	1 1 1
(c)		1 for diagram 1 for labelling of positive ions and electrons
A5 **(a)**	$BaCO_3 + 2HNO_3 \rightarrow Ba(NO_3)_2 + CO_2 + H_2O$ No. of moles of barium carbonate = 5 / (137+12+3x16) = 0.025381 mol No. of moles of dilute HNO_3 = (25/1000) x 0.4 = 0.01 mol Hence, HNO_3 is the limiting reactant.	 1 1 1
(b)	No. of moles of HNO_3 : no. of moles of $Ba(NO_3)_2$ = 2:1	

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	No. of moles of $Ba(NO_3)_2$ = 0.01 / 2 = 0.005 mol Mass of theoretical barium nitrate = 0.005 x (137 + 14 x 2 + 16 x 6) = 1.305 g Percentage yield = 1 / 1.305 x 100% = 76.6 % (to 3 s.f.)	1 1 1
(c)	calcium nitrate solution / aqueous calcium nitrate and dilute sulfuric acid / any soluble sulfate	1 1
A6 **(a)**	$2CH_4$ (g) + $3O_2$ (g) → 2CO (g) + $4H_2O$ (g)	1 for correct eqn 1 for state symbols
(b)	Let bond energy in carbon monoxide by X. 8(+412)+3(+496)+8(-463)-2X = -1080 kJ X = 1080 kJ/mol	 1 1
(c)	The reaction is **exothermic** as the energy taken in to break bonds in the molecules of methane (8 C-H bonds) and oxygen (3 O=O bonds) is less than energy given out to form the bonds in the molecules of carbon monoxide (2 C≡O bonds) and water (8 O-H bonds).	1 for exothermic 2 for explanation
A7 **(a)**	Place a lighted splint at the mouth of the test tube. The lighted splint will extinguish with a pop sound.	1 1
(b)		1m for the two repeat units drawn 1m for circling the correct linkage
(d)	Reagent: Hydrogen Conditions: 200°C, nickel catalyst	1 1 1
(e)	The aqueous bromine will turn from reddish brown to colourless. Or The reddish-brown aqueous bromine will be decolourised.	1
B8		
(a)	Cl_2 (g) + $2Br^-$ (aq) → $2Cl^-$ (aq) + Br_2 (aq)	1
(b)	Absorbance increases with time. Bromide ions are slowly oxidised to bromine. Colour intensity is gradually increasing.	1 1

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(c)	1st mark: Speed of reaction was **fast initially**. **Maximum/ high** concentration/amount of **bromide ions** and chlorine Very **high frequency of effective collision** between particles. 2nd mark: As reaction progresses, concentration/number of reacting particles **decreases, frequency of effective collision decreases**, **speed** of reaction **decreases**. 3rd mark: Absorbance is maximum/ no increase/ remains constant. Speed of reaction is **zero** as **all bromide ions are used up**.	1 1 1
(d) (i)	Experiment 2 [1]	
(ii)	Rate of reaction is **inversely** proportional to the time taken for the reaction to complete. OR The shorter the time taken for complete reaction, the faster the reaction rate.	
(iii)	Same absorbance reading at the end of the reaction was obtained because of the **same number of moles / concentration of bromide ions (limiting reactant) was reacted in both experiments**. A shorter time taken was taken (faster rate) for experiment **3** for reaction to finish because the **reaction was carried out at a higher temperature.** **OR** reverse argument	1 1
B9 (a)	Concentration of Na^+ and OH^- increases OR Concentration of sodium hydroxide increases. *Reject: concentration of electrolyte increases.*	1
(b)(i)	From the negative terminal to the positive terminal OR From left to right. *Reject: from anode to cathode unless student has identified which electrode is anode/cathode.*	1
(ii)	$2H_2$ (g) + $4OH^-$ (aq) → $4H_2O$(*l*) + $4e^-$ *State symbols are required.*	1 *(no state symbols = 0 m)*

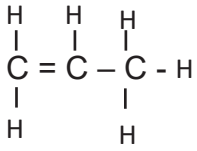
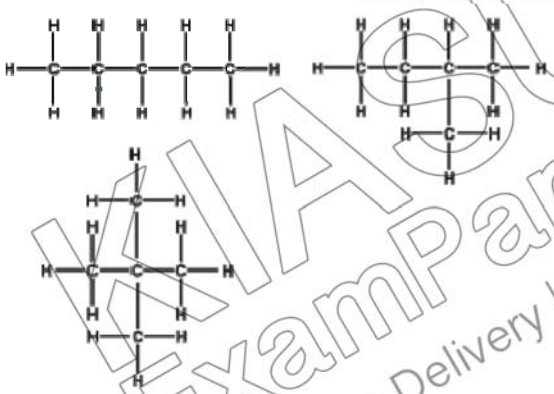
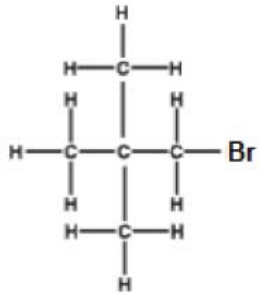
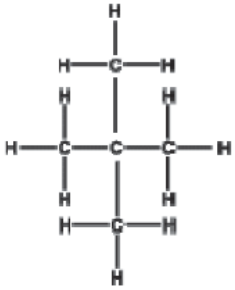
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(c)(i)	Formation of **carbon dioxide** due to complete combustion. [1] A **greenhouse** gas that can cause global warming, resulting in rising sea levels + melting ice caps [1] **OR** Formation of **carbon monoxide** due to incomplete combustion. [1] A **poisonous** gas as it combines irreversibly with haemoglobin in blood to form carboxyhaemoglobin which reduces ability of haemoglobin to carry oxygen to different parts of the body, resulting in breathing difficulties and eventually death [1] **OR** Unburnt hydrocarbons may be released due to incomplete combustion. [1] Formation of photochemical smog when present with other polluting gases [1] **OR** Formation of **nitrogen oxides** due to high temperatures in engine. Nitrogen oxides results in **acid rain** which increases acidity of lakes and rivers harming aquatic life / corrode metal and limestone structures / increases acidity of soil hindering plant growth.	2 *Reject: production of sulfur dioxide*
(ii)	To obtain hydrogen, we require **cracking of longer-chain hydrocarbons** [1] which requires **large amount of heat** [1] OR To obtain hydrogen, **electrolysis of water** must be carried out [1] which requires **large amount of electricity** [1] OR Hydrogen is **difficult to store as it is a gas / flammable / explosive**[1], hence it is expensive to construct special containers/equipment [1] to store it.	1 1
(iii)	**Nitrogen reacts with oxygen in air to form nitrogen oxides** [1] Both types of engines work / function at **high temperatures**. [1] *Reject: both engines are at comparable temperatures.*	
(iv)	In a hydrogen fuel cell powered engine, there is **absence of carbon monoxide to function as a reducing agent** in the catalytic converter. **OR** For a catalytic converter to remove NO, the following must happen: **$2CO + 2NO \rightarrow 2CO_2 + N_2$** However, there is **no carbon monoxide present** in the engine powered by the fuel cell. **OR** NO is **soluble in water** present in the fuel cell, and **will not reach the catalytic converter** for reaction to occur.	Any one. 1

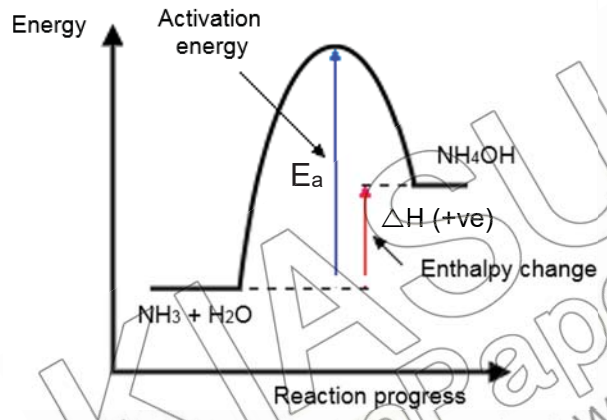
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B10 E		
(a)	aluminium oxide / silicon dioxide and high temperature at 600°C OR High temperature / catalyst	1
(b)		1
(c)	Mixture of hydrocarbons C, D and E is heated [1] and the vaopur [1] is passed into the fractionating coloumn. The hydrocarbon with the lowest boiling point [1] will be distilled and collected at the higher outlet in the fractionating column while hydrocarbon with the next higher b.p. will be distilled and collected at the lower outlet in the column. *Acceptable: methods which describe small scale fractional distillation*	1 1 1
(d) (i)	Isomerism is the existence of two or more compounds with the same molecular formula but with different structural formulae.	1
(ii)		2 m for all 3 correct isomers. 1 m for any 2 correct isomers. 0 m for only 1 correct isomer
(e)	Structure **F**:  Structure of the alkane used: 	

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OR B10		
(a)	$CO(NH_2)_2$ (aq) + H_2O (*l*) → $2NH_3$ (g) + CO_2 (g)	[1] correct equation [1] state symbols
(b)	400°C to 450°C 200 - 250 atm Iron catalyst	[1] for all 3 conditions correct
(c)(i)	It is a redox reaction. The oxidation state of N increases from **–3 in NH_3 to 0 in N_2.** [1] The oxidation state of O decreases from **0 in O_2 to –2 in H_2O.** [1]	
(c) (ii)	Ammonia	[1]
(c) (iii)	By volume ratio, volume of O_2 needed = 20 cm^3 Hence, volume of air needed = $20 \times \frac{100}{21} = 95.2$ cm^3 (3 s.f.)	[1]
(d)		Correct axes [1] Correct shape [1] Correct label [1]

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