



**HWA CHONG INSTITUTION**  
**C2 Preliminary Examinations**  
**Higher 1**

CANDIDATE  
NAME

CT GROUP

14S

**CHEMISTRY**

**8872/01**

Paper 1 Multiple Choice

**18 September 2015**

**50 min**

Additional Materials: Optical Mark Sheet (OMS)

Data Booklet

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Complete the information on the optical mark sheet (OMS) as shown below.

1. Enter your NAME ( as in NRIC ).



Write your **name**

2. Enter the SUBJECT TITLE.

3. Enter the PAPER NUMBER.

4. Enter your CT GROUP.



Write your **CT group**

5. Date.

6. Enter your NRIC NUMBER or  
FIN NUMBER.

7. Now SHADE the corresponding  
lozenge in the grid for  
EACH DIGIT or LETTER

NRIC / FIN															
S	0	0	0	0	0	0	0	0	0	A	K	U			
F	1	1	1	1	1	1	1	1	1	B	L	V			
G	2	2	2	2	2	2	2	2	2	C	M	W			
T	3	3	3	3	3	3	3	3	3	D	N	X			
	4	4	4	4	4	4	4	4	4	E	O	Y			
	5	5	5	5	5	5	5	5	5	F	P	Z			
	6	6	6	6	6	6	6	6	6	G	Q				
	7	7	7	7	7	7	7	7	7	H	R				
	8	8	8	8	8	8	8	8	8	I	S				
	9	9	9	9	9	9	9	9	9	J	T				

Write and  
shade your  
NRIC  
or FIN number

There are **thirty** 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 OMS.

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.

## SECTION A

- 1 A mixture of  $10\text{ cm}^3$  of methane and  $10\text{ cm}^3$  of ethane was sparked with an excess of oxygen.

After cooling to room temperature, the residual gas was passed through aqueous potassium hydroxide.

All gas volumes were measured at the same temperature and pressure.

What volume of gas was absorbed by the alkali?

- A  $15\text{ cm}^3$       B  $20\text{ cm}^3$       C  $30\text{ cm}^3$       D  $40\text{ cm}^3$

- 2 In which species are the numbers of protons, neutrons and electrons all different?

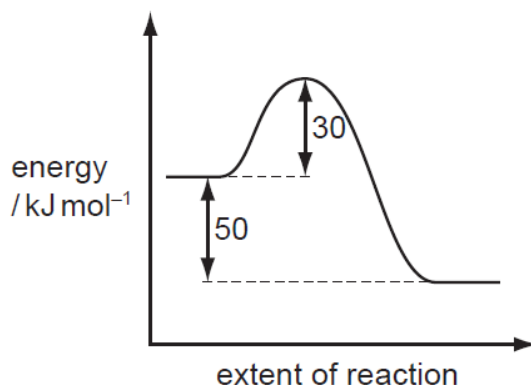
- A  $^{27}_{13}\text{Al}$       B  $^{35}_{17}\text{Cl}^-$       C  $^{32}_{16}\text{S}^{2-}$       D  $^{39}_{19}\text{K}^+$

- 3 When iron reacts with aqueous iron(III) ions, iron(II) ions are formed as the only product.

A final mixture, after the reaction has taken place, contains equal numbers of moles of  $\text{Fe}^{2+}(\text{aq})$  and  $\text{Fe}^{3+}(\text{aq})$ . Assuming the reaction has gone to completion, how many moles of  $\text{Fe}(\text{s})$  and  $\text{Fe}^{3+}(\text{aq})$  were in the starting mixture?

	moles of $\text{Fe}(\text{s})$	moles of $\text{Fe}^{3+}(\text{aq})$
A	1	2
B	1	3
C	1	5
D	2	3

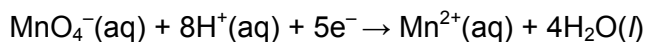
- 4 The reaction pathway for a reversible reaction is shown below.



Which statement is correct?

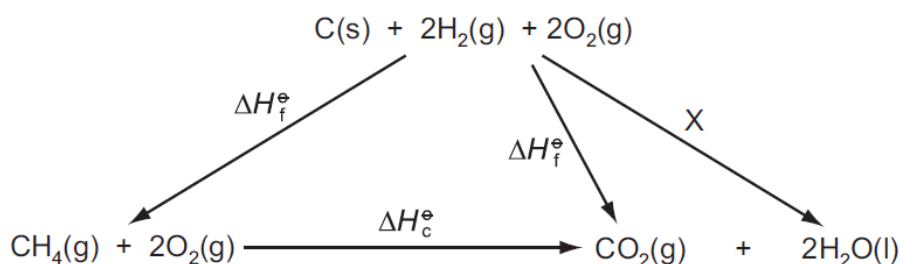
- A The activation energy of the reverse reaction is  $+80\text{ kJ mol}^{-1}$ .  
 B The enthalpy change for the forward reaction is  $+30\text{ kJ mol}^{-1}$ .  
 C The enthalpy change for the forward reaction is  $+50\text{ kJ mol}^{-1}$ .  
 D The enthalpy change for the reverse reaction is  $+30\text{ kJ mol}^{-1}$ .

- 5 Sulfur dioxide gas is converted into sulfate ions when it is bubbled into a solution containing aqueous manganate(VII) ions.



How will the pH of the reaction mixture change as sulfur dioxide is bubbled at constant rate into a well-stirred solution of manganate(VII) ions until its colour just fades?

- A a decrease  
B a decrease then an increase  
C an increase  
D an increase then a decrease
- 6 Enthalpy changes that are difficult to measure directly can often be determined using Hess' Law to construct an enthalpy cycle.  
Which enthalpy change is indicated by X in the enthalpy cycle shown?



- A  $-4 \times$  the enthalpy of combustion of hydrogen  
B  $+4 \times$  the enthalpy of combustion of hydrogen  
C  $-2 \times$  the enthalpy of formation of water  
D  $+2 \times$  the enthalpy of formation of water
- 7 The table shows the physical properties of four substances.  
Which substance has a giant covalent structure?

	melting point / $^\circ\text{C}$	boiling point / $^\circ\text{C}$	electrical conductivity of solid	electrical conductivity of liquid	electrical conductivity of aqueous solution
A	-119	39	poor	poor	insoluble
B	-115	-85	poor	poor	good
C	993	1695	poor	good	good
D	1610	2230	poor	poor	insoluble

- 8 Under the same conditions, which of the following ions would be deflected in a mass spectrometer to the same extent as  $^{12}_6\text{C}^{2+}$  ?

- A  $^6_3\text{Li}^+$   
 B  $^{12}_6\text{C}^+$   
 C  $^{12}_7\text{N}^{3+}$   
 D  $^{13}_6\text{C}^{2+}$

- 9 Values for the ionic product of water,  $K_w$ , at two different temperatures are given below.

temperature / °C	$K_w / \text{mol}^2 \text{dm}^{-6}$
25	$1.00 \times 10^{-14}$
62	$1.00 \times 10^{-13}$

What can be deduced from this information?

- A Water is not neutral liquid at 62 °C  
 B The ionic dissociation of water increases by a factor of 5 between 25 °C and 62 °C  
 C The association of water molecules by hydrogen bonding increases as temperature rises.  
 D The ionic dissociation of water is an endothermic process
- 10 Lead is the final product formed by a series of changes in which the rate-determining stage is the radioactive decay of uranium-238. This decay is a first-order reaction with half-life of  $4.5 \times 10^9$  years.

What would be the age of a rock sample originally lead-free, in which molar ratio of uranium to lead is 12.5% : 87.5% ?

- A  $1.5 \times 10^9$  years  
 B  $4.5 \times 10^9$  years  
 C  $12.6 \times 10^9$  years  
 D  $13.5 \times 10^9$  years

- 11  $10 \text{ cm}^3$  of a  $0.01 \text{ mol dm}^{-3}$  solution of nitric acid is diluted with  $90 \text{ cm}^3$  of water.

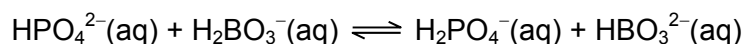
What is the pH of the resulting solution?

- A 1                      B 2                      C 3                      D 4

- 12 The magnitude of enthalpy change of neutralisation of aqueous sodium hydroxide by hydrochloric acid is  $57.2 \text{ kJ mol}^{-1}$ , but the magnitude of enthalpy change of neutralisation of aqueous sodium hydroxide by aqueous ethanoic acid is  $55.2 \text{ kJ mol}^{-1}$ .

Which statement best explains the numerical difference in these values?

- A** The process  $\text{CH}_3\text{CO}_2\text{H (aq)} \rightarrow \text{CH}_3\text{CO}_2^- \text{ (aq)} + \text{H}^+ \text{ (aq)}$  is exothermic
- B** The process  $\text{CH}_3\text{CO}_2\text{H (aq)} \rightarrow \text{CH}_3\text{CO}_2^- \text{ (aq)} + \text{H}^+ \text{ (aq)}$  is endothermic
- C** Aqueous ethanoic acid is a weak acid and has fewer hydrogen ions than hydrochloric acid of the same concentration.
- D** A smaller volume of aqueous hydrochloric acid is required for the neutralisation compared to that of ethanoic acid of the same concentration.
- 13 The equilibrium constant for the following reaction is very much less than 1.



Which one of the following gives the correct relative strengths of the acids and bases in the reaction?

	acids				bases			
<b>A</b>	$\text{H}_2\text{PO}_4^-$	>	$\text{H}_2\text{BO}_3^-$	and	$\text{HBO}_3^{2-}$	>	$\text{HPO}_4^{2-}$	
<b>B</b>	$\text{H}_2\text{BO}_3^-$	>	$\text{H}_2\text{PO}_4^-$	and	$\text{HBO}_3^{2-}$	>	$\text{HPO}_4^{2-}$	
<b>C</b>	$\text{H}_2\text{PO}_4^-$	>	$\text{H}_2\text{BO}_3^-$	and	$\text{HPO}_4^{2-}$	>	$\text{HBO}_3^{2-}$	
<b>D</b>	$\text{H}_2\text{BO}_3^-$	>	$\text{H}_2\text{PO}_4^-$	and	$\text{HPO}_4^{2-}$	>	$\text{HBO}_3^{2-}$	

- 14 The rate of the reaction  $3\text{X(g)} + \text{Y(g)} \rightarrow \text{Z(g)}$  is given by the rate equation,  $\text{rate} = k [\text{X}]^2 [\text{Y}]$ .

Two experiments using the same initial amounts of **X** and **Y** were carried out at temperature, *T*. The data is shown below.

experiment	volume of reaction vessel	initial rate of reaction
1	<i>V</i>	<i>R</i> <sub>1</sub>
2	2 <i>V</i>	<i>R</i> <sub>2</sub>

Which one of the following shows the relationship between *R*<sub>1</sub> and *R*<sub>2</sub>?

- A**  $R_2 = \frac{1}{8} R_1$       **B**  $R_2 = \frac{1}{4} R_1$       **C**  $R_2 = R_1$       **D**  $R_2 = 8R_1$

- 15 Use of the Data Booklet is relevant to this question.

A chemist took  $2.00 \text{ dm}^3$  of nitrogen gas, measured under room conditions, and reacted it with a large volume of hydrogen gas, in order to produce ammonia. Only 15.0% of the nitrogen gas reacted to produce ammonia.

What mass of ammonia was formed?

- A 0.213 g      B 0.425 g      C 1.42 g      D 2.83 g

- 16 Element Z is in period 3 of the Periodic Table. The following four statements describe the properties of element Z or its compounds.

Three statements are correct descriptions. One of the statements is not correct because it does not fit with the other three.

Which statement is **not** correct?

- A Element Z is a solid at room temperature which conducts electricity.  
B Element Z forms a chloride,  $\text{ZCl}_3$ , which reacts with more chlorine to give  $\text{ZCl}_5$ .  
C The chloride  $\text{ZCl}_3$  reacts with water to give an acidic solution.  
D Adding  $\text{NaOH(aq)}$  to the solution resulting from the reaction of  $\text{ZCl}_3$  with water produces a white precipitate which is soluble in an excess of  $\text{NaOH(aq)}$ .

- 17 Element G is found in Period 3 of the Periodic Table.

The oxide and chloride of element G are separately mixed with water. The two resulting solutions have the same effect on litmus paper.

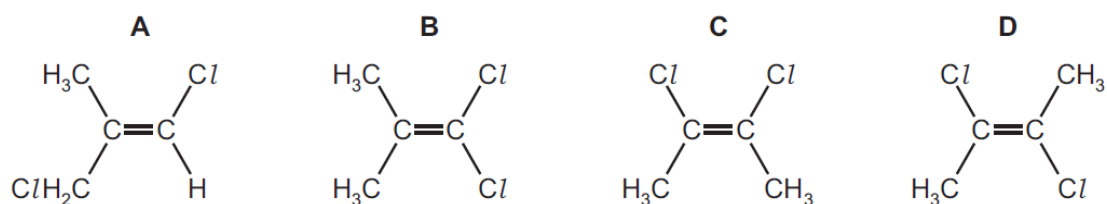
What is the identity of element G?

- A aluminium      C phosphorus  
B magnesium      D sodium

- 18 Which one of the following pairs of compounds does the first member have a higher boiling point than the second member?

- A butane, 2-methylpropane  
B ethanol, water  
C *trans* but-2-ene, *cis* but-2-ene  
D 2-hydroxybenzoic acid, 4-hydroxybenzoic acid

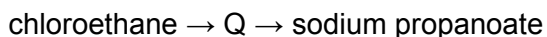
- 19 Which molecular structure will have the smallest overall dipole?



- 20 Compound X has the molecular formula C<sub>4</sub>H<sub>10</sub>O<sub>2</sub>.  
 X has an unbranched carbon chain and contains two OH groups.  
 On reaction with an excess of hot, acidified, aqueous manganate(VII) ions, X is converted into a compound of molecular formula C<sub>4</sub>H<sub>6</sub>O<sub>4</sub>.  
 To which two carbon atoms in the chain of X are the two OH groups attached?

- A 1st and 2<sup>nd</sup>
- B 1st and 3<sup>rd</sup>
- C 1st and 4<sup>th</sup>
- D 2<sup>nd</sup> and 3<sup>rd</sup>

- 21 Chloroethane can be used to make sodium propanoate.

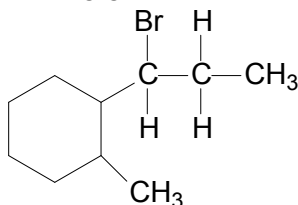


The intermediate, Q, is hydrolysed with boiling aqueous sodium hydroxide, to give sodium propanoate.

Which reagent would produce the intermediate, Q, from chloroethane?

- A concentrated ammonia solution
- B dilute sulfuric acid
- C hydrogen cyanide
- D potassium cyanide

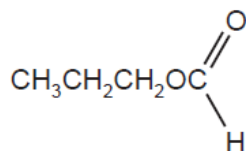
- 22 How many different alkenes, including geometrical isomers, could be produced when



reacts with hot ethanolic NaOH?

- |            |            |
|------------|------------|
| <b>A</b> 2 | <b>C</b> 4 |
| <b>B</b> 3 | <b>D</b> 5 |

- 23 The structural formula of a compound X is shown below.



What is the name of compound X and how does its boiling point compare with that of butanoic acid?

	name of X	boiling point of X
<b>A</b>	methyl propanoate	higher
<b>B</b>	methyl propanoate	lower
<b>C</b>	propyl methanoate	higher
<b>D</b>	propyl methanoate	lower

- 24 The hydrolysis of 1-chloropropane to produce propan-1-ol is much slower than the corresponding hydrolysis of 1-iodopropane. Which statement explains this observation?
- A** Chlorine is more electronegative than iodine.
- B** The bond strength of the C – I bond is less than that of the C – Cl bond.
- C** The carbon atom in the C – Cl bond is more  $\delta^+$  than that in the C – I bond.
- D** The hydrolysis involves a nucleophilic substitution reaction.

- 25 Use of the Data Booklet is relevant to this question.

2.30 g of ethanol were mixed with an excess of aqueous acidified potassium dichromate(VI). The reaction mixture was then boiled under reflux for one hour. The desired organic product was then collected by distillation.

The yield of product was 60.0 %. What mass of product was collected?

- A** 1.32 g                      **B** 1.38 g                      **C** 1.80 g                      **D** 3.20 g

## SECTION B

For each of the questions in this section, one or more of the three numbered statements 1 to 3 may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

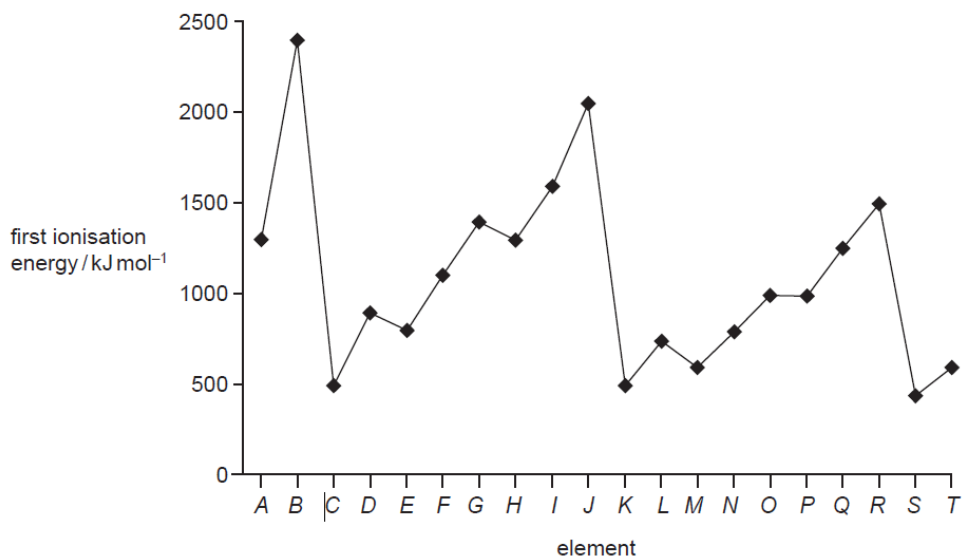
The responses **A** to **D** should be selected on the basis of

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>1, 2 and 3 are correct</b>	<b>1 and 2 only are correct</b>	<b>2 and 3 only are correct</b>	<b>1 only is correct</b>

No other combination of statements is used as a correct response.

- 26** The first ionisation energies of twenty successive elements in the Periodic Table are represented in the graph.

The letters given are not the normal symbols for these elements.



Which statements about this graph are correct?

- 1** Elements B, J and R are in Group 0 of the Periodic Table.
- 2** Atoms of elements D and L contain two electrons in their outer shells.
- 3** Atoms of elements G and O contain a half-filled p subshell.

- 27** Valence shell electron pair repulsion theory should be used to answer this question. Which species are trigonal planar?

- 1**  $\text{BH}_3$
- 2**  $\text{CH}_3^+$
- 3**  $\text{PH}_3$

The responses **A** to **D** should be selected on the basis of

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>1, 2 and 3 are correct</b>	<b>1 and 2 only are correct</b>	<b>2 and 3 only are correct</b>	<b>1 only is correct</b>

No other combination of statements is used as a correct response.

- 28** Use of the Data Booklet is relevant to this question.  
When the liquid  $\text{N}_2\text{F}_4$  is heated, it decomposes into a single product, X.  
Which statements are correct?
- 1** N – F bonds are broken during this decomposition.
  - 2** The enthalpy change when  $\text{N}_2\text{F}_4$  decomposes into X is approximately  $+160 \text{ kJ mol}^{-1}$ .
  - 3** Molecules of X are non-linear.
- 29** In which reactions is the organic compound oxidised by the given reagent?
- 1**  $\text{CH}_3\text{CH}_2\text{CHO} + \text{Fehling's reagent}$
  - 2**  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO} + \text{Tollens' reagent}$
  - 3**  $\text{CH}_3\text{CHO} + \text{alkaline iodine}$
- 30** Which reagents, when used in an excess, can be used to make sodium lactate,  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{Na}$ , from lactic acid,  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$ ?
- 1** Na
  - 2**  $\text{NaHCO}_3$
  - 3** NaOH

END