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Class	Register Number	Name
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南洋女子中学校
NANYANG GIRLS' HIGH SCHOOL

Mid-Year Examination 2014
Secondary Four

CHEMISTRY

Paper 1

Wednesday

Multiple Choice

7 May 2014

45 minutes

1030 – 1115 hrs

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

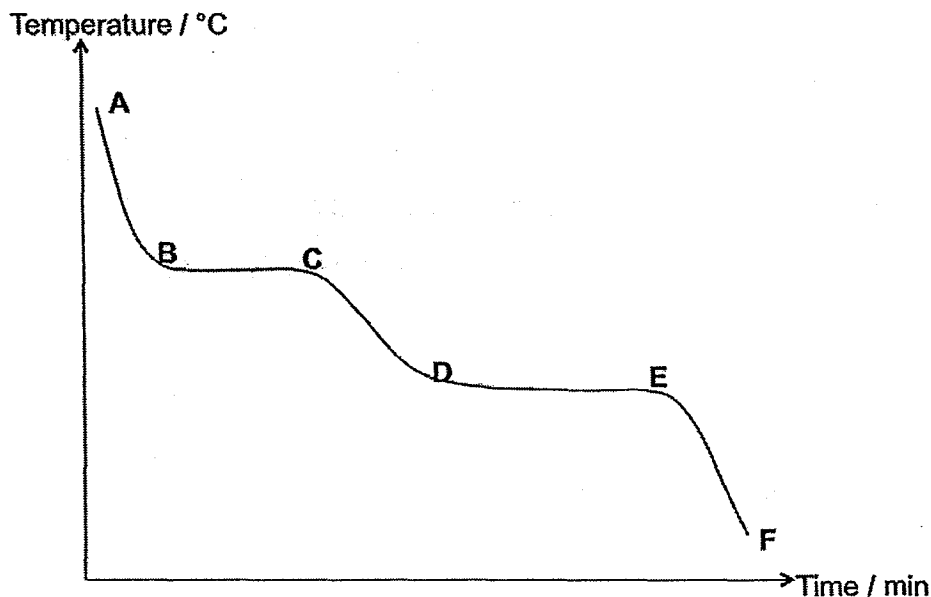
Write your name, class and register number on the Multiple Choice Answer Sheet provided.

There are **thirty** 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 answer sheet.

INFORMATION FOR CANDIDATES

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.

- 1 The diagram below shows the **cooling** curve of a substance.

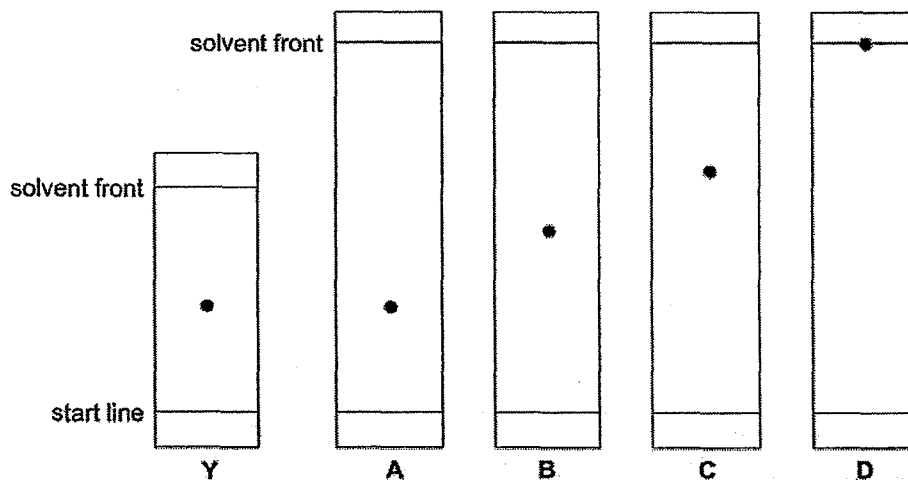


Which of the following describes the state(s) of the substance for the given segment of the curve?

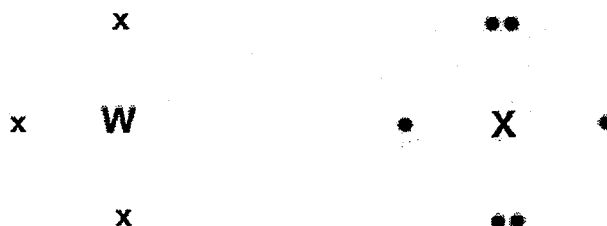
	<u>Segment of curve</u>	<u>States(s) of substance</u>
A	A to B	Solid only
B	C to D	Gas and liquid
C	D to E	Solid and liquid
D	E to F	Liquid only

- 2 A dye was dissolved in acetone and its paper chromatogram Y was obtained as shown below. A second chromatogram was run using a longer piece of paper and the same solvent.

Which of the following shows the second chromatogram that was obtained?



- 3 What happens when a hydrogen atom becomes a H^+ ion?
- A The hydrogen atom gains an electron.
B The hydrogen atom gains a positive charge.
C The atomic mass of the hydrogen atom increases.
D The proton number of the hydrogen atom does not change.
- 4 The diagram below shows the valence electrons of 2 elements, **W** and **X**.



Which of the following correctly shows the type of bonds and chemical formula of the compound formed between **W** and **X**?

	<u>Type of bonds</u>	<u>Chemical formula</u>
A	Ionic	WX
B	Covalent	WX₂
C	Ionic	W₂X₃
D	Ionic	W₃X₂

- 5 Ethanol boils at 78°C while water boils at 100°C.

Which of the following best explains the difference in boiling points between ethanol (C_2H_5OH) and water (H_2O)?

- A The O–H bonds in water molecules are stronger than the O–H and C–H bonds in ethanol molecules.
- B The intermolecular forces of attraction between water molecules are stronger than those between ethanol molecules.
- C The ionic bonds between H^+ and OH^- ions in water are stronger than the covalent bonds within ethanol molecules.
- D The ionic bonds between H^+ and OH^- ions in water are stronger than the ionic bonds between the H^+ and $C_2H_5O^-$ ions in ethanol.

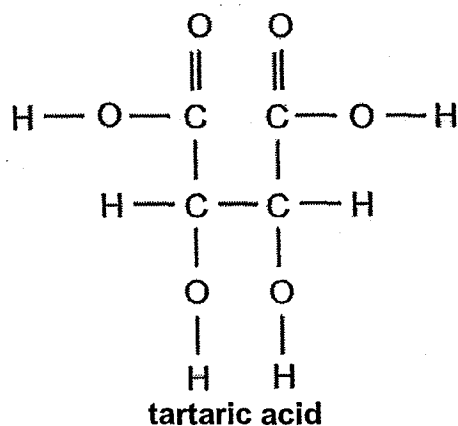
6 Which of the following compounds contains an atom that does **not** have a noble gas electronic configuration?

- A BF_3
- B CCl_4
- C PH_3
- D SO

7 Which of the following is **true** of oxides?

- A All metallic oxides are basic oxides.
- B All oxides react with acids to produce a salt.
- C Water and carbon monoxide are neutral oxides.
- D Acidic oxides react with acids to produce a salt.

8 The diagram below shows the structural formula of tartaric acid ($\text{C}_4\text{H}_6\text{O}_6$).



Which of the following salt(s) could be formed upon reacting tartaric acid with potassium hydroxide?

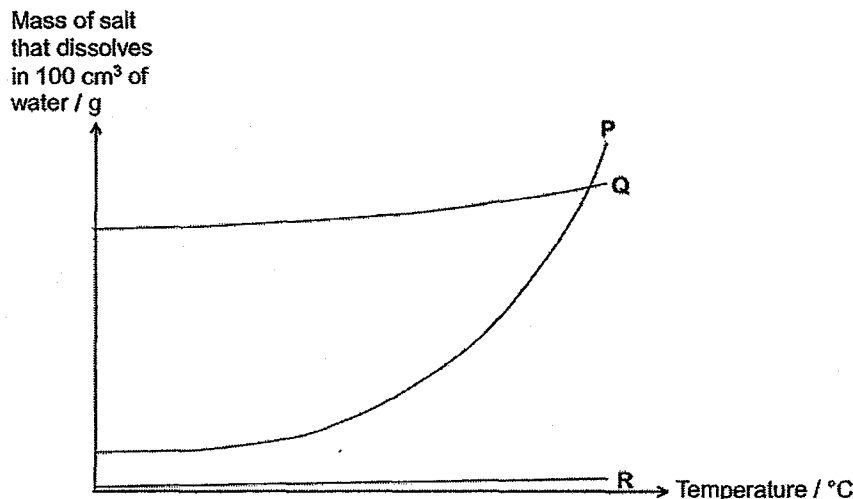
- I $\text{C}_4\text{H}_5\text{O}_6\text{K}$
- II $\text{C}_4\text{H}_4\text{O}_6\text{K}_2$
- III $\text{C}_4\text{H}_3\text{O}_6\text{K}_3$
- IV $\text{C}_4\text{H}_2\text{O}_6\text{K}_4$

- A II only
- B I and II only
- C II and III only
- D All of the above

- 9 Which of the following correctly shows the appropriate method and starting reagents to prepare a pure sample of copper(II) chloride?

	<u>Method</u>	<u>Starting reagents</u>
A	Titration	copper(II) carbonate and hydrochloric acid
B	Titration	copper(II) sulfate and hydrochloric acid
C	Acid and excess insoluble base	copper(II) oxide and hydrochloric acid
D	Ionic precipitation	copper(II) nitrate and sodium chloride

- 10 The diagram below shows the solubility curves of 3 salts, P, Q and R over a range of temperatures.



Which of the following shows the correct method of recovery for the 3 salts?

	<u>Salt P</u>	<u>Salt Q</u>	<u>Salt R</u>
A	Crystallisation	Ionic precipitation	Evaporation to dryness
B	Evaporation to dryness	Evaporation to dryness	Ionic precipitation
C	Evaporation to dryness	Crystallisation	Evaporation to dryness
D	Crystallisation	Evaporation to dryness	Ionic precipitation

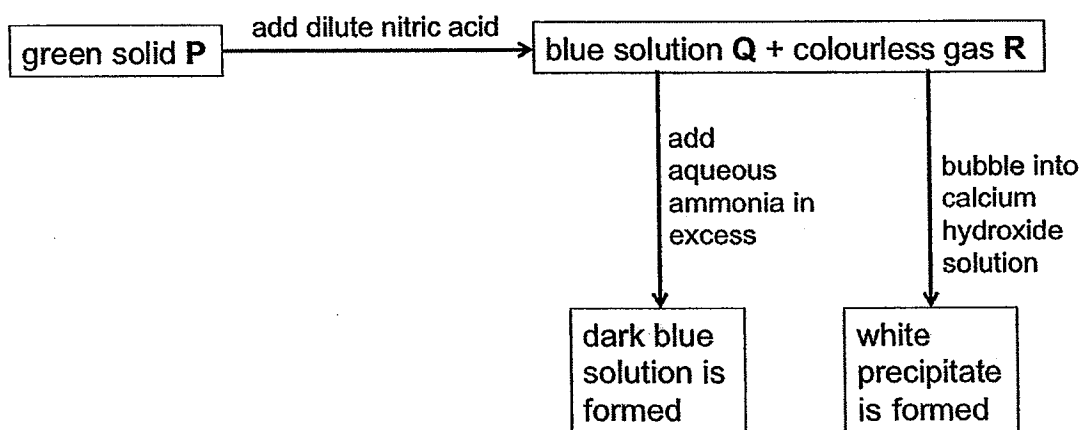
- 11 Alexis wanted to make calcium sulfate salt. Which one of the following steps would she be taking in the procedure?

- A Heat the pure salt solution until saturation point and then cool
- B Filter to separate calcium sulfate salt from the starting reagents
- C Add excess calcium carbonate to sulfuric acid until solid stops dissolving
- D Repeat the addition of calcium hydroxide to sulfuric acid without an indicator

- 12 Which of the following correctly shows the ionic equation for the preparation of potassium sulfate from the corresponding starting reagents?

	<u>Starting reagents</u>	<u>Ionic equation</u>
A	K ₂ CO ₃ and H ₂ SO ₄	$2\text{K}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{K}_2\text{SO}_4(\text{aq})$
B	K ₂ CO ₃ and H ₂ SO ₄	$\text{K}_2\text{CO}_3(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) + 2\text{K}^+$
C	KOH and H ₂ SO ₄	$\text{OH}^-(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
D	KOH and H ₂ SO ₄	$2\text{KOH}(\text{s}) + 2\text{H}^+(\text{aq}) + 2\text{SO}_4^{2-}(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{K}_2\text{SO}_4(\text{aq})$

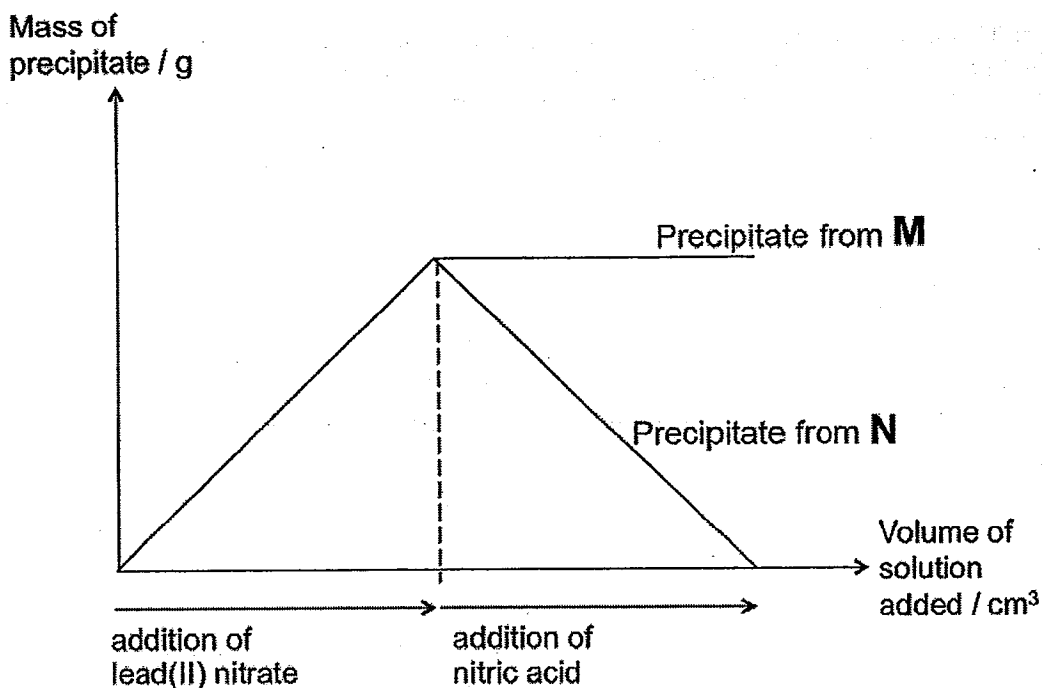
- 13 The diagram below shows a reaction scheme for an unknown green solid P.



What is the identity of the unknown P?

- A Cu
B CuCO₃
C FeCO₃
D Fe₂(CO₃)₃

- 14 The graph below shows the mass of precipitate formed when lead(II) nitrate and nitric acid are added successively to 2 solutions **M** and **N**.



What are the possible identities of the precipitates formed from solutions **M** and **N**?

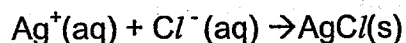
	<u>Precipitate from solution M</u>	<u>Precipitate from solution N</u>
A	PbCl_2	PbCO_3
B	PbCO_3	PbCl_2
C	Pb(OH)_2	PbCO_3
D	PbSO_4	PbCl_2

- 15 Melamine ($\text{C}_3\text{H}_6\text{N}_6$) is sometimes illegally added to food products to increase their nitrogen content.

What is the percentage by mass of nitrogen in melamine by mass?

- A 11.1%
B 51.9%
C 66.7%
D 84.0%

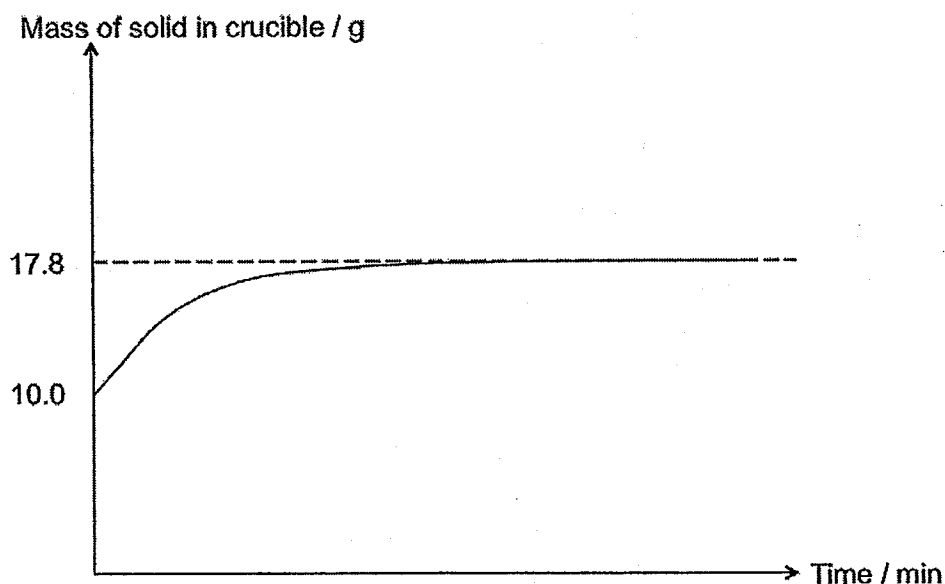
- 16 Chloride ions react with silver ions according to the following equation:



It was found that 20 cm³ of a 0.1 mol/dm³ solution of a chloride of a metal X needed 15 cm³ of 0.4 mol/dm³ of silver nitrate solution for complete reaction.

What is the formula of the chloride?

- A XCl
B XCl_2
C XCl_3
D X_2Cl_3
- 17 10.0 g of vanadium was placed in a crucible and heated strongly in excess oxygen to produce an oxide of vanadium of unknown chemical formula. The mass of the sample in the crucible was recorded over time as shown in the graph below.



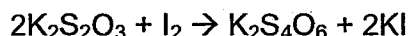
What is the formula of the oxide obtained?

- A VO
B VO_2
C V_2O_3
D V_2O_5

18 Which of the following is **not** a reaction involving oxidation and reduction?

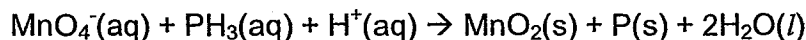
- A Rusting of an iron nail
- B Neutralisation of ammonia by sulfuric acid
- C Conversion of an alcohol to a carboxylic acid
- D Hydrogenation of vegetable oil to form saturated fat

19 Which of the following statements **incorrectly** describes the reaction below?



- A Sulfur is oxidised during the reaction.
- B $\text{K}_2\text{S}_2\text{O}_3$ is the reducing agent in the reaction.
- C The solution changes from reddish-brown to colourless.
- D The oxidation state of iodine remains unchanged after the reaction.

20 What is the change in oxidation state of manganese before and after the reaction shown below?



- A +6 to +2
- B +7 to +2
- C +7 to +4
- D +8 to +4

21 In some redox reactions, some substances can be both reduced and oxidised at the same time, a process known as disproportionation. Which of the following reactions shows disproportionation occurring?

- A $\text{C}_2\text{H}_6 \rightarrow \text{C}_2\text{H}_4 + \text{H}_2$
- B $\text{CaCO}_3 \rightarrow \text{CaO} + \text{O}_2$
- C $\text{Hg}_2\text{Cl}_2 \rightarrow \text{Hg} + \text{HgCl}_2$
- D $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$

22 Which of the pollutants below **cannot** be cut down by catalytic converters in vehicles?

- A Sulfur dioxide
- B Nitrogen oxide
- C Carbon monoxide
- D Unburnt hydrocarbons

- 23 Zinc reacts with sulfuric acid to produce zinc sulfate and hydrogen gas.

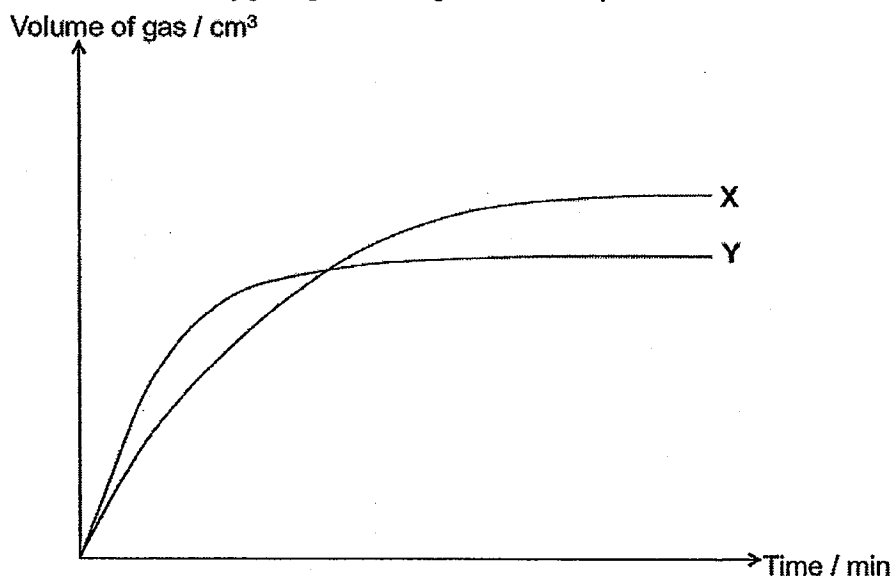
Which of the following would result in the highest rate of reaction?

- A Zinc ribbon with 100cm³ of 0.1 mol/dm³ sulfuric acid at 30°C
- B Zinc powder with 100cm³ of 0.1 mol/dm³ sulfuric acid at 30°C
- C Zinc ribbon with 100cm³ of 2.0 mol/dm³ sulfuric acid at 60°C
- D Zinc powder with 100cm³ of 2.0 mol/dm³ sulfuric acid at 60°C

- 24 Hydrogen peroxide decomposes according to the following equation:



100 cm³ of 0.10 mol/dm³ hydrogen peroxide was allowed to decompose until there was no change in the volume of oxygen gas collected. The graph X below was obtained by measuring the volume of oxygen gas during the decomposition.



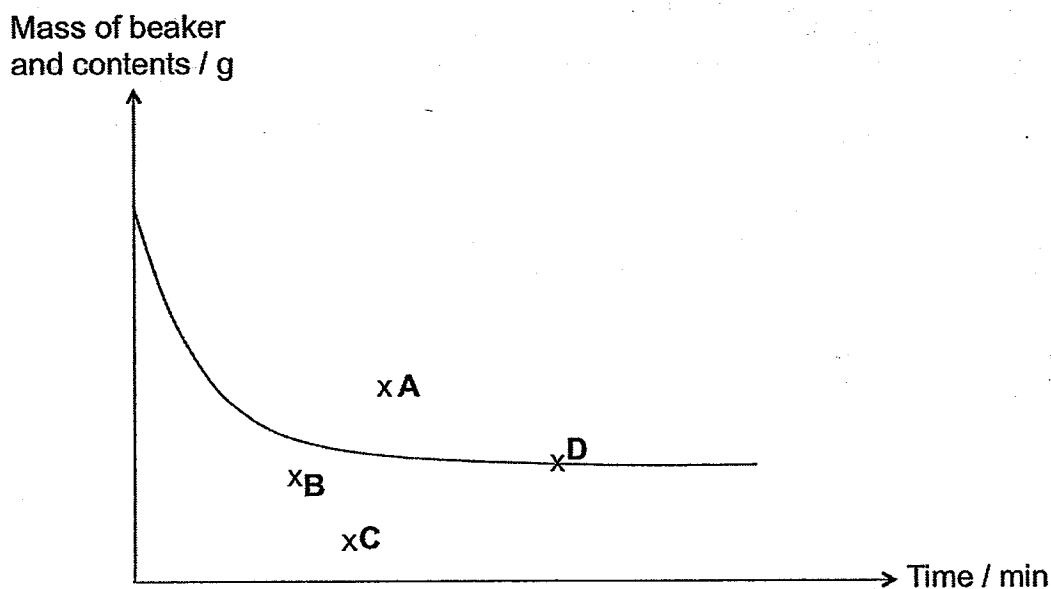
Which of the following changes to the experiment would produce the graph Y?

- A Adding manganese(IV) oxide as a catalyst
- B Increasing the temperature of the reactants
- C Using 90 cm³ of 0.10 mol/dm³ hydrogen peroxide
- D Using 60 cm³ of 0.15 mol/dm³ hydrogen peroxide

- 25 In which of the following reactions is the rate of reaction **not** affected by a change in surface area of the reactants?

- A Reaction between aluminium oxide and hydrochloric acid
- B Reaction between aqueous sodium hydroxide and nitric acid
- C Production of sodium chloride from sodium and chlorine gas
- D Decomposition of hydrogen peroxide solution with solid catalyst

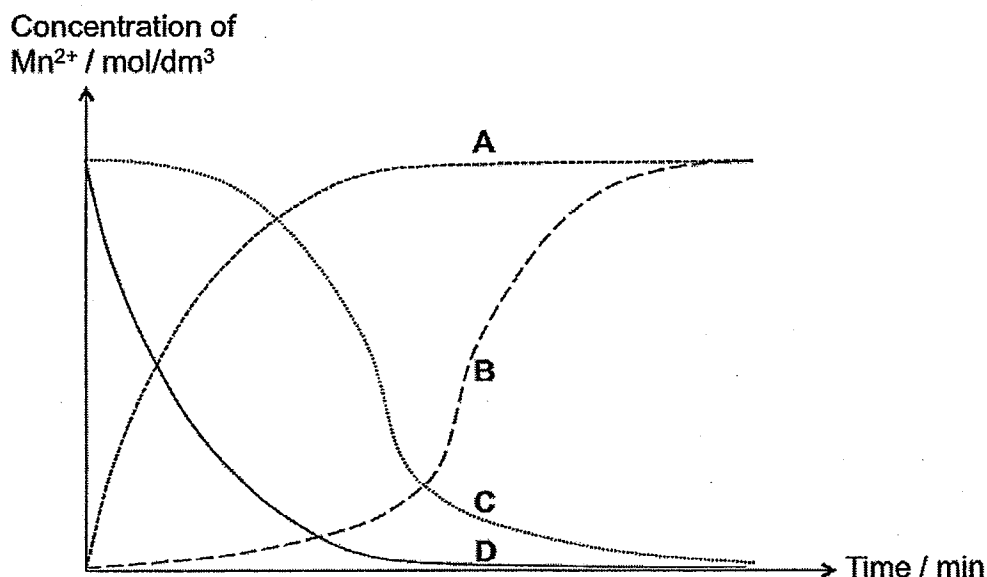
- 26 In an experiment 1, excess zinc carbonate was added to 100 cm^3 of 1.0 mol/dm^3 sulfuric acid in a beaker. The mass of the beaker and its contents was recorded at regular time intervals, and a graph was plotted as shown below.



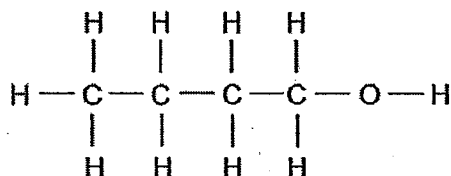
In experiment 2, excess zinc carbonate was added to 100 cm^3 of 2.0 mol/dm^3 nitric acid in a beaker. At which of the points on the graph shown will the mass in experiment 2 reach a constant?

- 27 Some reactions form products that are themselves catalysts of the reaction. These products are known as autocatalysts.

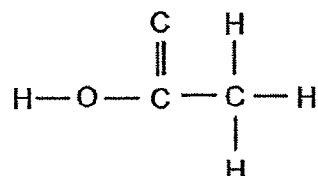
In an experiment, manganese(II) ion Mn^{2+} is formed and is an autocatalyst. Which of the following graphs shows how the concentration of Mn^{2+} varies as the reaction progresses?



- 28 Which of the following is **not true** of alkanes?
- A Their general formula is C_nH_{2n+2} .
 - B They can be produced in the cracking of larger hydrocarbons.
 - C They undergo combustion in excess oxygen to give carbon dioxide and water.
 - D They can be converted from an alkene by mixing with hydrogen gas at room temperature.
- 29 Which of the following occurs during the reduction of ethene by hydrogen gas?
- A Breaking of carbon-carbon single bond
 - B Breaking of carbon-carbon double bond
 - C Breaking of carbon-hydrogen single bond
 - D Breaking of hydrogen-hydrogen single bond
- 30 The diagram below shows the structures of an alcohol and a carboxylic acid that are reacted under suitable conditions.

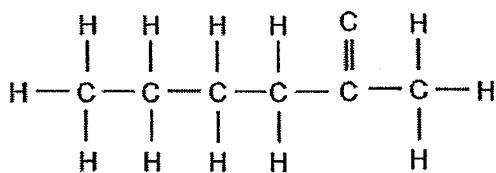


Alcohol

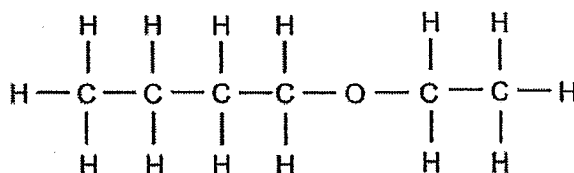


Carboxylic acid

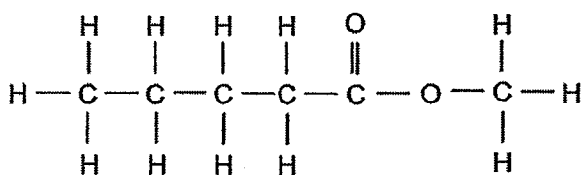
Which of the following shows the product that is formed?



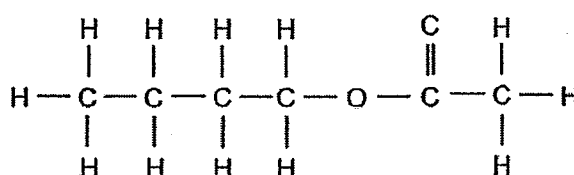
A



B



C



D

Group										
I	II	III	IV	V	VI	VII	0			
7 Li lithium 3	9 Be beryllium 4	1 H hydrogen 1 relative atomic mass atomic symbol atomic number					2 He helium 2			
23 Na sodium 11	24 Mg magnesium 12						11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8
39 K potassium 19	40 Ca calcium 20	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			
85 Rb rubidium 37	88 Sr strontium 38	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36			
133 Cs caesium 55	137 Ba barium 56	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54			
- Fr francium 87	- Ra radium 88	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	- Po polonium 84	- At astatine 85	- Rn radon 86			

*58-71	140	141	144	-	150	152	157	159	162	165	167	169	173	175
Lanthanoid series	Ce cerium 58	Pr praseodymium 59	Nd neodymium 60	Pm promethium 61	Sm samarium 62	Eu europium 63	Gd gadolinium 64	Tb terbium 65	Dy dysprosium 66	Ho holmium 67	Er erbium 68	Tm thulium 69	Yb ytterbium 70	Lu lutetium 71
+90-103	232	-	238	-	-	-	-	-	-	-	-	-	-	-
Actinoid series	Th thorium 90	Pa protactinium 91	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 dm^3 at room temperature and pressure (r.t.p.).

2014 Sec 4 Mid-Year Chemistry Answers

Paper 1

1	C	2	B	3	D	4	C	5	B
6	A	7	C	8	B	9	C	10	D
11	B	12	C	13	B	14	A	15	C
16	C	17	D	18	B	19	D	20	C
21	C	22	A	23	D	24	D	25	B
26	D	27	B	28	D	29	B / D	30	D

Class	Register Number	Name
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南洋女子中学校
NANYANG GIRLS' HIGH SCHOOL

Mid-Year Examination 2014
Secondary Four

CHEMISTRY

Paper 2

Theory Paper

Wednesday

Additional materials: Writing papers

7 May 2014

1 hour 15 minutes

1145-1300

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name, register number and class in the spaces at the top of this page and on any separate answer paper used.

Section A (40 marks)

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Section B (10 marks)

Answer **all** questions.

Write your answers on the separate writing paper provided.

At the end of the examination,

1. fasten all your work securely together;
2. hand in Section A and Section B separately

INFORMATION FOR CANDIDATES

The intended number of marks is given in the brackets [] at the end of each question or part question. You are advised to spend no longer than one hour on Section A and no longer than 15 minutes on Section B.

Use of scientific calculators is allowed.

A copy of the periodic table is found on page 10.

Examiner's Use	
Section A	
Section B	
Total	

This document consists of 10 printed pages.

Setters: SC, MI, CHG

NANYANG GIRLS' HIGH SCHOOL

[Turn over]

Section A

Answer all questions.

Write your answers in the spaces provided.

A1 Dieticians recommend that saturated fats in our diet be replaced by polyunsaturated vegetable oils. Vegetable oils can often be converted by reacting with hydrogen through a process called hydrogenation.

(a) Explain the meaning of the term '*polyunsaturated*'. [1]

(b) What type of a reaction is hydrogenation? [1]

(c) Name a catalyst needed for the reaction in (b). [1]

(d) 10.0 g of an oil ($M_r = 800$) is completely reacted with 1.80 dm³ of hydrogen measured at r.t.p. Calculate the number of moles of hydrogen that will react with one mole of the oil. Hence deduce how many C=C bonds there are in one molecule of this oil. [3]

Total [6]

A2 An unlabelled solution is identified as either aqueous aluminium nitrate or aqueous lead(II) nitrate.

(a) Describe what you would see when aqueous ammonia is added dropwise to the solution until in excess. [1]

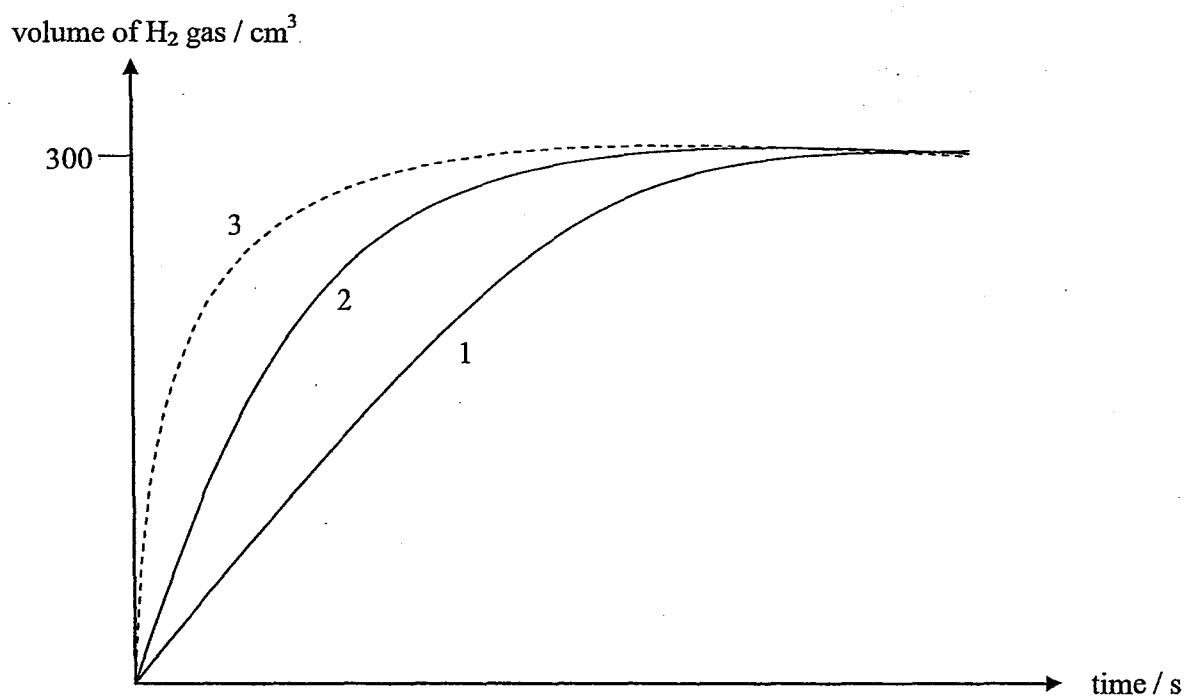
(b) Suggest a reagent to determine the identity of the solution. [1]

Total [2]

A3 A student placed 0.50 g of metal **X** into a conical flask containing 80 cm³ of 1.00 mol/dm³ HCl. The volume of hydrogen gas was measured at regular intervals at 25°C. The whole experiment was repeated using 0.50 g of metal **X** and 50 cm³ of 2.00 mol/dm³ HCl. Metal **X** belongs to Group II of the Periodic Table.

Experiment	Mass of Metal X	Volume and concentration of HCl
1	0.50 g	80 cm ³ , 1.00 mol/dm ³
2	0.50 g	50 cm ³ , 2.00 mol/dm ³

The results obtained are shown on the following graphs:



Graph 1: Result from Experiment 1

Graph 2: Result from Experiment 2

- (a) Which reagent is in excess, metal **X** or HCl in Experiment 1? Explain your answer [2]
without utilizing any calculation.

- (b) Suggest a method for measuring the volume of hydrogen gas liberated. [1]

- (c) Experiment 2 was repeated by changing one of the conditions. Suggest three different ways of changing the condition of the experiment, without changing the concentration of the HCl, that might lead to the same result shown by graph 3. [3]

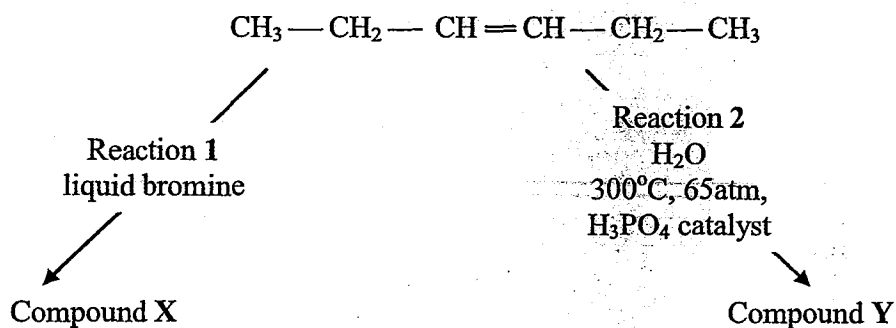
- (d) Draw a graph that would be obtained if experiment 1 was repeated using 0.25 g of metal X on the same axes as graphs 1, 2 and 3. All other conditions remain unchanged. Label the graph as 4. [1]

- (e) Calculate the relative atomic mass of metal X and hence identify metal X. [3]

- (f) Draw a graph on the same axes as graphs 1, 2 and 3 which would be obtained if experiment 1 was repeated using 80 cm³ of 1.00 mol/dm³ sulfuric acid keeping all other conditions unchanged. Label the graph as 5. [1]

[Total:11]

A4 Hex-3-ene undergoes reactions as shown below.



(a) Draw the full structural formula of compound X and give its IUPAC name. [2]

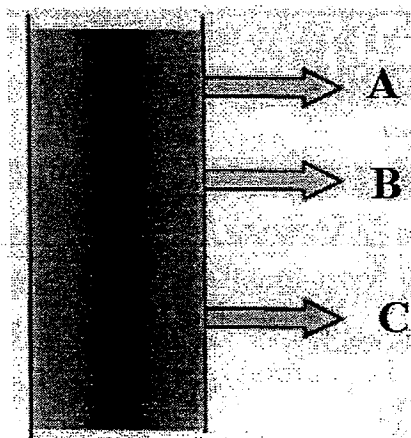
(b) Draw the full structural formula of compound Y and give its IUPAC name. [2]

(c) Explain the consequence of carrying out Reaction 1 in the presence of sunlight. [1]

(d) Give the IUPAC name of an isomer of the product of Reaction 2. [1]

Total [6]

A5



In the figure below, three consecutive fractions **A**, **B** and **C** of petroleum are extracted from a fractionating column.

- (a) If **B** is petrol, what are fractions **A** and **C**? [2]

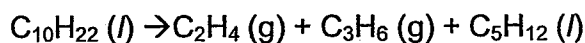
Fraction **A** is _____

Fraction **C** is _____

- (b) State the difference in molecular size and boiling point between the three fractions, **A**, **B** and **C**. [1]

Total [3]

- A6** (a) The catalytic cracking process is used to break up decane, $C_{10}H_{22}$, into smaller alkane and alkene molecules. One possible reaction during the cracking process is given by the equation below:



- (i) State the conditions required for the cracking process. [2]

Conditions:

- (ii) Name the process used to separate the three different products.

[1]

Name of process: _____

- (iii) State two possible reasons for carrying out catalytic cracking of crude oil.

[2]

- (iv) Calculate the mass of ethene that can be produced from cracking 12.0 dm^3 of decane, assuming a 20% yield.

[2]

(b) When an alkane, $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{CH}(\text{CH}_3)_2$ was subjected to catalytic cracking, three products were identified. Of these, two of the products decolourised liquid bromine in the dark while one product did not.

- (i) The mass spectrum of the mixture showed molecular ion peaks at mass-to-charge ratio (m/e) values of **42**, **56** and **72**, indicating the relative molecular masses of the three products. Deduce and hence draw the full-displayed structures of the three molecules in the cracking process. [3]

$m/e=42$

$m/e=56$

$m/e=72$

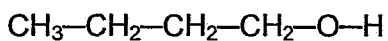
- (ii) Name two other possible products from (bi) above that did not decolourise liquid bromine in the dark. [2]

Total [12]

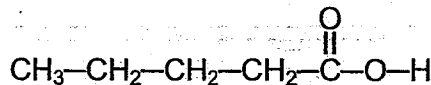
Section B

Answer all questions.

- B7** Organic compounds **A** and **B** are colourless liquids. The structural formulae of the compounds are shown.



Compound **A**



Compound **B**

- (a) Name a reagent which can distinguish the two compounds. Describe clearly all observations that would be made. Write chemical equation(s) to show the reaction(s) that have taken place. State symbols are **not** required. [3]
- (b) Compound **A** can be converted into compound **B**.
- (i) Assuming that both compounds are soluble in water and have similar densities, explain how would you separate compound **B** from the reaction mixture containing compound **B** and compound **A**. [2]
- (ii) Name the type of reaction that has taken place in the process of converting compound **A** to compound **B**. [1]
- (c) Compound **A** can also react with compound **B** to form an ester.
- (i) Draw the full structural formula of the ester, and name the ester. [2]
- (ii) A student prepared the ester using 22.0 g of Compound **A** and excess compound **B**. It was found that 38.1 g of the ester was obtained. Calculate the percentage yield of this reaction. [2]

Total [10]

End of paper

The Periodic Table of the Elements																	
Group																	
I	II	III										IV	V	VI	VII	0	
1 H hydrogen 1																	
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 aluminum 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	- Ra radium 88	- Ac actinium 89															

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

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

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

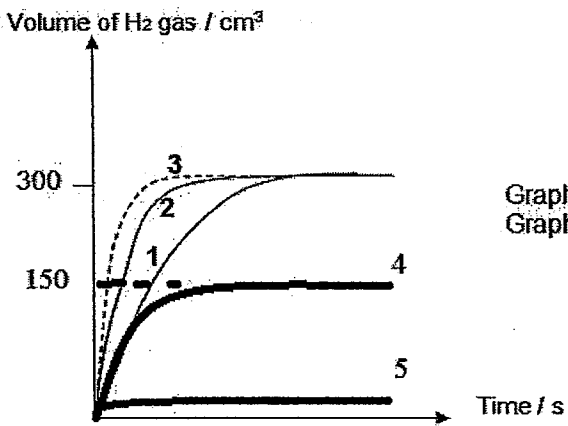
Key
a X

Q.10 The volume of one mole of any gas is 24 dm^3 at room temperature and

2014 Sec 4 Mid-Year Chemistry Answers

Paper 2

No	Answers	Marks
A1 a)	The term polyunsaturated refers to the presence of more than one carbon to carbon double (C=C) or triple bonds in a molecule. [reject : double bonds]	[1]
b)	Addition [accept: redox reaction]	[1]
c)	Nickel	[1]
d)	No of moles of oil = 0.0125 No of moles of hydrogen gas used = 0.075 mol 0.0125 mol of oil needed 0.075 mol of hydrogen gas 1 mol of oil will need $0.075/0.0125 = 6$ mol of hydrogen gas Therefore, the oil has 6 double bonds.	[1] [1] [1]
A2 a)	A white precipitate insoluble in excess aqueous ammonia is observed. [reject : insoluble white precipitate]	[1]

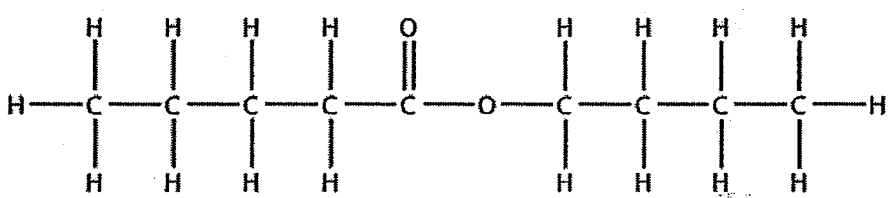
No	Answers	Marks
b)	Any aqueous halide or sulfate	[1]
A3	HCl is present in excess in experiment I.	[1]
a)	Same volume of gas produced when mass of metal used is the same but different no. of moles of HCl used. OR Despite the different number of moles of HCl used, the volume of gas produced is the same. Reject: There is more HCl than metal X.	[1]
b)	Connect the conical flask containing the reaction mixture to a gas syringe.	[1]
c)	Any three of the following: addition of catalyst; using (finely) powdered form of metal X; higher temperature	[3]
d)	Same gradient (rate) as graph 1 and volume of H₂ = 150 cm³ 	[1]
e)	No. of mol of H₂(g) = $\frac{300}{24000} = 0.0125$ Since X is a group II element, $X(s) + 2HCl \rightarrow XCl_2(aq) + H_2(g)$ OR	[1]

No	Answers	Marks
	Mole ratio of X to H ₂ is 1:1 No of moles of X = 0.0125 $\therefore A_r \text{ of X} = \frac{0.50}{0.0125} = 40$ X is calcium.	 [1] [1]
f)	volume of H ₂ lower than graph 4 (and steeper gradient than graph 1) refer to graph in part (d)	[1]
A4 a)	<pre> H H H H H H H-C-C-C-C-C-C-H H H Br Br H H </pre> 3,4-dibromohexane	[1] [1]
b)	<pre> H H H H H H H-C-C-C-C-C-C-H H H H O H H H </pre> hexan-3-ol	[1] [1]
c)	Substitution will occur as well, resulting in multiple organic products 1 mark for either substitution or multiple organic products being mentioned	[1]
d)	hexan-1-ol or any other valid isomer	[1]
A5 a)	A is petroleum gas. B is naphtha.	[2]
b)	The molecular size and boiling points increase from A to C.	[1]
A6 a)	Conditions for catalytic cracking:	[2]
i)	600°C, with use of catalysts such as aluminium oxide or silicon(IV)	

No	Answers	Marks
	oxide. [temperature = [1], name of catalyst = [1]]	
ii)	Fractional Distillation	[1]
iii)	To produce fuels such as petrol; To produce hydrogen gas; To produce short-chain alkenes such as ethene and propene which are used in the petrochemical industries [any 2 of the above]	[2]
iv)	12 dm ³ of decane will produce 12 dm ³ of ethane OR 0.5mole of ethane is formed. 20% yield would mean that only 2.4 dm ³ of ethene is produced. Mass of 2.4dm ³ of ethene = (28/24) x 2.4 = 2.8 g	[1] [1]
b) i)	2 fractions were able to react with liquid bromine in the dark. The 2 fractions are alkenes. Relative molecular mass of <u>42 is likely to be propene.</u> $ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}=\text{C}-\text{H} \\ \\ \text{H} \end{array} $ Relative molecular mass of <u>56 is likely to be butene</u> (either but-1-ene or but-2-ene will be accepted) $ \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}-\text{H} \\ \qquad \qquad \\ \text{H} \qquad \qquad \text{H} \end{array} $ OR	[1]

No	Answers	Marks
	<pre> H H H H H-C=C-C-C-H H H </pre> $C_nH_{2n+2} = 72$ $12n + 2n + 2 = 72$ $14n = 70$ $n = 5$ <pre> H H H H H H-C-C-C-C-C-H H H H H H </pre> <u>Relative molecular mass of 72 is likely to be pentane or any isomer of pentane will be accepted.</u> All 3 full structures must be correct. [names only = 0 marks]	[1]
ii)	Pentane or 2-methylbutane or 2,2-dimethylpropane [depends on what the student has drawn for b(i)] The answer of the 2 isomers here <u>must be different</u> from the full structure that the student has drawn for b)(i).	[2]
B7 a)	Reagent: sodium carbonate (accept any suitable carbonate or magnesium, zinc, iron) Observations: Compound B – Effervescence / bubbles of gas / gas evolved produces a white precipitate with aqueous calcium hydroxide or gas extinguishes a lighted splint with a 'pop' sound. Compound A - no effervescence / no visible change. [1 for <u>both</u> observations]	[1]

No	Answers	Marks
	Equation: $2\text{C}_4\text{H}_9\text{COOH} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{C}_4\text{H}_9\text{COONa} + \text{CO}_2 + \text{H}_2\text{O} \text{ [1] OR}$ $2\text{C}_4\text{H}_9\text{COOH} + \text{Mg} \rightarrow (\text{C}_4\text{H}_9\text{COO})_2\text{Mg} + \text{H}_2$ Reject: Metals from Group I and Aluminium. Aluminium generally has a layer of aluminium oxide over it and is not likely to react if the oxide layer was not removed. Equation given NO mark once proposed method is wrong. <u>OR</u> Reagent: Acidified aqueous potassium manganate(VII) Observations: Compound B – Acidified aqueous potassium manganate(VII) remains purple when it is <u>warmed</u> with compound B. Compound A - Acidified aqueous potassium manganate(VII) changes from purple to colourless when <u>warmed</u> with compound A. 1 for <u>both</u> observations Equation: $\text{C}_4\text{H}_9\text{OH} + 2[\text{O}] \rightarrow \text{C}_3\text{H}_7\text{COOH} + \text{H}_2\text{O} \text{ OR}$ $5 \text{C}_4\text{H}_9\text{OH} + 4 \text{KMnO}_4 + 6 \text{H}_2\text{SO}_4 \rightarrow 5 \text{C}_3\text{H}_7\text{COOH} + 4 \text{MnSO}_4$ $+ 2 \text{K}_2\text{SO}_4 + 11 \text{H}_2\text{O}$ comments: zero marks awarded if the mixture is not warmed	[1] [1]
b)	Fractional distillation	[1]
i)	Compounds A and B are separated on basis of their difference in their boiling points . Boiling point of compound A is 117.4 °C while compound B is 185°C.	[1]

No	Answers	Marks
	reject: distillation or simple distillation	
ii)	oxidation (Accept redox reaction) reject: incorrect spelling of oxidation. This is a chemical term. You need to be able to get the spelling correct to be awarded the marks	[1]
c) i)	 Name of ester: butyl pentanoate [Marks awarded only for FULL structural formula because that is what is asked for. No marks awarded for wrong spelling of the ester]	[1] [1]
ii)	No of moles of alcohol: $22/74 = 0.2973 \text{ mol}$ No of moles of ester: 0.2973 mol Theoretical mass of ester: $0.2973 \times 158 = 46.97\text{g}$ % yield of reaction: $38.1 / 46.97 = 80.1\% \text{ (3sf)}$	[1] [1]