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Geylang Methodist School (Secondary) Preliminary Examination 2017

CHEMISTRY

5073/01

Paper 1 Multiple Choice

Sec 4 Express

Additional materials : OAS

1 hour

Setter : Mr Lim Zong Han

14 Aug 2017

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 on 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.

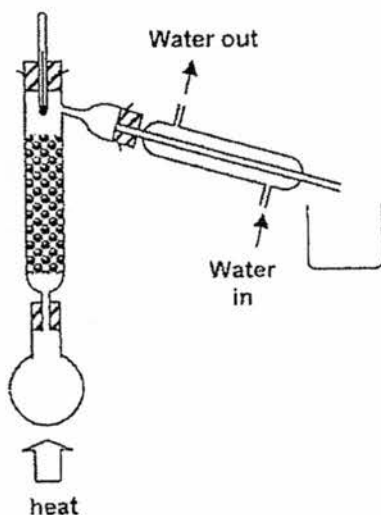
Any rough working should be done in this booklet.

A copy of the Periodic table is printed on page 17

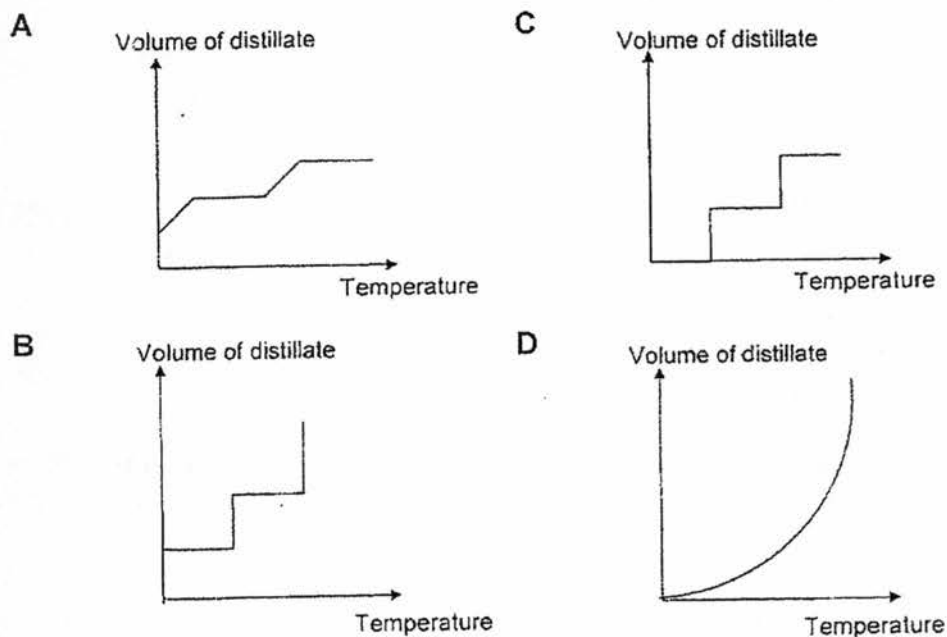
This document consists of 17 printed pages and 1 blank page.

[Turn over

- 1 The diagram shows the apparatus used to separate Methylcyclopentane (boiling point 70°C) and heptane (boiling point 98°C).



Which graph would be obtained if volume of distillate collected was plotted against temperature?



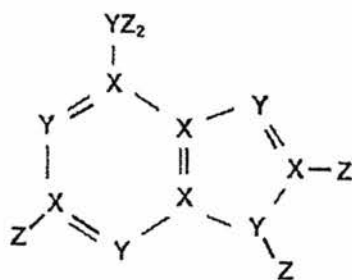
- 2 Which one of the following pairs of gases diffuses at the same speed?

- A nitrogen and oxygen
- B nitrogen and carbon monoxide
- C nitrogen and ammonia
- D nitrogen and nitrogen dioxide

- 3 Sulfur dioxide gas is over twice as dense as nitrogen gas. A gas jar of sulfur dioxide was placed on top of a gas jar of nitrogen gas with the open ends together.

After half an hour, which of these statements would be true?

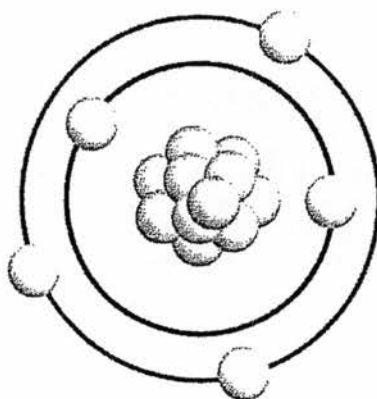
- A The top gas jar contained nitrogen gas only.
 - B Some of each gas would have moved into the other gas jar.
 - C The gases would not have mixed.
 - D The bottom gas jar would contain nearly all the sulfur dioxide
- 4 A stable molecule containing atoms of the elements X, Y and Z has the following structure:



Which of the following is a possible combination of elements?

- | | X | Y | Z |
|---|----|----|----|
| A | Si | P | Na |
| B | P | Si | F |
| C | F | Si | P |
| D | Si | P | F |
- 5 Which particle has the least number of electrons in its valence shell?
- A I
 - B N^{3-}
 - C Ne
 - D O^{2-}

- 6 The diagram represents an atom of an isotope X of an element.



If the element consists of only two isotopes, which one of the following is likely to represent the particles of the other isotope of the element?

	Proton	Neutron	Electron
A	5	6	5
B	5	5	5
C	6	5	5
D	11	12	11

- 7 Which of the following substances contain delocalised electrons?

- I copper
- II graphite
- III solid copper (II) chloride
- IV molten copper (II) chloride

- A I and II
- B I and IV
- C II and III
- D III and IV

- 8 Elements P and R react to form compound S which is a liquid at room conditions. The formula of S is P_2R .

If R is a group VI element, P is

- A sodium
 - B phosphorous
 - C hydrogen
 - D silicon
- 9 12.0 g of anhydrous magnesium sulfate combines with 12.6 g of water to form hydrated magnesium sulfate.

What is the formula of hydrated magnesium sulfate?

- A $MgSO_4 \cdot 3H_2O$
 - B $MgSO_4 \cdot 5H_2O$
 - C $MgSO_4 \cdot 7H_2O$
 - D $MgSO_4 \cdot 9H_2O$
- 10 A hydrocarbon contains 86% carbon and 14% hydrogen by mass.

What is the probable molecular formula?

- A CH_4
 - B C_4H_8
 - C C_6H_6
 - D C_8H_{18}
- 11 Compound X is a white solid. When X is warmed with sodium hydroxide solution, a gas with pungent smell is liberated. The gas turns moist red litmus paper blue. When a solution of X is treated with dilute hydrochloric acid, bubbles are seen in the solution.

What is X most likely to be?

- A ammonium sulfate
- B ammonium carbonate
- C potassium nitrate
- D potassium hydrogen carbonate

12 The following tests were carried out on a green solid.

- I It produced water when it was gently heated alone.
- II It gave a green precipitate when dissolved in water and added to aqueous ammonia
- III It gave a white precipitate when dissolved in water and added to silver nitrate solution.

From these tests, identify the green solid.

- A anhydrous copper (II) chloride
 - B hydrated iron (II) chloride
 - C hydrated iron (II) sulfate
 - D hydrated copper (II) sulfate
- 13 Which one of the following reagents gives a precipitate with a solution of $\text{Cu}^{2+}(\text{aq})$, which dissolves in excess reagent?
- A $\text{NaOH}(\text{aq})$
 - B $\text{NH}_3(\text{aq})$
 - C $\text{AgNO}_3(\text{aq})$
 - D $\text{Na}_2\text{CO}_3(\text{aq})$
- 14 The table below gives information about three indicators.

indicator	colour in strongly acidic solution	pH at which colour changes	colour in strongly alkaline solution
methyl orange	red	4.5	Yellow
bromothymol blue	yellow	6.5	Blue
phenolphthalein	colourless	9.0	Pink

If equal amounts of indicators were added to separate samples of pure water, what would be the colours of the resulting solutions?

- | | methyl orange | bromothymol blue | phenolphthalein |
|---|---------------|------------------|-----------------|
| A | yellow | blue | pink |
| B | red | yellow | colourless |
| C | yellow | yellow | colourless |
| D | yellow | blue | colourless |

15 Which of the following mixtures produces ammonia when heated?

- A $\text{CH}_3\text{COONH}_4 + \text{Ba}(\text{OH})_2$
- B $\text{NH}_4\text{NO}_3 + \text{NaCl}$
- C $\text{NH}_4\text{NO}_3 + \text{HCl}$
- D $\text{NH}_4\text{NO}_3 + \text{Al}$

16 Which of the equation does **not** represent a redox reaction?

- A $3\text{Cl}_2(\text{g}) + 2\text{Fe}(\text{s}) \rightarrow 2\text{FeCl}_3(\text{s})$
- B $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$
- C $\text{Fe}^{2+}(\text{aq}) + \text{Mg}(\text{s}) \rightarrow \text{Fe}(\text{s}) + \text{Mg}^{2+}(\text{aq})$
- D $\text{Zn}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$

17 In which reaction does chromium undergo a change in oxidation number?

- A $\text{Cr}_2\text{O}_3 + 3\text{H}_2\text{SO}_4 \rightarrow \text{Cr}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$
- B $\text{Cr}_2(\text{SO}_4)_3 + 6\text{NaOH} \rightarrow 2\text{Cr}(\text{OH})_3 + 3\text{Na}_2\text{SO}_4$
- C $\text{K}_2\text{Cr}_2\text{O}_7 + 4\text{H}_2\text{SO}_4 + 6\text{HCl} \rightarrow \text{Cr}_2(\text{SO}_4)_3 + \text{K}_2\text{SO}_4 + 7\text{H}_2\text{O} + 3\text{Cl}_2$
- D $2\text{K}_2\text{CrO}_4 + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{Cr}_2\text{O}_7 + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$

18 Small portions of aqueous potassium iodide (KI) and acidified potassium manganate (VII) (KMnO_4) were separately added to four solutions.

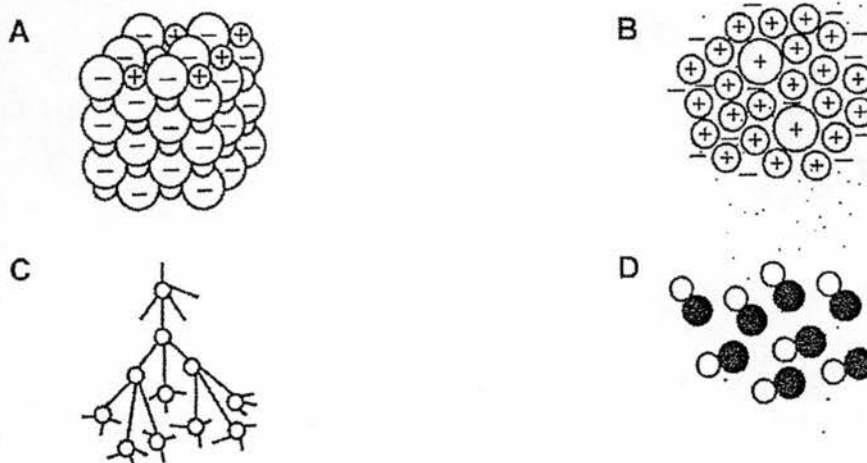
The colour changes are shown in the table below:

solution number	potassium iodide	potassium manganate
1	colourless to brown	purple to colourless
2	colourless to brown	no change
3	no change	purple to colourless
4	no change	no change

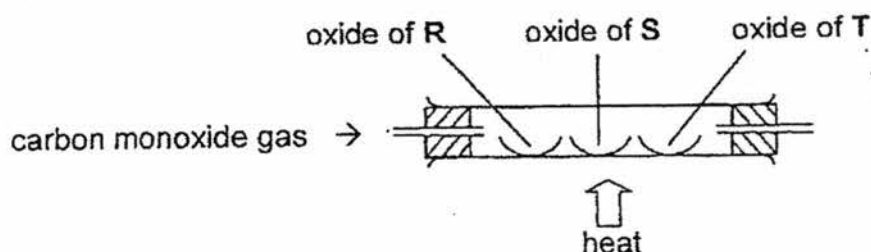
Which solution(s) contained an oxidising agent?

- A 1 only
- B 1 and 2
- C 1 and 3
- D 2 and 4

19 Which of the following diagrams shows the structure of bronze?



20 Three metallic oxide powders containing metals, R, S and T are heated strongly in a hard glass tube as shown below. At the same time, carbon monoxide gas is directed through the tube.



Oxide of R glows slightly, oxide of T glows strongly while oxide of S does not undergo any changes.

Based on these observations, which list shows the descending order of reactivity (most reactive first) of metal R, S and T?

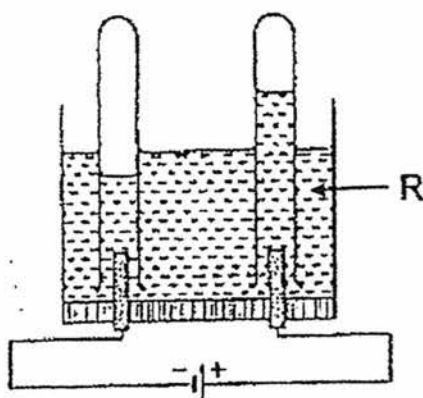
- A R, S, T
- B T, R, S
- C S, R, T
- D T, S, R

- 21 Several properties of metals can be explained by the fact that layers of atoms can slide over each other.

Which one of the following properties of metals is **not** explained by this fact?

- A Metals are malleable.
- B Metals conduct electricity.
- C Pure metals are softer than alloys.
- D Metals are ductile.

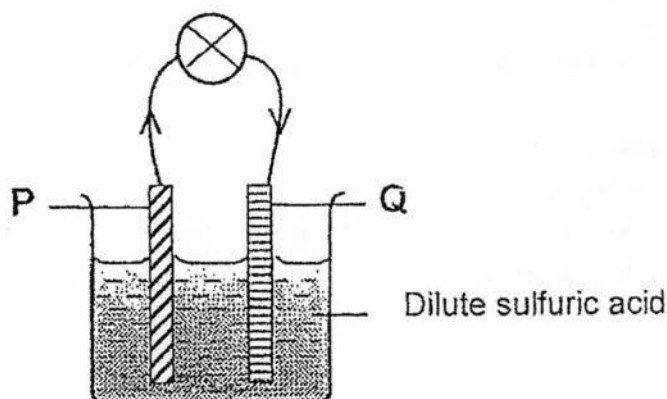
- 22 The diagram shows the results of an electrolysis using inert electrodes.



Which of the following could be liquid R?

- A aqueous silver nitrate
- B aqueous sodium carbonate
- C concentrated hydrochloric acid
- D molten magnesium iodide

- 23 The diagram below shows a simple electrochemical cell.



An electric current flows from P to Q. Suggest the identity of P and Q.

	P	Q
A	copper	magnesium
B	zinc	magnesium
C	zinc	iron
D	copper	iron

- 24 When an aqueous solution containing Fe^{2+} and V^{n+} ions is electrolysed, the same amount of charge produces 16.8 g of iron and 10.2 g of vanadium.

What is the value of n in V^{n+} ion?

- A 1
- B 2
- C 3
- D 4

- 25 The element astatine (At) is beneath iodine in Group VII of the Periodic Table.

Which one of the following is a likely property of astatine?

- A It can be liberated from a solution of its salt by chlorine gas.
- B It conducts electricity in molten state.
- C It forms a basic oxide.
- D It displaces iodine from aqueous potassium iodide.

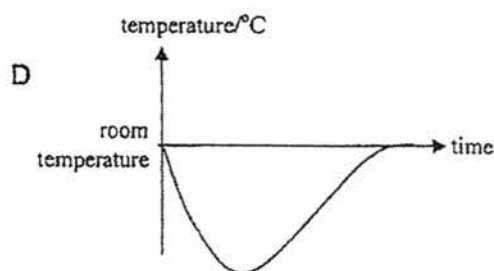
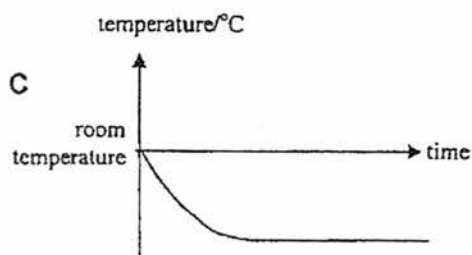
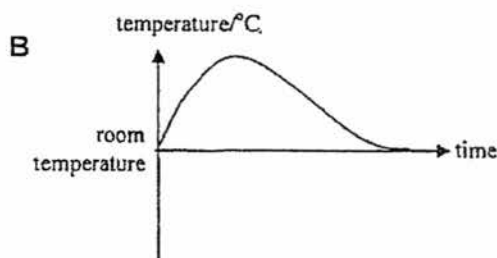
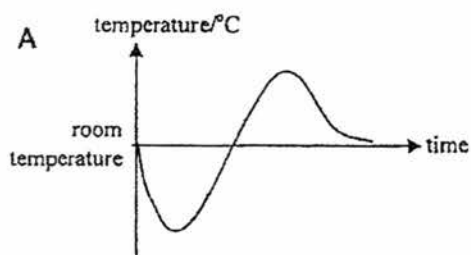
- 26 The table below represents 8 elements P, Q, R, S, T, U, V and W across Period 2 of the Periodic Table.

${}_3\text{P}$	${}_4\text{Q}$	${}_5\text{R}$	${}_6\text{S}$	${}_7\text{T}$	${}_8\text{U}$	${}_9\text{V}$	${}_{10}\text{W}$
----------------	----------------	----------------	----------------	----------------	----------------	----------------	-------------------

Which of the following properties is **incorrect**?

- A The chlorides of T have high melting points whereas chlorides of P have low melting points.
 B The oxides of T are acidic whereas the oxides of P are alkaline.
 C P and Q are metals whereas V and W are non-metals.
 D V atoms are smaller than P atoms.
- 27 Which statement about groups in the Periodic Table is correct?
- A All elements form either positively charged ions or negatively charged ions.
 B In Group I, all the elements form covalent compounds with hydrogen.
 C In Group VII, all the elements form ionic bonds with most metals.
 D All groups contain acidic and basic oxides.
- 28 The process of dissolving potassium iodide in water is endothermic.

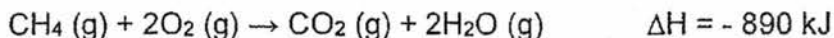
Which of the following graphs shows the temperature changes that occur when potassium iodide is stirred with water until no further change in temperature is observed?



29 Which one of the following is an endothermic process?

- A $\text{C (s)} + \text{O}_2 \text{ (g)} \rightarrow \text{CO}_2 \text{ (g)}$
- B $\text{HCl (aq)} + \text{NaOH (aq)} \rightarrow \text{NaCl (aq)} + \text{H}_2\text{O (l)}$
- C $6\text{CO}_2 \text{ (g)} + 6\text{H}_2\text{O (g)} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6\text{(aq)} + 6\text{O}_2\text{(g)}$
- D $\text{H}_2\text{O (g)} \rightarrow \text{H}_2\text{O (l)}$

30 The combustion of methane is an exothermic process.



How much methane should be used to produce 2670 kJ of heat?

- A 48 g
- B 64 g
- C 96 g
- D 120 g

31 Sodium thiosulfate reacts with hydrochloric acid to form sulfur.

Which sodium thiosulfate solution gives the highest initial rate of reaction?

- A 4 g of sodium thiosulfate dissolved in 50 cm³ of water.
- B 10 g of sodium thiosulfate dissolved in 100 cm³ of water.
- C 20 g of sodium thiosulfate dissolved in 500 cm³ of water.
- D 40 g of sodium thiosulfate dissolved in 2000 cm³ of water.

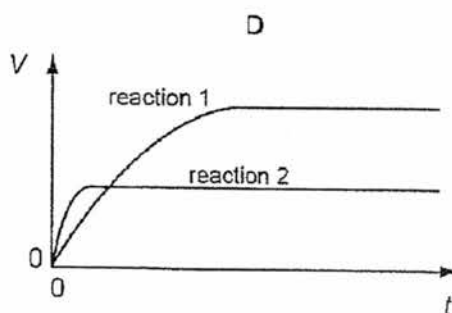
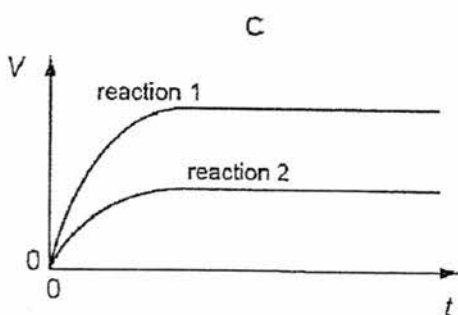
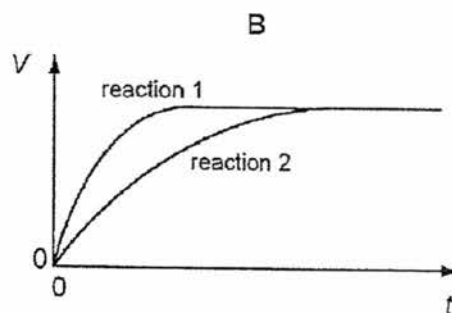
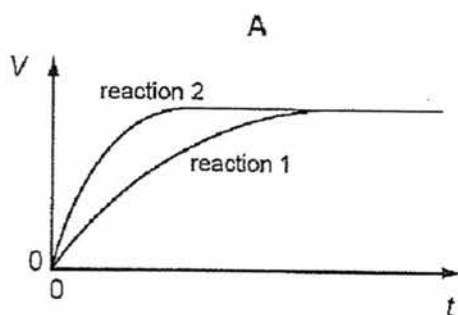
32 A student performs two reactions.

Reaction 1 10 g of magnesium ribbon with excess 2.0 mol/dm^3 dilute hydrochloric acid

Reaction 2 5 g of magnesium powder with excess 2.0 mol/dm^3 dilute hydrochloric acid

In both experiments, the volume of hydrogen produced, V , is measured against time, t , and the result plotted graphically.

Which set of graphs is correct?

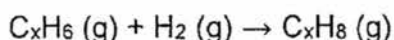


33 Ammonia is produced industrially by Haber process.

Which of the following statement is **not** true about the Haber process?

- A Nitrogen is obtained from air.
- B High temperature is applied to overcome the activation energy.
- C A catalyst is added to decrease the enthalpy change of the forward reaction.
- D High pressure is applied to increase the yield of ammonia.

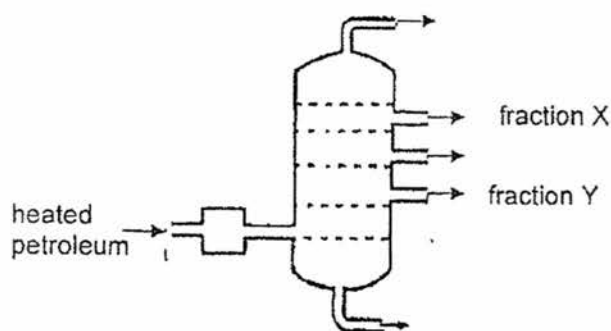
- 34 Which one of the following pairs of gases are common pollutants of the atmosphere?
- A nitrogen and sulfur dioxide
 - B chlorine and hydrogen
 - C carbon dioxide and ammonia
 - D sulfur dioxide and nitrogen dioxide
- 35 Which one of the following explains why carbon monoxide is poisonous?
- A It is oxidised to carbon dioxide in the lungs.
 - B It is reduced to carbon in the lungs.
 - C It combines with haemoglobin.
 - D It is inflammable.
- 36 Which one of these pollutant gases in the air is mainly responsible for the greenhouse effect?
- A sulfur dioxide
 - B carbon dioxide
 - C carbon monoxide
 - D nitrogen dioxide
- 37 The reaction between the hydrocarbon C_xH_6 and hydrogen can be represented by the equation:



Which of the following statements about the above reaction is true?

- A It is a substitution reaction.
- B UV light is required for the reaction to take place.
- C The molecular formula of the hydrocarbon is C_2H_6 .
- D The molecular formula of the hydrocarbon is C_3H_6 .

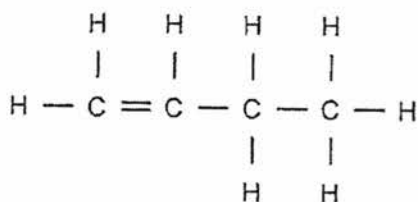
- 38 The diagram shows the fractional distillation of petroleum.



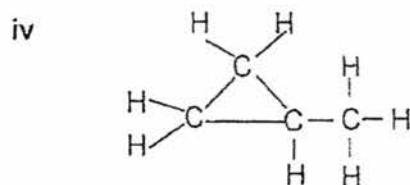
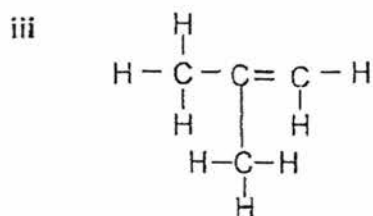
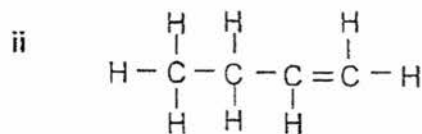
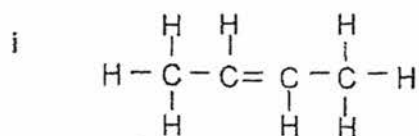
Which statements about fractions X and Y are correct?

	X is more flammable than Y	X burns with a less sooty flame than Y	X is more viscous than Y
A	Yes	No	No
B	Yes	Yes	No
C	No	Yes	Yes
D	No	No	Yes

- 39 The diagram shows the structure of a hydrocarbon X.

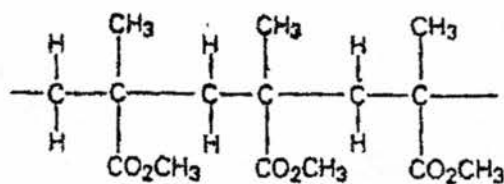


Which of the following structures are isomers of hydrocarbon X?



- A i, ii
 B i, iii
 C i, iii, iv
 D i, ii, iii, iv

40 The structure of the plastic Perspex is shown below.



What is the molecular structure of the monomer from which this plastic is formed?

- A
-
- B
-
- C
-
- D
-

End of Paper

18
Answers

GMS(S)/Chem/P1/Prelim2017/4E

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



Geylang Methodist School (Secondary) Preliminary Examination 2017

Candidate
Name

Class

Index Number

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CHEMISTRY

5073/02

Paper 2

Sec 4 Express

Additional materials : NIL

1 hour 45 minutes

Setter : Mrs Loh Kim Woon

17 Aug 2017

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, the last question is in the form either/or.
Write your answers in the spaces provided.

At the end of the examination, detach Section A from Section B and hand them in 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 22.

For Examiner's Use	
Section A	/50
B7	/12
B8	/ 8
B9	/10
Total	/80

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Section A

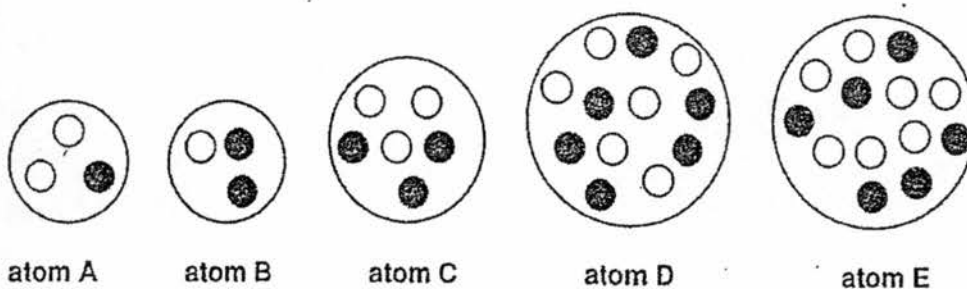
Answer **all** the questions in this section in the spaces provided.
The total mark for this section is 50.

A1 The diagram shows the nuclei of five different atoms.

key

○ neutron

● proton



- (a) Which atom is most likely to be in Group 0?
.....[1]
- (b) Which atom has an atomic number of 3?
.....[1]
- (c) Which atom has a nucleon number of 6?
.....[1]
- (d) Which **two** atoms are isotopes of the same element?
.....and.....[1]
- (e) Suggest the name of the element in (d).
.....[1]
- (f) Which **two** atoms lose an electron when they form ions?
.....[2]

[Total: 7]

- A2 The table below shows the concentration of different ions found in a sample of aqueous industrial waste.

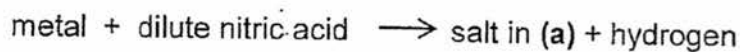
ion	concentration (mol/dm ³)
Ca ²⁺	0.125
H ⁺	2.300
K ⁺	0.234
NO ₃ ⁻	3.680
Cu ²⁺	0.450

Use the information in the table to answer the following questions.

- (a) Write the chemical formula of a coloured salt that could be obtained from the sample.

.....[1]

- (b) A student wants to obtain the salt in (a) using the following method.



Why is this method **not** feasible?

..... [1]

- (c) Suggest a modification to the method in (b) to obtain a pure and dry sample of the salt in (a).

.....

.....

.....

.....

.....

.....

..... [3]

- (d) Is the sample of aqueous industrial waste acidic, neutral or alkaline?
Explain your answer.

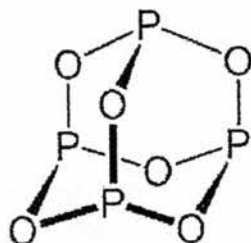
.....
..... [1]

- (e) What would be **observed** when aqueous sodium hydroxide is added to a sample of the aqueous industrial waste until no further change is seen?

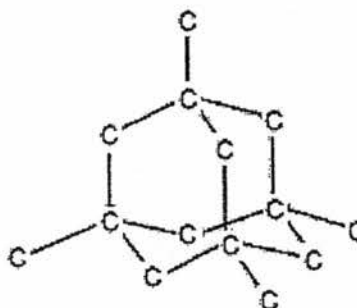
.....
..... [2]

[Total: 8]

- A3 The structures of phosphorus trioxide and diamond are shown below. Phosphorus trioxide is a covalent compound with a simple molecular structure. Diamond has a giant molecular structure of carbon atoms.



phosphorus trioxide



diamond

- (a) Write down the molecular formula of phosphorus trioxide.

..... [1]

- (b) Describe how a *simple molecular structure* differs from a *giant molecular structure*.

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

- (c) Explain why the melting point of phosphorus trioxide is lower than that of diamond.

.....

.....

.....

.....

.....

..... [3]

- (d) An oxide was found to have the following composition by mass.

element	percentage by mass
phosphorus	43.7
oxygen	56.3

Deduce whether this oxide could be phosphorus trioxide by determining its empirical formula.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 9]

- A4 (a) Ammonia is manufactured by the Haber Process.



The table below shows how the percentage yield of ammonia at equilibrium varies with both temperature and pressure.

pressure / atm	percentage yield of ammonia at equilibrium			
	200 °C	300 °C	400 °C	500 °C
40	72	34	13	5
100	81	51	25	10
200	86	63	36	18
300	88	69	40	24

- (i) Describe how the percentage yield of ammonia at equilibrium changes with temperature.

.....
[1]

- (ii) Describe how the percentage yield of ammonia at equilibrium changes with pressure.

.....
[1]

- (iii) Explain how using a catalyst in the Haber Process has an economic advantage.

.....

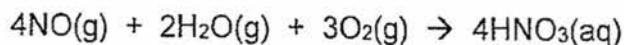
[2]

- (b) Ammonia is used to manufacture nitric acid by a two-stage process.

Stage 1 Ammonia is converted to nitrogen monoxide.



Stage 2 Nitrogen monoxide is converted to nitric acid.



- (i) It is possible to find out whether the reaction in **Stage 1** has completed by following the pH changes during the reaction.
Samples of gas are taken from the reaction vessel at regular time intervals and bubbled through water to form a solution. The pH of each solution is measured.

Explain why the measured pH changes during the reaction.

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.....

.....

.....[3]

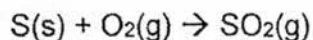
- (ii) Use the equations in the two stages to construct an overall equation for the conversion of ammonia to nitric acid.

.....[1]

[Total: 8]

A5 The manufacture of sulfuric acid is described below.

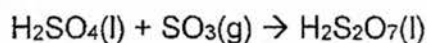
step 1: Sulfur is burnt in excess air to form sulfur dioxide.



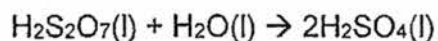
step 2: Sulfur dioxide reacts with more oxygen to form sulfur trioxide.



step 3: Sulfur trioxide is dissolved in concentrated sulfuric acid to form oleum, $\text{H}_2\text{S}_2\text{O}_7$.



step 4: Oleum can then react safely with water to produce concentrated sulfuric acid.



- (a) Is step 3 a redox reaction? Use ideas about oxidation states to explain your answer.

.....

 [2]

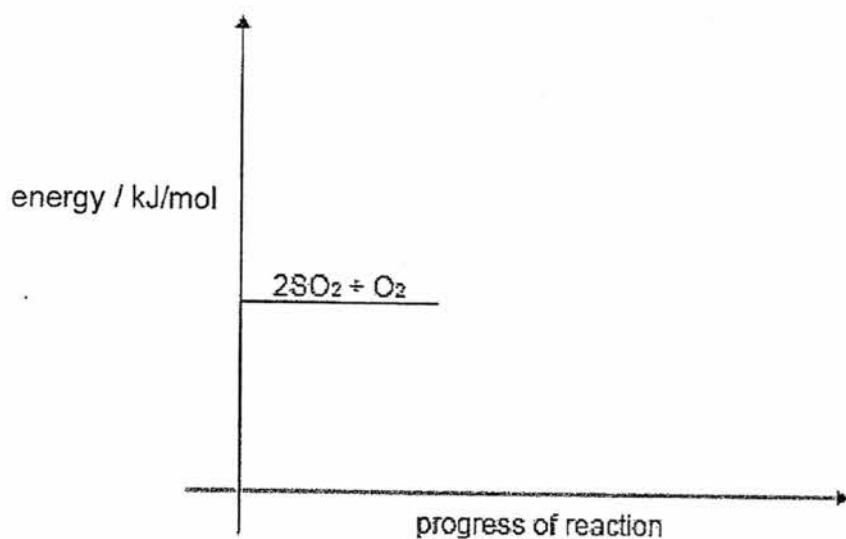
- (b) Explain, in terms of collisions between reacting particles, how a higher pressure affects the rate of reaction in step 1.

.....

 [2]

- (c) (i) Complete the energy profile diagram below for the reaction of sulfur dioxide and oxygen to produce sulfur trioxide. The activation energy for this reaction is 2200 kJ/mol.

Label clearly the **reaction enthalpy change** and the **activation energy**.



[3]

- (ii) State the values of the enthalpy change, ΔH , and the activation energy, E_a , of the reverse reaction.

$\Delta H = \dots\dots\dots$ kJ/mol

$E_a = \dots\dots\dots$ kJ/mol

[2]

[Total: 9]

A6 The atmosphere contains a large number of gases including oxygen, nitrogen, carbon dioxide, sulfur dioxide, oxides of nitrogen, methane and chlorofluorocarbons (CFCs).

(a) Carbon dioxide, methane and CFCs are greenhouse gases.

(i) State **one** effect of an increase in the atmospheric concentration of carbon dioxide and methane.

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

(ii) State **one** source of methane gas.

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

(iii) State one **other** environmental effect of the presence of CFCs in the atmosphere.

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

(b) The formula of one chlorofluorocarbon is CFC₃.
Draw a dot-and-cross diagram to show the bonding in a molecule of CFC₃.
You only need to show outer shell electrons.

[2]

(c) Oxides of nitrogen are produced during the combustion of petrol (gasoline) in a car engine.

(i) Describe the chemical reaction that takes place within a car engine to form nitric oxide, NO.

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

(ii) Most of the nitric oxide and other pollutants present in the exhaust gases of a car are removed in a catalytic converter.
Describe the redox reactions that happen within a catalytic converter.

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

(d) Nitrogen dioxide is one of the causes of acid rain.
Two moles of nitrogen dioxide react with one mole of water to make an aqueous solution of two acids only.
One of these acids is nitric acid.
Deduce the formula of the other acid.

.....[1]

[Total: 9]

End of Section A

Name: _____ ()

Class: _____

Section BAnswer 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.

The total mark for this section is 30.

- B7** Alkenes are unsaturated hydrocarbons. They contain one or more carbon-carbon double bonds. Alkenes can exist as branched or unbranched hydrocarbons. Short-chain alkenes such as ethene and propene are used as starting materials for making ethanol and plastics.

Table 1 shows the boiling points of some straight chain alkenes.**Table 1**

name	formula	boiling point / °C
ethene	C_2H_4	-104
propene	C_3H_6	-47
butene	C_4H_8	-6
pentene	C_5H_{10}	30
hexene	C_6H_{12}	63

Table 2 shows properties of branched isomers of some of the alkenes.**Table 2**

	number of carbon atoms in molecule	formula	boiling point / °C
branched alkene 1	4	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}=\text{C} \\ \quad \\ \text{H} \quad \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \end{array} $	-7
branched alkene 2	5	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}=\text{C} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \end{array} $	20

- (a) How is the boiling point of a straight chain alkene affected by branching in isomerism?

Use evidence from **Table 1** and **Table 2** to explain your reasoning.

.....

.....

.....

.....

.....

.....

.....[3]

- (b) X is a gaseous hydrocarbon which can decolourise a solution of bromine and has a density of 1.75 g/dm^3 at room temperature and pressure.

- (i) Calculate the relative molecular mass of X.

.....

.....[1]

- (ii) Hence, identify X. Explain your reasoning.

.....

.....

.....

.....[2]

- (c) Both ethene and ethane can react with chlorine to form dichloroethane. Give **two** differences between the two reactions.

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.....[2]

- (d) Alkynes are hydrocarbons containing carbon-carbon triple bond ($C\equiv C$). Table 3 shows some properties of the first four members of the alkyne homologous series.

Table 3

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

- (i) Draw the full structural formula of the alkyne with 6 carbon atoms.

[1]

- (ii) Do alkenes or alkynes burn with a smokier flame? Explain your answer.

.....

[1]

- (e) A Chemistry book has the following line.

.....in general, the higher the relative molecular mass of the molecule, the higher the melting and boiling points of the compound due to the higher intermolecular forces of attraction.

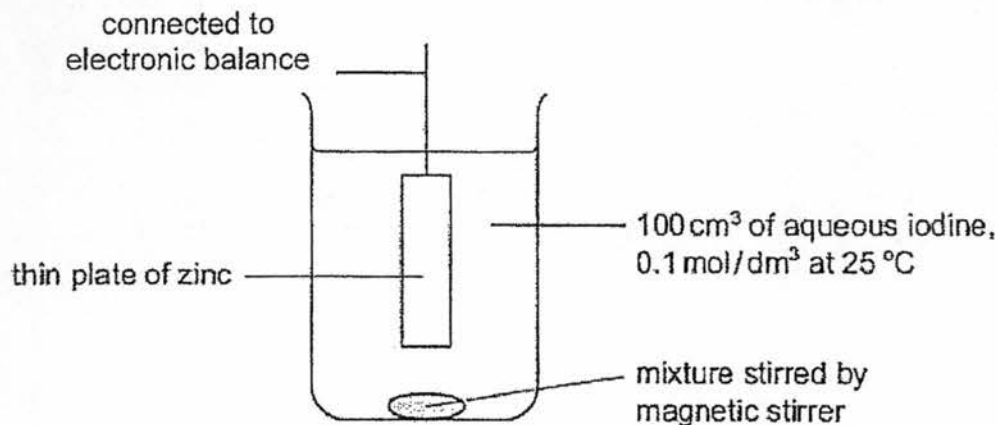
Use the data in Table 1 and Table 3 to justify whether the statement is valid.

.....

[2]

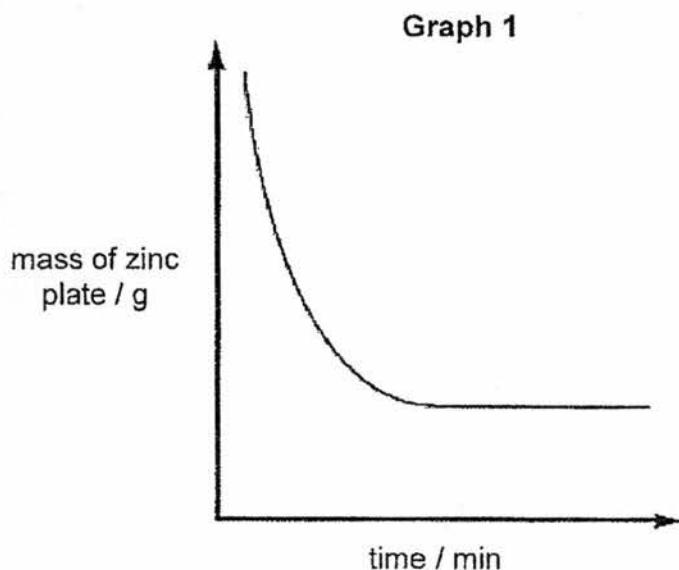
[Total: 12]

- B8 Zinc reacts with aqueous iodine to form zinc iodide. The following apparatus was used to measure the rate of the reaction between zinc and aqueous iodine at 25°C.



The mass of the zinc plate was measured every minute until the reaction was complete.

Graph 1 shows the results obtained.



- (a) Identify the reagent that was used in excess.

.....[1]

- (b) (i) The experiment was repeated with 100 cm³ of 0.05 mol/dm³ aqueous iodine and keeping all other conditions the same. On the same axes as **Graph 1** above, sketch the curve that would be obtained and label it 'Y'. [1]

- (ii) Explain the shape of the graph obtained in (b)(i).

.....

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.....

.....

.....[2]

- (c) Explain, in terms of collisions between reacting particles, the effect on the speed of reaction if the experiment was repeated at 15°C with all other conditions kept constant.

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.....

.....

.....[2]

- (d) Describe and explain what would be observed if aqueous chlorine was bubbled into the resulting zinc iodide solution.

.....

.....

.....

.....[2]

[Total: 8]

EITHER

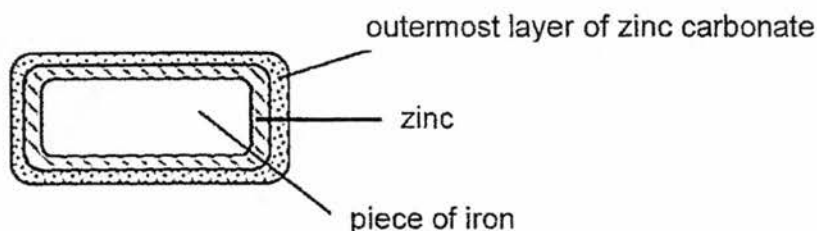
- B9** Galvanisation is the process of coating the entire surface of a piece of iron with zinc to prevent it from rusting. Two common ways of galvanising iron are hot-dip galvanisation and electro-galvanisation.

(a) Hot-dip galvanisation

The piece of iron to be galvanised is dipped into a molten bath of zinc at a temperature of around 460°C . The piece of iron is then cooled and exposed to the air. The outermost layer of zinc then reacts with oxygen and carbon dioxide in the air as follows:

- reaction 1: zinc reacts with oxygen to form zinc oxide
 reaction 2: zinc oxide reacts with carbon dioxide to form zinc carbonate

The resulting iron piece is as shown.



- (i) Write balanced chemical equations for reaction 1 and reaction 2.

reaction 1[1]

reaction 2[1]

- (ii) Use reaction 2 to explain how zinc oxide acts as a basic oxide.

.....[1]

- (b) A student says 'galvanising a piece of iron is more effective in preventing it from rusting than painting it.'

Do you agree with the student? Explain your reasoning.

.....

[2]

(c) **Electro-galvanisation (electroplating an object with zinc)**

The piece of iron to be galvanised and a piece of zinc are used as electrodes and dipped into an electrolyte containing a mixture of aqueous zinc cyanide, $\text{Zn}(\text{CN})_2$, and aqueous sodium hydroxide at room temperature and pressure. An external electrical power supply is used. Zinc ions are discharged to form zinc atoms, which are coated onto the piece of iron.

- (i) Draw a labelled diagram of the experimental setup for electro-galvanisation.

[2]

- (ii) What is the formula for the cyanide ion?

.....[1]

- (iii) Some processes of electro-galvanisation employ the use of dilute acids in the electrolyte instead of aqueous sodium hydroxide.

Explain what problem this could pose.

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

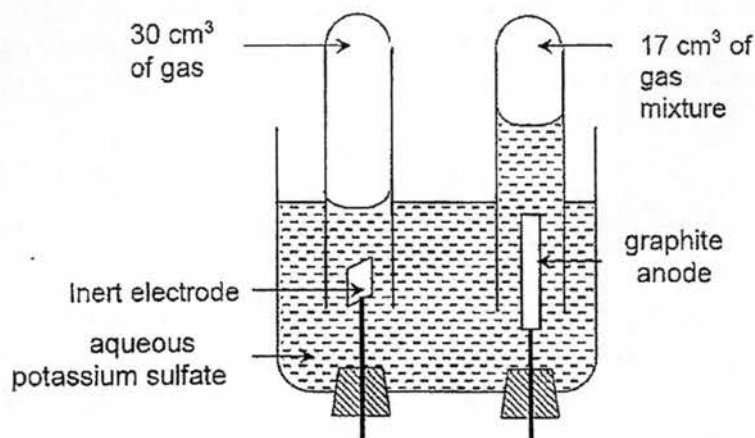
- (d) Suggest an **advantage** that electro-galvanisation has over hot-dip galvanisation.

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

[Total: 10]

OR

- B9** The diagram below shows the electrolysis of an aqueous solution of potassium sulfate using inert electrodes.



- (a) Write equations for the reactions that happen at each electrode during the electrolysis of aqueous potassium sulfate. Include state symbols.

At the cathode :

At the anode :

[3]

- (b) When graphite anode and a very high current are used in this electrolysis, the gas liberated is a mixture of oxygen, carbon monoxide and carbon dioxide. In the experiment illustrated above, 30 cm^3 of gas formed above the cathode and 17 cm^3 of gas formed above the anode.

- (i) Explain, with the help of **two** equations, why the oxides of carbon are produced at the anode.

.....

[3]

- (ii) Using the equations in **b(i)**, explain why the volume of gas collected at the anode is larger than expected.

.....
[1]

- (iii) The gas at the anode was collected and its volume was reduced to 9 cm^3 when shaken with aqueous sodium hydroxide.
Deduce the volume of carbon dioxide in the gas mixture at the anode and explain the reaction that results in the reduction of volume.

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

- (c) An experiment is set up to electroplate a fresh flower with silver.
Suggest why the fresh flower must be coated with carbon particles first.

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

[Total: 10]

End of Paper

Marking Scheme

Geylang Methodist School (Secondary)
Prelim Exam 2017
Chemistry 5073

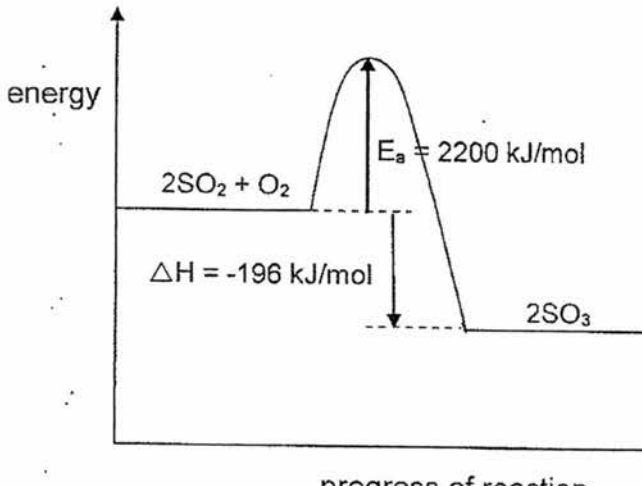
Paper 1

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

Paper 2

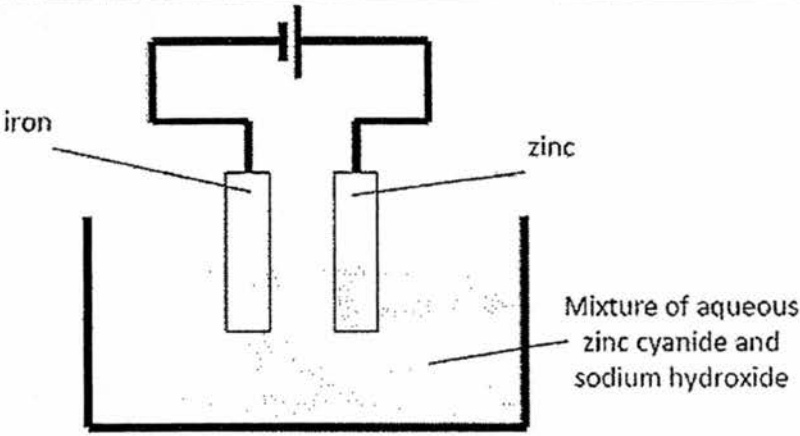
Qns	Answers	Marks
A1a	B	1
b	C	1
c	C	1
d	D and E	1
e	carbon	1
f	A and C	2
A2a	$\text{Cu}(\text{NO}_3)_2$	1
b	Copper <u>does not react</u> with dilute acids.	1
c	Add <u>excess copper(II) oxide / copper(II) carbonate</u> with <u>dilute nitric acid</u> and stir. <u>Filter</u> to remove the excess copper(II) oxide and collect copper(II) nitrate as the filtrate. <u>Heat</u> copper(II) nitrate solution until it is saturated. <u>Cool</u> the saturated solution. <u>Wash</u> the crystals with a little cold water and <u>dry</u> between sheets of filter paper.	1 1 1 1
d	Acidic. There are H^+ ions present.	1

Qns	Answers	Marks																		
e	A white precipitate is formed. The precipitate is insoluble in excess sodium hydroxide. OR A blue precipitate is formed. The precipitate is insoluble in excess sodium hydroxide.	1 1 1 1																		
A3a	P ₄ O ₆	1																		
b	A simple molecular structure has small discrete molecules with weak intermolecular forces while a giant molecular structure is a lattice of many atoms covalently bonded together.	1 1																		
c	A small amount of energy is needed to overcome the weak intermolecular forces between the molecules in phosphorus trioxide. A very large amount of energy is needed to overcome the strong covalent bonds between the carbon atoms in the structure of diamond.	1 1 1																		
d	<table border="1"> <thead> <tr> <th>element</th><th>P</th><th>O</th></tr> </thead> <tbody> <tr> <td>mass (g) / % by mass</td><td>43.7</td><td>56.3</td></tr> <tr> <td>number of moles</td><td>$\frac{43.7}{31} = 1.410$</td><td>$\frac{56.3}{16} = 3.519$</td></tr> <tr> <td>molar ratio</td><td>$\frac{1.410}{1.410} = 1$</td><td>$\frac{3.519}{1.410} \approx 2.5$</td></tr> <tr> <td>simplest ratio</td><td>2</td><td>5</td></tr> <tr> <td>empirical formula</td><td colspan="2">P₂O₅</td></tr> </tbody> </table> Since the empirical formula of phosphorus trioxide is P₂O₃, not P₂O₅, this oxide cannot be phosphorus trioxide.	element	P	O	mass (g) / % by mass	43.7	56.3	number of moles	$\frac{43.7}{31} = 1.410$	$\frac{56.3}{16} = 3.519$	molar ratio	$\frac{1.410}{1.410} = 1$	$\frac{3.519}{1.410} \approx 2.5$	simplest ratio	2	5	empirical formula	P ₂ O ₅		1 1 1
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empirical formula	P ₂ O ₅																			
A4a(i)	The percentage yield of ammonia decreases with increasing temperature.	1																		
(ii)	Percentage yield of ammonia increases with increasing pressure.	1																		
(iii)	Catalyst speeds up the reaction / lowers activation energy. Catalyst shortens the production time / lowers energy costs as less energy is used.	1 1																		

Qns	Answers	Marks
b(i)	Ammonia is an alkaline gas, while oxygen, nitrogen monoxide and water vapour are neutral gases.	1
	Ammonia gas is gradually used up, the pH decreases as the products are neutral.	1
	When pH value remains constant at 7, it indicates that ammonia gas is used up completely for reaction and left with the neutral gases.	1
(ii)	$\text{NH}_3 + 2\text{O}_2 \rightarrow \text{HNO}_3 + \text{H}_2\text{O}$	1
A5a	No. The oxidation states of S, O and H remains the same at +6, -2 and +1 respectively in both reactants and products.	Minus 1 mark for each mistake in oxidation states.
b	The rate of reaction is faster at higher pressure. The gas molecules are closer together. There are more molecules per unit volume of the gas and they collide more frequently.	1 1
c(i)		correct E_a – 1m correct ΔH – 1m correct exothermic graph – 1m
(ii)	$\Delta H = +196 \text{ kJ/mol}$ $E_a = 2396 \text{ kJ/mol}$	1 1
A6 a(i)	Global warming/ ice caps melting/ sea level rising	1
(ii)	One source of methane is rotting vegetation.	1
(iii)	CFCs cause ozone depletion.	1

Qns	Answers	Marks
b		Minus 1 mark for each mistake
c(i)	Reaction of nitrogen with oxygen at high temperature produces nitric oxide.	1
(ii)	Nitric oxide is reduced to form nitrogen gas. Carbon monoxide is oxidised to form carbon dioxide.	1 1
d	HNO ₂	1
B7a	Branching in isomerism <u>decreases</u> the boiling point of straight chain alkenes. From the data, the boiling point of straight chain butene (-6 °C) is higher than the branched butene (-7 °C). The boiling point of straight chain pentene (30 °C) is also higher than the branched pentene (20 °C).	1 1 1
b(i)	$M_r = \text{density} \times 24 \text{ dm}^3$ $= 1.75 \times 24$ $= 42$	1
(ii)	X is propene / C ₃ H ₆ with M_r of propene = $(12 \times 3) + (1 \times 6) = 42$. As X decolourises aqueous bromine, it is unsaturated / an alkene with general formula C _n H _{2n} .	1 1
c	differences: any two - substitution in ethane requires UV light whereas addition in ethene does not. - substitution in ethane involves breaking of C-H bond whereas addition in ethene involves breaking of C=C bond. - substitution in ethane produces many products whereas addition in ethene produces only one product (dichloroethane). - substitution in ethane produces a by-product (HCl) whereas addition in ethene does not.	1m – each difference

Qns	Answers	Marks
d(i)	$ \begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{H} & & \\ & & & & & & \\ \text{H} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C}\equiv\text{C} & -\text{H} \\ & & & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & & \end{array} $	1
(ii)	Alkynes burn with a smokier flame because they have a higher percentage of carbon compared to alkenes.	1
e	Although ethyne ($M_r = 26$) has a relative molecular mass smaller than ethene ($M_r = 28$), the boiling point of ethyne is -84°C whereas the boiling point of ethene is lower at -104°C . The statement is invalid as alkynes have higher boiling points even though they have smaller relative molecular mass.	1 1
B8a	zinc	1
b(i)	graph 1	1
(ii)	Gradient is less steep as the concentration of iodine is halved, resulting in a slower speed of reaction. Half the mass of zinc reacted since only half the number of mole of the limiting reagent, iodine is present.	1 1
c	At 15°C , the zinc atoms and iodine molecules have lower kinetic energy. Hence, less particles have energy greater or equal to the activation energy. The frequency of effective collisions between the zinc atoms and iodine molecules decreases. Hence, speed of reaction decreases.	1 1
d	The colourless zinc iodide solution will turn brown. Chlorine displaces the iodine from zinc iodide solution as chlorine is more reactive than iodine.	1 1

Qns	Answers	Marks
EITHER	reaction 1: $2\text{Zn} + \text{O}_2 \rightarrow 2\text{ZnO}$	1
B9a(i)	reaction 2: $\text{ZnO} + \text{CO}_2 \rightarrow \text{ZnCO}_3$	1
(ii)	It reacts with an <u>acidic oxide (carbon dioxide)</u> to form a salt (zinc carbonate).	1
b	Yes, galvanising protects the piece of iron from coming into contact with oxygen and water. If the protective layer is scratched, the exposed iron beneath will not rust as zinc is more reactive than iron and will corrode in place of iron. If the paint layer is scratched, the exposed iron beneath will start to rust when it reacts with oxygen and water.	1 1
c(i)	 Iron electrode connected to negative electrode of cell.	correct electrodes -1m correct electrolyte -1m
(ii)	CN^-	1
(iii)	The acids in the electrolyte will react with the zinc and iron pieces.	1
d	Electro-galvanisation is carried out at room temperature and no heating is needed. Hot-dip galvanisation is carried out at 460°C.	1

Qns	Answers	Marks
OR B9(a)	At the cathode : $2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$ At the anode : $4\text{OH}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g}) + 4\text{e}^-$	correct equations – 1m each correct state symbols – 1m
b(i)	Oxygen produced reacts with the carbon electrode to form carbon dioxide, which continues to react with the carbon electrode to form carbon monoxide. $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ $\text{C} + \text{CO}_2 \rightarrow 2\text{CO}$ or $2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$	1 1 1
(ii)	1 mol of oxygen produces 2 mols carbon monoxide.	1
(iii)	8 cm^3 Carbon dioxide, an acidic oxide reacts with the alkali, sodium hydroxide.	1 1
c	Carbon is a conductor of electricity.	1