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Geylang Methodist School (Secondary) Preliminary Examination 2014

CHEMISTRY

5073/01

Paper 1 Multiple Choice

Sec 4 Express

Additional materials : OAS

1 hour

Setter : Ms Tong Ai Li

1 September 2014

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.

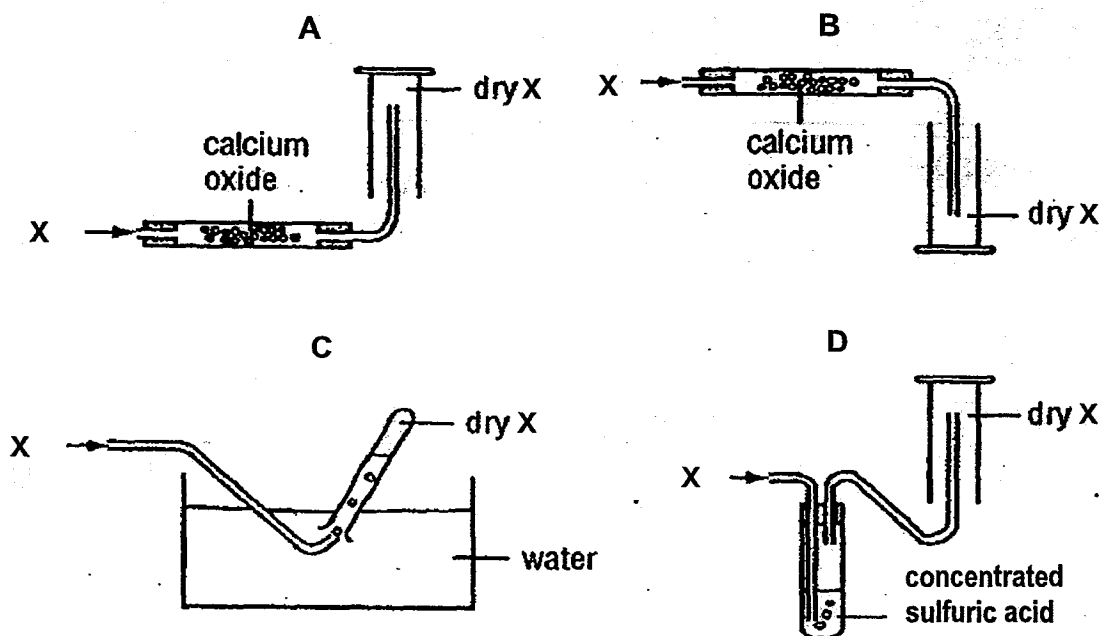
A copy of the Periodic Table is printed on page 19.

This document consists of **18** printed pages and **1** blank page.

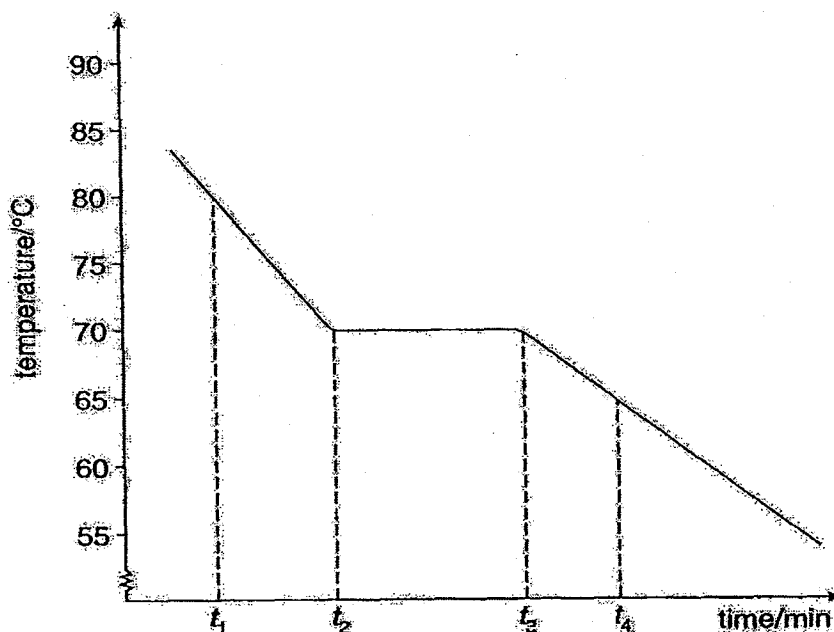
[Turn over

- 1 Gas X is less dense than air, very soluble in water and is alkaline in nature.

Which method is used to obtain a dry sample of the gas?



- 2 Stearic acid is a solid at room temperature. The cooling curve of stearic acid is shown below.



From the graph, we can infer that

- A at the time interval t_1 to t_2 , heat is absorbed from the surroundings.
- B at time t_2 , all the stearic acid exists as a solid.
- C at the time interval t_2 to t_3 , crystals of stearic acid are formed.
- D at the time interval t_2 to t_3 , all the stearic acid exists as a solid.

- 3 50 cm³ of methane diffused through a porous pot in 100 seconds. 50 cm³ of gas Y took 400 seconds to diffuse under the same conditions of temperature and pressure.

What could gas Y be?

- | | |
|------------------|------------------|
| A ammonia | C butane |
| B carbon dioxide | D sulfur dioxide |

- 4 A student was given an unknown white solid X. He did a melting point determination and obtained a value of 121 °C. A Chemistry book listed a substance called benzoic acid as having a melting point of 121°C. To check whether or not X was benzoic acid, he mixed X with benzoic acid using 1 part of X to 4 parts of benzoic acid. He found that the melting point of this mixture was 116°C.

What can he deduce about substance X from this?

- A X is benzoic acid.
B X is not benzoic acid.
C X is impure benzoic acid.
D X really melts at 116 °C and not 121 °C.

- 5 Derek and Adrian were investigating the substances that produce the colour in a type of sweet. The solution obtained from the sweet was separated by chromatography. The chromatograms obtained by Derek and Adrian are shown in Figures M and N.

Why are the two chromatograms different?

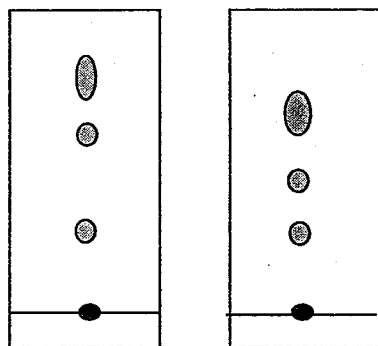


Figure M

Figure N

- A Derek and Adrian used different solvents.
B One of the boys did not use enough solvent.
C The solvent moved up the paper at different speeds.
D The solvent in Figure N did not reach the top of the paper.

- 6 The ion X^- contains 19 particles in the nucleus and 10 electrons outside the nucleus.

What does the nucleus of the ion X^- contain?

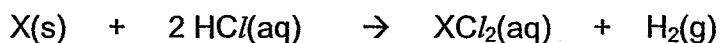
	protons	neutrons
A	8	11
B	11	8
C	9	10
D	10	9

- 7 Element P and Q form a compound with formula PQ_3 . This compound exists as a liquid at room temperature.

What are the correct electron arrangements of atoms P and Q?

	P	Q
A	1	2.3
B	2.1	2.8.3
C	2.8.3	2.7
D	2.8.5	2.8.7

- 8 The equation shows the reaction between element X and dilute hydrochloric acid.



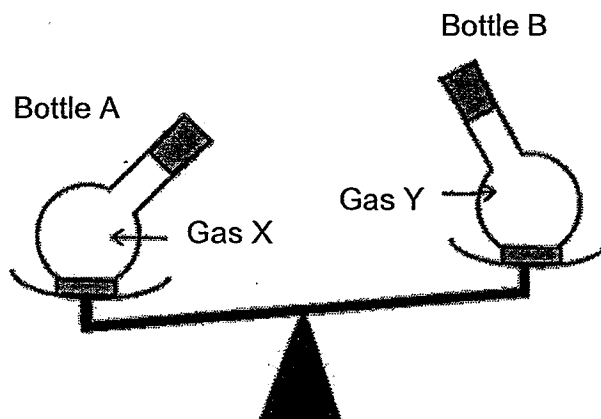
What types of bonding are present in element X and in compound XCl_2 ?

	in element X	in compound XCl_2
A	covalent	covalent
B	covalent	ionic
C	metallic	covalent
D	metallic	ionic

- 9 Chlorine gas is a severe irritant to the eyes and respiratory system. The maximum safe toleration level of chlorine gas in air is 0.005 mg/dm^3 . ($1 \text{ mg} = \frac{1}{1000} \text{ g}$)

How many molecules of chlorine gas are present in 1 dm^3 of air at this toleration level?

- A $\frac{0.005}{6 \times 10^{23}} \times 71$
- B $\frac{0.005}{71} \times 6 \times 10^{23}$
- C $\frac{0.005}{1000} \times \frac{1}{71} \times 6 \times 10^{23}$
- D $\frac{0.005}{1000} \times 71 \times 6 \times 10^{23}$
- 10 At room temperature and pressure, two identical flasks which have been filled up with gas X and Y were put on a balance. The result is shown below.



Which of the following statements is correct?

- A The number of gas particles in bottle A is greater than the number of gas particles in bottle B.
- B The number of moles of gas particles in bottle A is greater than the number of moles of gas particles in bottle B.
- C The molar mass of gas particles in bottle A is greater than the molar mass of gas particles in bottle B.
- D The molar volume of gas particles in bottle A is greater than the molar volume of gas particles in bottle B.

- 11 30.0 cm³ of aqueous KOH is required to completely react with 15.0 cm³ of 0.20 mol/dm³ of aqueous H₂SO₄?

What is the concentration of the aqueous KOH used?

- A 0.10 mol/dm³
- B 0.20 mol/dm³
- C 0.40 mol/dm³
- D 0.50 mol/dm³

- 12 Element X exists as a gaseous molecule X₂ at room temperature and pressure. One volume of element X combines with two volumes of hydrogen gas to form 2 volumes of gaseous hydride of X.

What is the chemical formula of the hydride of X formed?

- A HX
- B HX₂
- C H₂X
- D H₂X₂

- 13 The table shows the properties of four compounds.

Which compound could be ethanoic acid?

compound	degree of ionization in water	addition of an aqueous solution of the compound to magnesium
A	high	hydrogen produced
B	high	no reaction
C	low	hydrogen produced
D	low	no reaction

- 14 Which of the following cannot be prepared by reacting metal with dilute acid?

- A Aluminium nitrate
- B Copper(II) nitrate
- C Magnesium nitrate
- D Zinc sulfate

- 15 Methylamine, CH_3NH_2 , is a weak base. Its properties are similar to those of ammonia.

Which of the following reagents will displace methylamine from its salt, methylammonium sulfate?

- A magnesium
- B dilute hydrochloric acid
- C aqueous sodium carbonate
- D aqueous potassium hydroxide

- 16 In which equation is the underlined substance reduced?

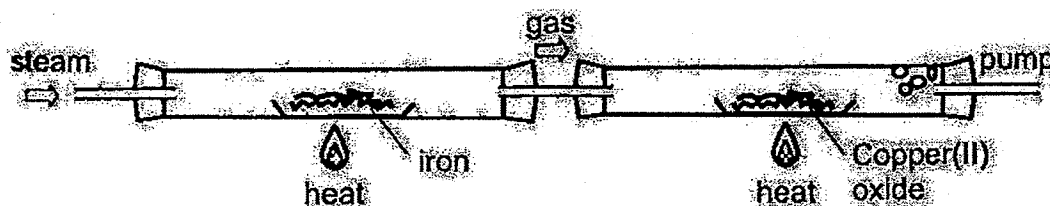
- A $\underline{\text{CuSO}_4}(\text{aq}) + \text{Mg}(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{MgSO}_4(\text{aq})$
- B $2\underline{\text{FeCl}_2}(\text{s}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{FeCl}_3(\text{s})$
- C $2\underline{\text{SO}_2}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$
- D $\underline{\text{NaOH}}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$

- 17 A coil of clean copper wire is suspended in aqueous silver nitrate. Crystals of silver are deposited on the copper wire.

Which statement is not correct?

- A The copper is oxidised.
- B The total mass of the crystals of silver increases gradually.
- C The total number of positive ions in the solution is unchanged.
- D The solution turns blue.

- 18 Which of the following is not a product of the reaction sequence below?



- | | |
|-------------------|----------------|
| A copper | C oxygen |
| B iron(III) oxide | D water vapour |

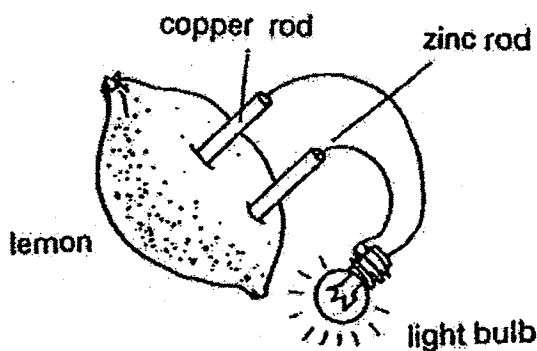
- 19 The following observations were made when nickel and iron were placed separately into solutions of metals P, Q and R.

	salt solution of P	salt solution of Q	salt solution of R
nickel	displaced	not displaced	not displaced
iron	displaced	displaced	not displaced

What is the correct order in decreasing reactivity of the five metals?

- A P, Ni, Fe, Q, R
- B R, Fe, Ni, Q, P
- C R, Fe, Q, Ni, P
- D R, Q, Fe, Ni, P

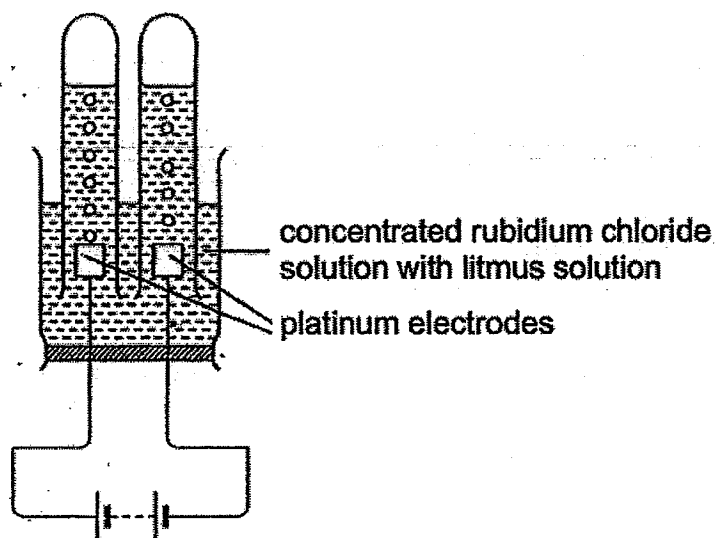
- 20 The diagram below shows a simple cell made with lemon.



Which of the following statements concerning this lemon cell is not correct?

- A Electrons flow from zinc rod to copper rod.
- B The light bulb will not light up if the copper rod is replaced by a magnesium rod.
- C The electrolyte in a lemon cell is the organic acid and mineral salts in the lemon.
- D The light bulb will also light up if the lemon is replaced by an orange.

- 21 A few drops of litmus solution were added to concentrated rubidium chloride and the resultant solution was electrolysed using platinum electrodes.



Which of the following statements is true?

- A The anode decreases in mass.
 B The pH of the electrolyte decreases.
 C A greenish-yellow gas is formed at the cathode.
 D The solution turns purple around the cathode.
- 22 In electroplating a chromium bracelet with silver, which of the following combinations is correct?

	anode	cathode	electrolyte
A	bracelet	silver	silver nitrate
B	silver	bracelet	silver nitrate
C	bracelet	silver	chromium nitrate
D	silver	bracelet	chromium nitrate

- 23 The table below gives some information about element Y.

Density / g/cm ³	6.2
Melting point / °C	1280
Formulae of oxides	YO (white) Y ₂ O ₃ (brown)
Chemical properties	Reacts readily with O ₂ or Cl ₂

Which of the following statements about element Y is likely to be correct?

- A Y is an alkali metal.
- B Y is a metal in Group III.
- C Y is a transition metal.
- D Oxides of Y are amphoteric.

- 24 The metal rubidium is below potassium in Group I of the Periodic Table.

Which statement is most likely to be correct?

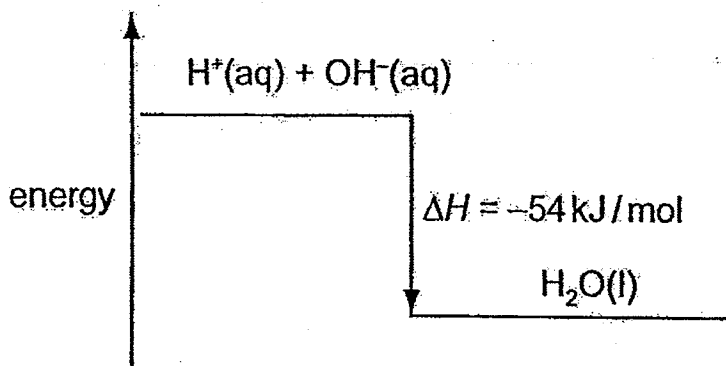
- A Rubidium has a higher melting point than potassium.
- B Rubidium has a higher tendency to be oxidised than potassium.
- C Rubidium is less dense than potassium.
- D Rubidium reacts less vigorously in water than potassium.

- 25 Which process is endothermic?

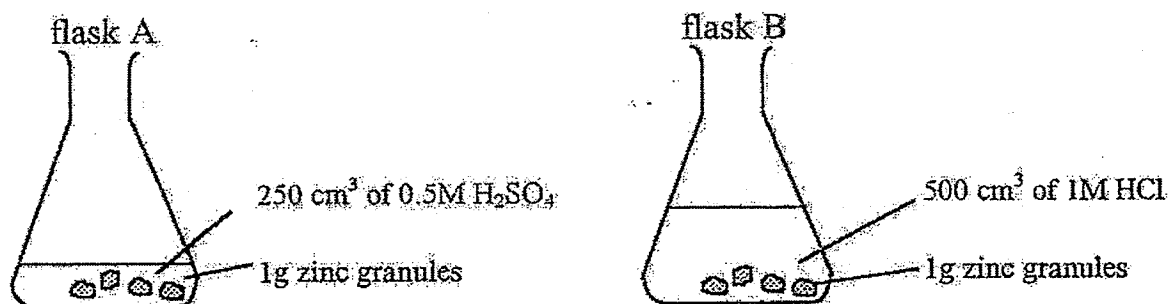
- A The combustion of ethanol in air
- B The addition of water to anhydrous copper(II) sulfate
- C The oxidation of carbon to carbon dioxide
- D The decomposition of calcium carbonate in blast furnace

- 26 The energy level diagram for the reaction between sodium hydroxide and hydrochloric acid is shown below.

What can be deduced from the diagram?

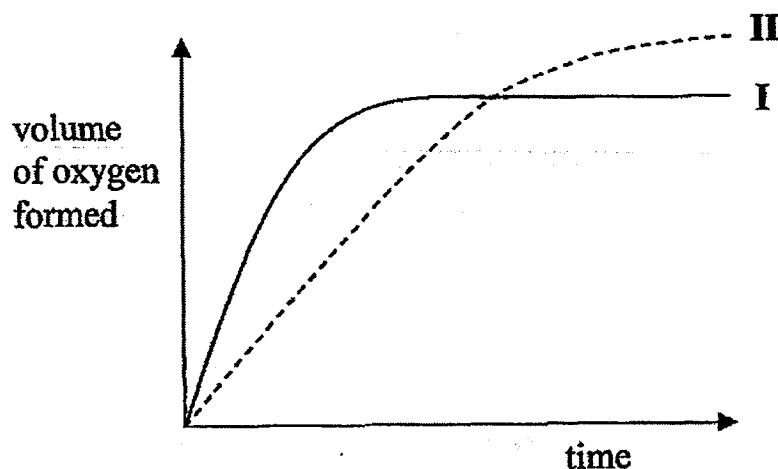


- A The reaction is rapid.
- B Heat is needed to start the reaction.
- C The OH^- ions have more energy than the H^+ ions.
- D The products contain less energy than the reactants.
- 27 Which of the following statements about the experiment below is correct?



- A Flask A produces a larger volume of gas
- B Flask B produces a larger volume of gas
- C Flask B produces gas at a faster rate
- D Both flask A and flask B produce gas at the same rate

- 28 Curve I is obtained by the decomposition of 100 cm^3 of 1 mol/dm^3 aqueous hydrogen peroxide, catalysed by manganese(IV) oxide.



What change to the conditions will produce curve II?

- A Lowering the temperature.
 - B Using 150 cm^3 of 1 mol/dm^3 aqueous hydrogen peroxide.
 - C Using 150 cm^3 of 0.5 mol/dm^3 aqueous hydrogen peroxide.
 - D Using 150 cm^3 of 0.75 mol/dm^3 aqueous hydrogen peroxide.
- 29 Nitrogen and hydrogen reacts to form ammonia in the Haber process.
- Which statement is correct?
- A A high yield of ammonia is favoured by high temperature.
 - B Increasing the pressure speeds up the reaction.
 - C Nickel catalyst is used to increase the production of ammonia.
 - D The reaction between nitrogen and hydrogen is irreversible.

- 30 A metal R lies between magnesium and iron in the reactivity series.

Which reaction is R most likely to undergo?

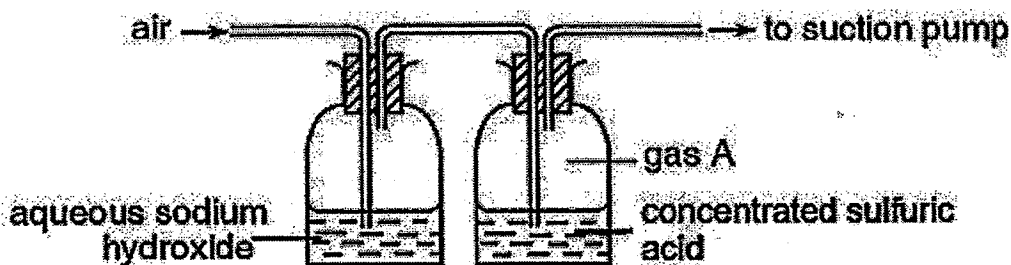
- A It displaces sodium from an aqueous solution of sodium salt.
- B Its oxide decomposes to give the metal on heating.
- C It liberates hydrogen from dilute hydrochloric acid.
- D It reduces magnesium oxide to magnesium on heating.

- 31 The depletion of the ozone layer in the upper atmosphere reduces the Earth's natural protection from harmful ultraviolet radiation.

Which compound would cause the most depletion of the ozone layer?

- A CCl_3F
- B CF_4
- C CHClF_2
- D CH_2F_2

- 32 A sample of air is passed through the apparatus shown below.

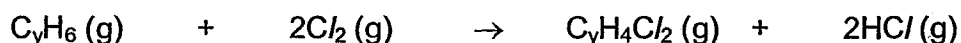


What would be the composition of gas A after passing air through aqueous sodium hydroxide and then concentrated sulfuric acid?

- A Noble gases only
- B Oxygen, carbon dioxide, nitrogen
- C Oxygen, nitrogen, water vapour
- D Noble gases, oxygen, nitrogen

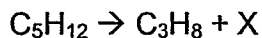
- 33 Which one of the following statements correctly describes the fraction collected at the bottom of the fractionating column during fractional distillation of petroleum?
- A It has the lowest boiling point.
 - B It has the highest viscosity.
 - C It has the lowest density.
 - D It contains small molecules.

- 34 The reaction between a hydrocarbon C_yH_6 and chlorine can be represented as follows.



Which of the following statement is correct?

- A It is an addition reaction.
 - B Ultraviolet light is required for the reaction to take place.
 - C The molecular formula of the hydrocarbon is C_3H_6 .
 - D High temperature and a catalyst are required in the reaction.
- 35 The equation shows the cracking of one mole of pentane, C_5H_{12} , into two organic compounds at high temperature, in the presence of a solid catalyst.

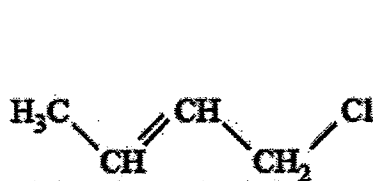


Compound X is further reacted with 1 mole of chlorine to form Y.

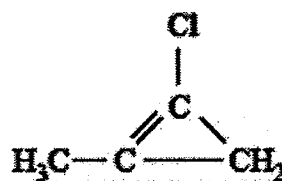
Which of the following is likely to be the structure of compound Y?

- A CH_2CH_2
- B CH_2ClCH_2Cl
- C $CHCl_2CHCl_2$
- D CH_3CHCl_2

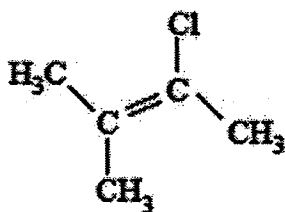
36 Which of the following formulae represents a pair of isomers?



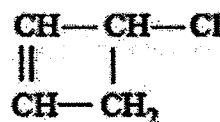
(I)



(II)



(III)



(IV)

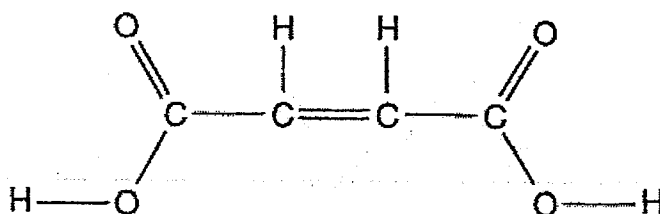
- | | | | |
|---|--------------|---|---------------|
| A | (I) and (II) | C | (I) and (III) |
| B | (I) and (IV) | D | (II) and (IV) |

37 Methanoic acid reacts with propanol to form a sweet smelling substance Z.

Which of the following gives a correct description of Z?

	name	chemical formula
A	methyl propanoate	$\text{C}_2\text{H}_5\text{COOCH}_3$
B	methyl propanoate	$\text{CH}_3\text{COOC}_2\text{H}_5$
C	propyl methanoate	$\text{C}_2\text{H}_5\text{COOCH}_3$
D	propyl methanoate	HCOOC_3H_7

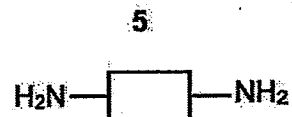
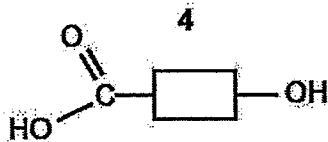
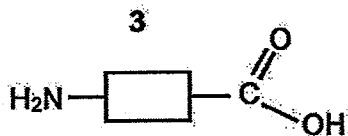
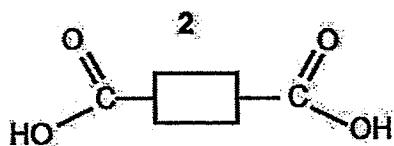
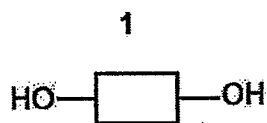
- 38 The structure of an organic compound is shown below:



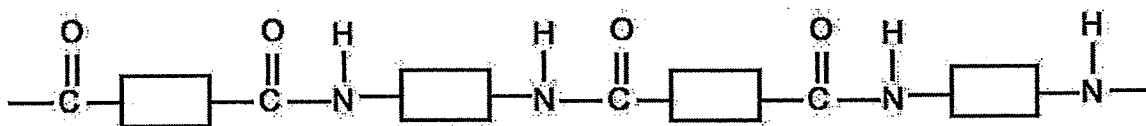
Which one of the following statements is not correct?

- A Its aqueous solution reacts with sodium carbonate.
 - B It decolourises an aqueous solution of bromine.
 - C It is oxidised by acidified potassium manganate(VII) to form an alcohol.
 - D It is an unsaturated compound.
- 39 Which of the following can best be used to distinguish between propene and propane?
- A Limewater
 - B Litmus solution
 - C Aqueous bromine
 - D Acidified potassium manganate(VII)

40 The structure of five monomers are shown.



Which pair of monomers will form a polyamide with the following structure?



A 1 and 2

C 2 and 5

B 2 and 3

D 4 and 5

End of Paper 1

GEYLANG METHODIST SCHOOL (SECONDARY)
Prelim 2014
4E Pure Chemistry 5073/01 Answers

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

17
DATA SHEET

GMS(S)/CHEM/P2/PRELIM 2014/4E

The Periodic Table Of The Elements

Group																			
I	II											III	IV	V	VI	VII	0		
																1 H Hydrogen 1		4 He Helium 2	
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10		
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18		
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36		
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54		
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86		
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89																	

*58-71 Lanthanoid series
+90-103 Actinoid series

Key	a X b	a = relative atomic mass X = atomic symbol b = proton (atomic) number
-----	-------------	---

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



Geylang Methodist School (Secondary) Preliminary Examination 2014

Candidate
Name

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Class

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Index Number

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CHEMISTRY

5073/02

Paper 2

Sec 4 Express

Additional materials: Writing papers

1 hour 45 minutes

Setters : Ms Ng Peck Suan
Mr Lim Zong Han

28 August 2014

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 on the Question Paper.

Section B

Answer **all three** questions, the last question is in the form either/or.
Write your answers on the writing paper provided.

At the end of the examination, fasten all your work securely together.
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	
B8	
B9	
B10	
Total	80

This document consists of 16 printed pages and 1 blank page.

[Turn over

Section A

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

A1 Choose from the following substances to answer the questions below.

Hydrogen	Oxygen	Helium	Caesium
Sulfur	Nylon	Sodium chloride	

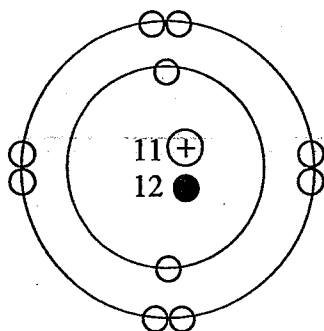
Each substance can be used once, more than once, or not at all.

Name a substance which

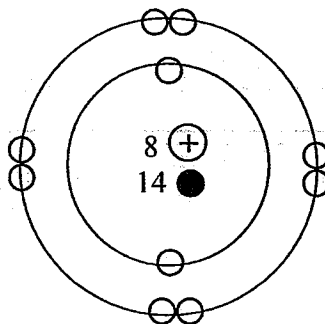
- (a) is an element and is soft with a low density;
.....[1]
- (b) is a polymer containing amide linkage;
.....[1]
- (c) conduct electricity in the solid state;
.....[1]
- (d) combust to produce a pollutant;
.....[1]
- (e) is produced at the anode during electrolysis of dilute copper(II) sulfate.
.....[1]

[5 marks]

A2 The structures of two particles, **A** and **B**, are shown.



Particle A



Particle B

Key:

- $\oplus$ proton
- neutron
- electron

(a) Give the formula of each particle.

..... [1]

(b) Give the formula of the compound formed between **A** and **B**.

..... [1]

(c) Calculate the mass of one mole of the compound formed between **A** and **B**.

.....
 [2]

[4 marks]

A3 The table below shows the colours of manganese in different oxidation states.

(a) Fill in the missing oxidation state of manganese in the following ions.

ion / substance	colour	oxidation state of manganese
MnO_4^-	Purple	
Mn^{2+}	Light pink	
MnO_4^{2-}	Green	+6
MnO_2	Black	

[1]

(b) When solid manganese(II) nitrate, $\text{Mn}(\text{NO}_3)_2$, is heated, the products are solid manganese(IV) oxide, MnO_2 , and a brown gas, NO_2 , only.

(i) Write a balanced chemical equation, including state symbols for the above reaction.

..... [2]

(ii) Describe any colour change observed when manganese(II) nitrate is heated.

..... [1]

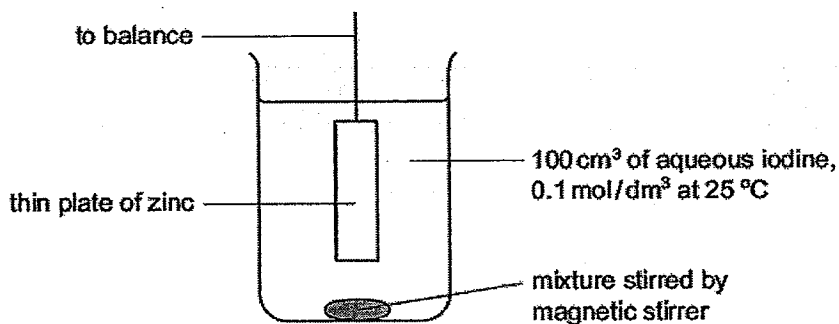
(iii) Using the change in oxidation state, explain whether manganese(II) nitrate is oxidized or reduced.

.....

 [2]

[6 marks]

- A4** 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.

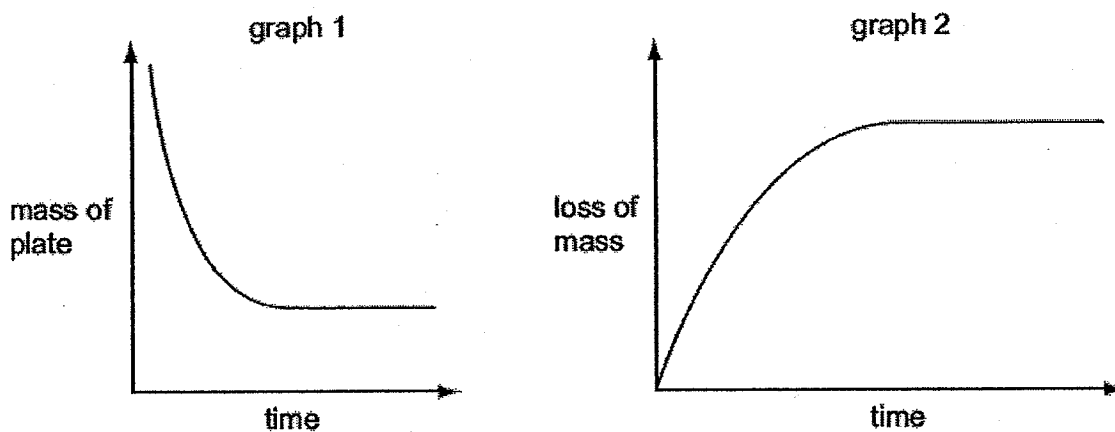


The mass of the zinc plate was measured every minute until the reaction was complete.

- (a) Describe what test can be done to confirm the presence of zinc ions in the solution.

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

- (b) From the results of this experiment, two graphs were plotted.



- (i) Which reagent, iodine or zinc, was in excess? Give a reason for your choice with reference to the graphs above.

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

(ii) Explain why the mass of the zinc plate decreased.

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

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

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

(d) The experiment was repeated with 100 cm³ of 0.05 mol/dm³ iodine, keeping all other conditions the same. Sketch the curve that would be obtained on graph 1 and label it 'X'. [1]

(e) In another experiment, the aqueous iodine was replaced with 100 cm³ of 0.1 mol/dm³ aqueous chlorine. Sketch the curve that would be obtained on graph 2 and label it 'Y'. [1]

(f) Describe and explain what would be observed if chlorine was bubbled into the zinc iodide solution formed.

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

[10 marks]

A5 Iron(III) chloride can be prepared by passing chlorine gas over heated iron filings which are in excess.

(a) State how the solid iron(III) chloride formed can be obtained from the mixture.

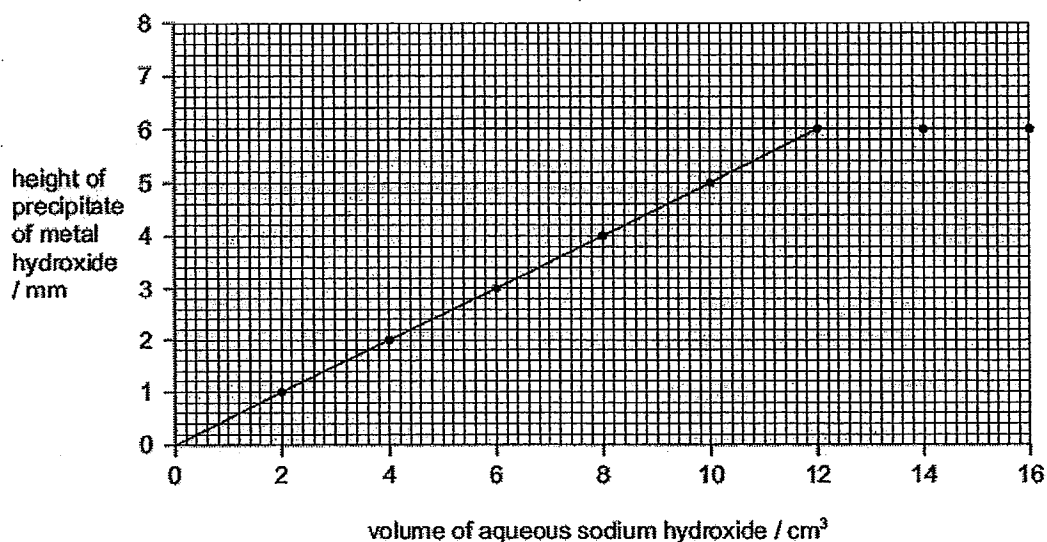
.....
..... [1]

- (b) Iron(II) chloride can be prepared from iron and hydrochloric acid.

Describe how a pure solution of aqueous iron(II) chloride can be prepared.

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

- (c) 2.0 cm³ portions of aqueous sodium hydroxide was added to 4.0 cm³ of aqueous iron (III) chloride. Both solutions had a concentration of 1.0 mol/dm³. After each addition of sodium hydroxide, the mixture was stirred, allowed to settle and the height of the precipitate formed was measured. The results are shown on the following graph.



- (i) Write the ionic equation with state symbols for the formation of the precipitate.

..... [2]

- (ii) Calculate the number of moles of iron(III) chloride used.
Hence calculate the maximum mass of precipitate formed in the above reaction.

[3]

- (d) If the iron(II) chloride had been used instead of iron(III) chloride, using the graph above, predict the minimum volume of sodium hydroxide that would be required to produce the maximum height of precipitate

..... [1]

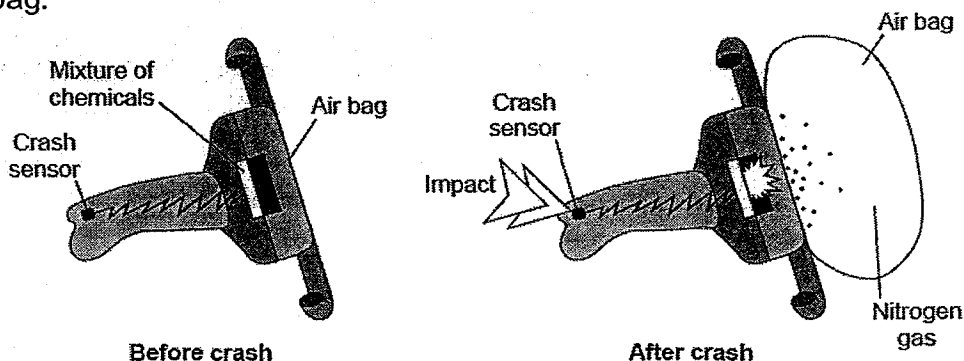
- (e) Describe and explain how the graph would be different if aluminium chloride had been used instead of iron (III) chloride.

.....

 [2]

[11 marks]

- A6** Air bags are used to protect passengers in a car during an accident. When the crash sensor detects an impact it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag.



- (a) The mixture of chemicals contains sodium azide (NaN_3), which decomposes on heating to form sodium and nitrogen.



An air bag contained 130 g of sodium azide. When the sodium azide decomposed, 60 dm^3 of nitrogen was obtained at room temperature and pressure.

- (i) Calculate the percentage yield of nitrogen from the decomposition of sodium azide.

[3]

- (ii) By showing valence electrons only, draw a dot and cross diagram to show the bonding in nitrogen gas.

[2]

- (b) The sodium produced when the sodium azide decomposes is dangerous. The mixture of chemicals in the air bag contains potassium nitrate and silicon dioxide which help to make the sodium safe. Sodium reacts with potassium nitrate to produce sodium oxide, potassium oxide and nitrogen.

- (i) Write the equation for the reaction between sodium and potassium nitrate.

..... [1]

- (ii) The silicon dioxide reacts with the sodium oxide and potassium oxide to form silicates.

Suggest why sodium oxide and potassium oxide are dangerous in contact with the skin.

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

[7 marks]

- A7** In the Haber Process, ammonia gas is produced. One of the uses of ammonia is to make fertilizers. Ammonium sulfate, ammonium phosphate and urea are three fertilizers. They are used to provide soil with essential elements for plants growth. Some information on the fertilizers are given below.

fertilizer	relative molecular mass	cost / kg
ammonium sulfate $(\text{NH}_4)_2\text{SO}_4$	132	1.30
ammonium phosphate $(\text{NH}_4)_3\text{PO}_4$	149	1.00
urea $\text{CO}(\text{NH}_2)_2$	60	1.10

- (a) If you are a farmer and you would like to buy fertilizer to enhance the protein formation in plants, which one of the above fertilizers would you buy? Explain your choice of answer and show your working.

.....

.....

.....

.....

..... [2]

- (b) In regions where acid rain is frequent, it is not a practice for farmers to neutralize the acidic soil with slaked lime, calcium hydroxide at the same time as adding the fertilizer. Explain.

.....

.....

..... [1]

- (c) Calculate the mass of ammonia required to produce 13.2 tonnes of ammonium sulphate. (1 tonne = 1000 kg)

[2]

(d) State the source of reactants used in the Haber process.

.....

.....

.....

..... [2]

[7 marks]

End of Section A

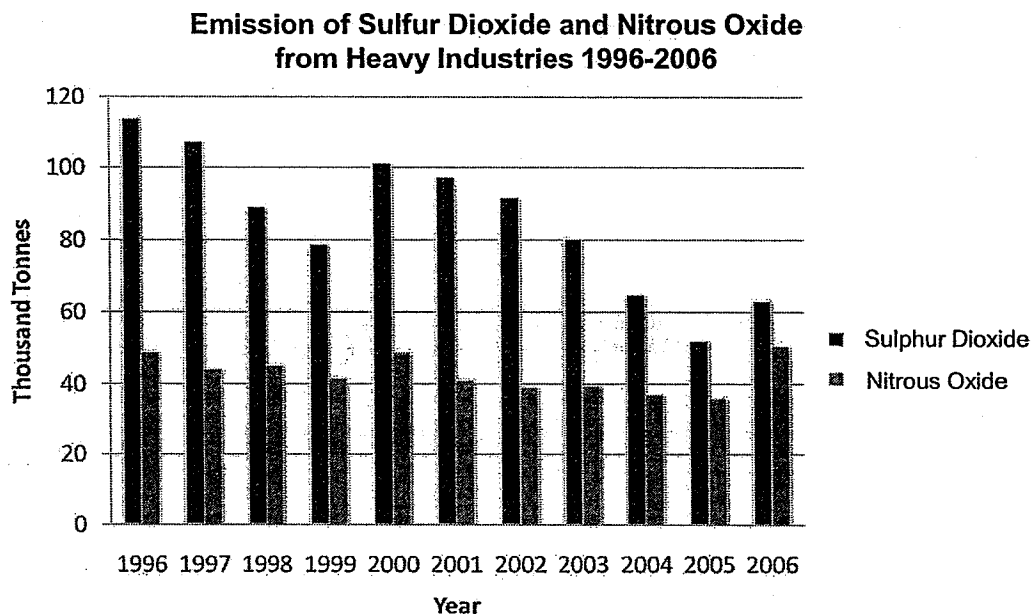
Section B

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.

The total mark for this section is 30.

- B8** The bar chart illustrates the amount of air pollutants, namely sulfur dioxide and nitrous oxide gases from heavy industries in the past ten years in Scotland.



Source: UK National Air Quality Archive

- (a) (i) State one effect of sulfur dioxide gas on humans. [1]
- (ii) Suggest a reason why the emission of nitrous oxide is always less than sulfur dioxide. [1]
- (b) There is a downward trend in the amount of sulfur dioxide gas emitted from the year 2000 to 2005.
- (i) Suggest a method that may be used by the government to minimise the amount of sulfur dioxide gas released by the industrial factories. [1]
- (ii) Explain how the method suggested in **b(i)** helps to remove the sulfur dioxide gas. [2]
You should include chemical equations in your answer.
- (c) Sulfur dioxide and nitrous oxide gases both contribute to the formation of acid rain when they are dissolved in rainwater.
- (i) Describe a **simple** test to be conducted to show which one of the acid formed is stronger as compared to the other. [1]
- (ii) Explain why both gases will form acids of different strengths. [3]
- (d) Explain why rain water is slightly acidic even if there is completely no emission of sulfur dioxide and nitrous oxide gases from heavy industries. [1]

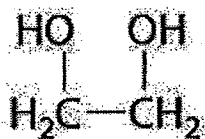
[Total: 10]

- B9** Ethylene glycol is oxidized by a purple solution to form colourless products. The time taken for the purple colour to decolourise can be used to measure the rate of this reaction.

Peter was asked to perform the experiment and the table below shows the results obtained.

concentration of ethylene glycol (% by volume)	4	10	15	24	30
time taken for purple colour to decolourise (s)	375	150	95	62	50

- (a) Using a graph paper provided, putting time taken on the y-axis, draw a smooth curve using the data above. [3]
- (b) Use your graph to estimate the time taken for the purple colour to decolourise when the concentration of ethylene glycol is 20%. [1]
- (c) If the concentration of ethylene glycol increases from 20% to 40%, what will happen to the rate of reaction? [1]
- (d) By using the collision theory, give a reason to support your answer in (c). [2]
- (e) (i) Suggest the identity of the purple solution.
Explain your answer. [2]
- (ii) Ethylene glycol is also known as ethane-1,2-diol and it has the following structural formula.



Write the structural formula of the compound formed when ethylene glycol is being oxidized by the purple solution.

[1]
[Total: 10]

EITHER

- B10** Magnesium is the eighth most common element in the Earth's crust. The metal is widely used in alloys which are light and strong. The Mg^{2+} cation is the second most abundant cation in seawater, which makes seawater and sea-salt an attractive commercial source of magnesium.

To extract the magnesium, calcium hydroxide is added to seawater to form magnesium hydroxide precipitate.

Magnesium hydroxide (brucite) is filtered out and reacted with hydrochloric acid to obtain concentrated magnesium chloride.

- (a) Write the chemical equation for the reaction between brucite and hydrochloric acid. [1]

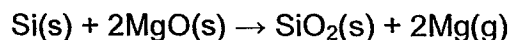
From the concentrated magnesium chloride, electrolysis produces magnesium and chlorine gas.

- (b) Write the ionic half equation that has occurred at
(i) the cathode
(ii) the anode [2]

- (c) Why is the outcome of the electrolysis unexpected? [2]

The United States has traditionally been the major world supplier of magnesium metal. However, as of 2005, China has taken over as the dominant supplier, pegged at 60% world market share. Unlike the electrolytic process described above, China relies on a different method of obtaining the metal from its ores, the silicothermic Pidgeon process.

The basic chemical equation for this process is



The magnesium is obtained by distilling the magnesium vapour.

- (d) Compare the physical states of the two products of the Pidgeon process and explain why SiO_2 exists as a solid at such high temperatures. [2]

- (e) (i) Under very high temperatures, carbon can reduce magnesium oxide.

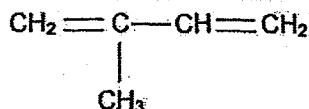
Write the chemical equation, with state symbols, of the reduction reaction between carbon and magnesium oxide. [2]

- (ii) With reference to equations above, explain why the use of carbon, instead of silicon should not be used in this process to extract magnesium. [1]

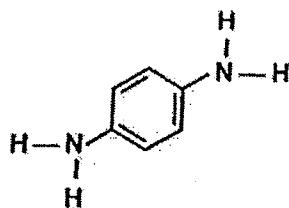
[Total: 10]

OR

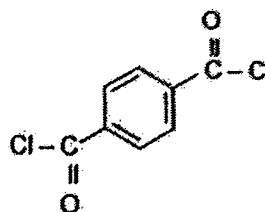
- B10** Natural rubber is used extensively as synthetic rubber. It is originated from latex, which is a soft, natural polymer of cis-1,4-polyisoprene, more commonly known as isoprene. It is often used in the automotive industry for tyres, belts, and dampeners. Its structural formula is shown below.



- (a) (i) Which homologous series would you classify isoprene? Give a reason for your answer. [2]
- (ii) Describe one chemical test to justify your answer in (a)(i).
State any observations made. [2]
- (b) What type of polymerisation would isoprene monomers undergo to form synthetic rubber? [1]
- (c) Draw a repeat unit of the synthetic rubber formed. [1]
- (d) Another polymer that has a wide range of applications is Kevlar, a polyamide. For example, Kevlar fibers are used to make bulletproof vests. It is synthesised from the monomers, 1,4-phenylene-diamine and terephthaloyl chloride in a polymerisation reaction yielding hydrogen chloride as a by-product.



1,4-phenylene-diamine



terephthaloyl chloride

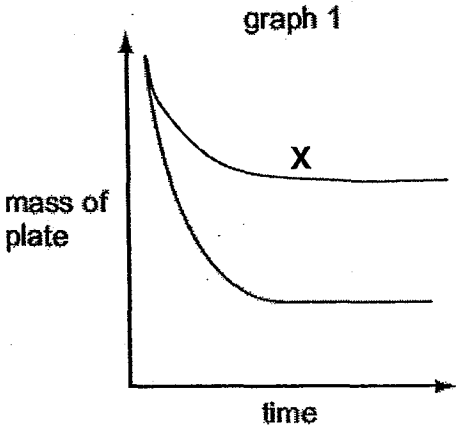
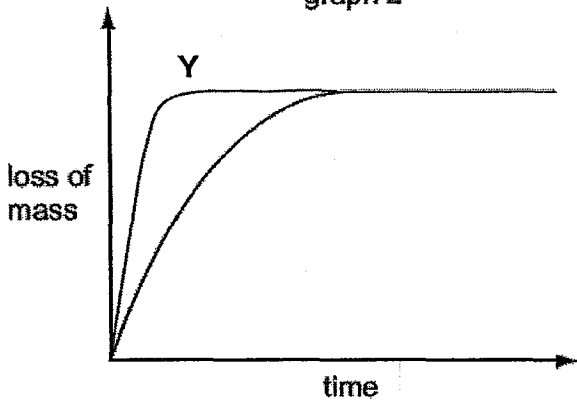
- (i) What type of polymerisation would 1,4-phenylene-diamine and terephthaloyl chloride monomers undergo to form Kevlar? [2]
Explain your answer.
- (ii) Draw a repeat unit of Kevlar. [1]
- (iii) State one physical property of Kevlar that makes it a suitable material to make sports (badminton, squash, tennis... etc) rackets. [1]

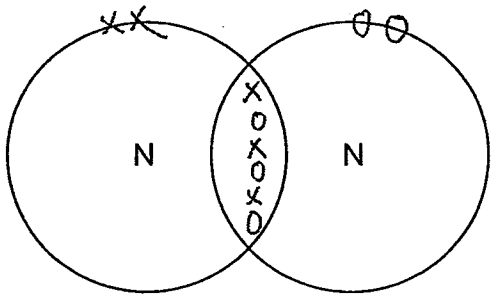
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End of Paper

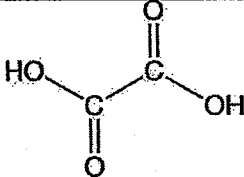
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Preliminary Exam 2014
Sec 4EXP P Chemistry Papers 2 5073 / 02
Marking Scheme

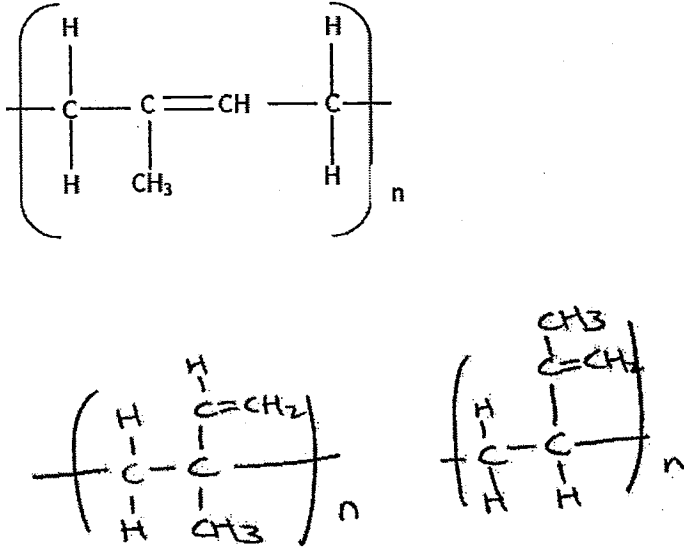
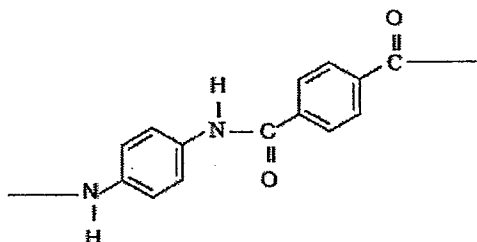
	Paper 2 Section A	marks															
A1 (a)	Caesium	[1]															
(b)	Nylon	[1]															
(c)	Caesium	[1]															
(d)	Sulfur or nylon	[1]															
(e)	Oxygen	[1]															
A2 (a)	A ⁺ , B ²⁻	Both correct [1m] Only 1 correct [0]															
(b)	A ₂ B	[1]															
(c)	Mass = 1 x (23x2)+22 = 68.0 g	[1] [1]															
A3 (a)	<table border="1"> <thead> <tr> <th>ion / substance</th><th>colour</th><th>oxidation state of manganese</th></tr> </thead> <tbody> <tr> <td>MnO₄⁻</td><td>Purple</td><td>+7</td></tr> <tr> <td>Mn²⁺</td><td>Light pink</td><td>+2</td></tr> <tr> <td>MnO₄²⁻</td><td>Green</td><td>+6</td></tr> <tr> <td>MnO₂</td><td>Black</td><td>+4</td></tr> </tbody> </table>	ion / substance	colour	oxidation state of manganese	MnO ₄ ⁻	Purple	+7	Mn ²⁺	Light pink	+2	MnO ₄ ²⁻	Green	+6	MnO ₂	Black	+4	All 3 oxidation states correct [1m] Any one incorrect [0]
ion / substance	colour	oxidation state of manganese															
MnO ₄ ⁻	Purple	+7															
Mn ²⁺	Light pink	+2															
MnO ₄ ²⁻	Green	+6															
MnO ₂	Black	+4															
(b) (i)	Mn(NO ₃) ₂ (s) → MnO ₂ (s) + 2NO ₂ (g)	[1] for equation, [1] for state symbols															
(ii)	Pink Mn(NO ₃) ₂ turns black with brown gas evolved	[1]															
(iii)	The oxidation state of <u>manganese</u> increased from <u>+2</u> in <u>Mn(NO₃)₂</u> to <u>+4</u> in <u>MnO₂</u> . Hence Mn(NO ₃) ₂ is oxidised.	[1] [1]															
A4 (a)	Add aqueous ammonia slowly to the solution until is in excess; If a white precipitate forms and the precipitate is soluble in excess aqueous ammonia, zinc ions are present.	[1] [1]															
(b) (i)	Zinc is in excess. This is because the mass of zinc dropped to a constant value which was not zero indicating that zinc was not used up in the reaction.	Both main points in [1m] Either point not in [0]															
(ii)	The zinc has reacted with the iodine molecules to form zinc ions in solution. OR The zinc has ionized or been oxidized .	[1]															

(c)	When the temperature is lowered from 25°C to 15°C, the kinetic energy of the reactant particles decreases and the particles move slower. This results in a decrease in the number of collisions between reactant particles and the probability of effective collisions occurring decreases and thus the rate of reaction decreases	[1] [1]
(d)	graph 1 	[1]
(e)	graph 2 	[1]
(f)	When chlorine is bubbled into colourless aqueous zinc iodide, a brown solution of iodine is formed; This is because chlorine is more reactive than iodine and can displace iodide ions from the aqueous zinc iodide to form brown iodine solution.	[1] [1]
A5 (a)	The iron(III) chloride can be separated from the excess iron using a magnet. Also accept : Add excess water and filter, crystallise filtrate	[1]
(b)	Add excess iron to a fixed volume of hydrochloric acid; Filter the mixture to obtain a pure solution of iron (II) chloride.	[1] [1]

(c) (i)	$\text{Fe}^{3+}(\text{aq}) + 3\text{OH}^{-}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s})$	Ionic eqn [1] State symbols [1]
(ii)	No. of moles of iron (III) chloride reacted = $1 \times 0.004 = 0.004$ No. of moles of precipitate formed = 0.004 Mass of precipitate formed = $0.004 \times (56 + 3 \times 17) = 0.428 \text{ g}$	[1] [1] [1]
(d)	8 cm^3 Working not required. Should students asked for explanation: $\text{Fe}^{3+}(\text{aq}) + 3\text{OH}^{-}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s})$ $\text{Fe}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_2(\text{s})$ From the graph, 3 mol of OH^{-} requires 12 cm^3 of NaOH to produce max ht of ppt Thus, 2 mol of OH^{-} will require $\frac{2}{3} \times 12 = 8 \text{ cm}^3$ of NaOH to produce max ht of ppt	[1]
(e)	Difference: The graph will increase from zero to a maximum value then decreases back to zero as the volume of sodium hydroxide increases. Reason for difference: The precipitate of aluminium hydroxide formed dissolves in excess sodium hydroxide thus the mass of precipitate decreases as it dissolves.	[1] [1]
A6 (a)(i)	No. of moles of sodium azide used = $\frac{130}{65} = 2$ No. of moles of nitrogen produced = 3 Theoretical yield of nitrogen = $3 \times 24 = 72 \text{ dm}^3$ Percentage yield of nitrogen = $\frac{60}{72} \times 100 = 83.3\%$	[1] [1] [1]
(ii)		[1] - for correct number of electrons [1] - for correct number of shared electrons
(b)(i)	$10\text{Na} + 2\text{KNO}_3 \rightarrow 5\text{Na}_2\text{O} + \text{K}_2\text{O} + \text{N}_2$	[1]
(ii)	Sodium oxide and potassium oxide form strong and corrosive alkalis when in contact with moisture on the skin.	[1]

	Paper 2 Section B	
B8		
(a) (i)	- Irritates the eyes - Cause breathing difficulties by irritating the lungs. - Inflammation of lungs (bronchitis) (any 1 of the above)	[1] Do not accept formation of acid rain
(ii)	The fossil fuels burnt in the heavy industries contain a high percentage of sulfur as an impurity , thus it will be oxidised to form sulfur dioxide gas, thus the emission of nitrous oxide is comparatively lesser than sulfur dioxide.	[1]
(b) (i)	Installing a Flue Gas Desulfurisation plant (FGD).	[1]
(ii)	- As sulfur dioxide passes through the plant, it reacts with an aqueous suspension of calcium carbonate / calcium oxide to form calcium sulphite. $\text{CaCO}_3(\text{s}) + \text{SO}_2(\text{g}) \rightarrow \text{CaSO}_3(\text{s}) + \text{CO}_2(\text{g})$ - The calcium sulphite is further oxidised to calcium sulphate by atmospheric oxygen. $2 \text{CaSO}_3(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2 \text{CaSO}_4(\text{s})$	[2] for both points and correct equations [1] for at either both points / one point and one correct equation
(c) (iii)	Use a pH meter or universal indicator to determine which acid is stronger. [0] for addition of metal to acid / other chemical reaction	[1]
(iv)	Sulfur dioxide dissolves in water to form sulfurous acid which oxidises to sulfuric acid . Nitrogen dioxide dissolves in water to form nitric acid . Sulfuric acid contains twice the amount of hydrogen ions as compared to nitric acid, thus sulfuric acid is stronger than nitric acid.	[1] [1] [1]
	Carbon dioxide found in the atmosphere (0.03%) dissolves in rainwater to form carbonic acid, which is a weak acid.	[1]
B9		
(a)	Chart Title $y = 1498.2x^{-1.004}$ ● (% by volume) ● Time taken for purple colour to decolourise (s)	[1] for smooth curve [1] for correct points [1] for appropriate axes

(b)	73.5 s	[1] Accept range between 70 s to 75 s
(c)	Increases Do not accept if time taken for the reaction is shorter	[1]
(d)	Increase in concentration of ethylene glycol means <u>more particles per unit volume</u> Increasing the frequency of <u>successful/effective collision</u> Leading to shorter time taken for decolourisation	[1] [1]
(e) (i)	Purple solution is <u>acidified aqueous potassium manganate(VII)</u>	[1]
	It is an oxidising agent which <u>oxidises</u> ethylene glycol / when it reacts with ethylene glycol, it changes from <u>purple to colourless</u> rapidly.	[1]
(ii)		[1]
B10	Either	
(a)	$\text{Mg}(\text{OH})_2 + 2\text{HCl} \rightarrow \text{MgCl}_2 + 2\text{H}_2\text{O}$	[1]
(b) (i) (ii)	$\text{Mg}_2^+ + 2\text{e} \rightarrow \text{Mg}$ $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}$	[1] [1]
(c)	At the cathode, hydrogen ions should be preferentially discharged to form hydrogen gas. Hydrogen ions are less stable than magnesium ions.	[1] [1]
(d)	Macromolecular structure. Strong covalent bonds between the silicon and oxygen atoms which extend throughout the entire structure. Large amount of energy required to overcome these strong bonds.	[1] [1]
(e) (i)	$\text{C}(\text{s}) + 2\text{MgO}(\text{s}) \rightarrow \text{CO}_2(\text{g}) + 2\text{Mg}(\text{g})$	[1] correct equation [1] correct state symbols
(ii)	Carbon dioxide gas produced will contaminate the magnesium vapour.	[1]

B11	Or	
(a) (i)	Alkene Contains at least one set of C=C double bond 2	[1] [1]
(ii)	Add bromine water to isoprene bromine water turned from reddish brown to colourless rapidly	[1] [1]
(b)	Addition	[1]
(c)		[1]
(d) (i)	Condensation polymer. Due to the production of small molecules / hydrochloric acid. (OR) A byproduct is also formed.	[1] [1]
(ii)		[1]
(iii)	Strong / High strength Low density / light weight Do not accept Hard	[1] accept any right answer

End of Paper