HWA CHONG INSTITUTION
C2 Preliminary Examinations
Higher 1

CANDIDATE NAME		**CT GROUP**	**15S**
CENTRE NUMBER		**INDEX NUMBER**	

CHEMISTRY

8872/01

Paper 1 Multiple Choice

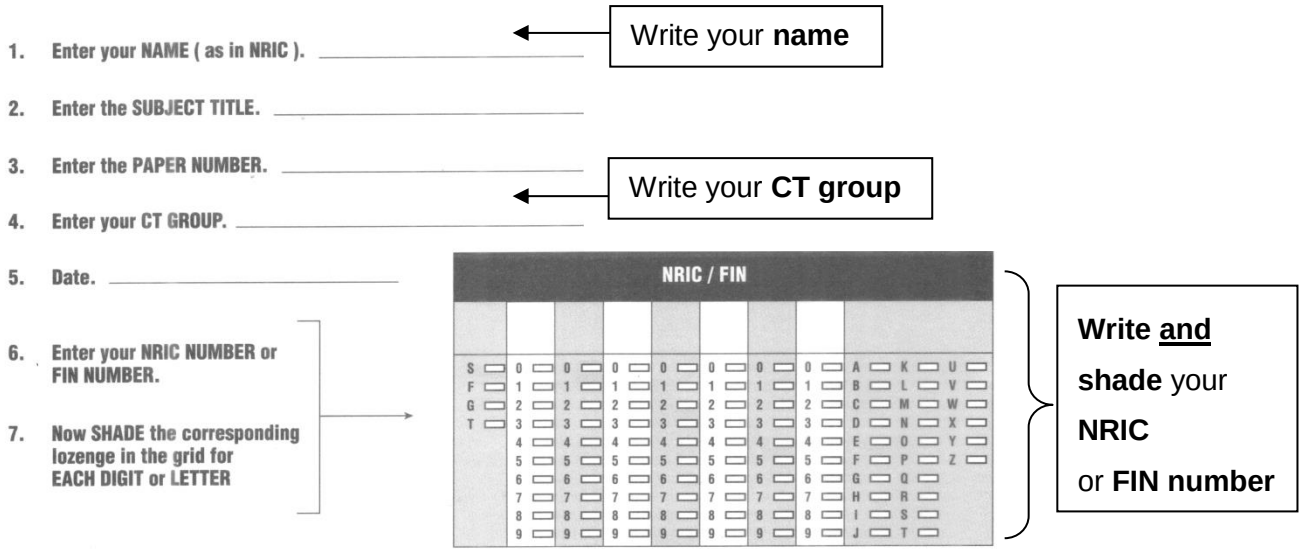
21 September 2016

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.



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 How many neutrons are present in 0.13 g of ^{13}C?
[L = the Avogadro constant]

A 0.06 L **B** 0.07 L **C** 0.13 L **D** 0.91 L

2 A protonated oxoanion of vanadium has been characterised at pH 3 with the formula $HV_{10}O_{28}^{5-}$.
Which oxoanion contains vanadium in a **different** oxidation state from that shown in $HV_{10}O_{28}^{5-}$?

A VO_2^+ **B** VO^{2+} **C** $V_4O_{12}^{4-}$ **D** VO_3^-

3 The double salt $(NH_4)_2SO_4.FeSO_4.6H_2O$ is used as a standard in volumetric analysis for titrations with oxidising agents.
What is the electronic configuration of the metal ion in this salt?

A $[Ar]4s^23d^6$ **B** $[Ar]4s^23d^4$ **C** $[Ar]3d^6$ **D** $[Ar]3d^5$

4 The table shows the successive ionisation energies for an element Q.

	1st	2nd	3rd	4th
Ionisation energy / kJ mol^{-1}	418	3070	4600	5860

What is the likely formula of the oxide of Q?

A QO **B** Q_3O_2 **C** Q_2O **D** Q_2O_3

5 Which statement about an element in the Periodic Table is correct?

A Magnesium is a metalloid, has a giant structure and is a good conductor of electricity

B Silicon is a metalloid, has a simple molecular structure and is a semi-conductor of electricity.

C Sodium is a metal, has a giant structure and is a good conductor of electricity.

D Sulfur is a non-metal, has a giant structure and is a poor conductor of electricity

6 The metal niobium, Nb, has a relative atomic mass of 92.9 and is used in various stainless steel alloys. It is made by reducing niobium chloride with sodium. In this reaction, 54.08 g of niobium chloride produces 18.58 g of niobium.
What is the formula of the niobium chloride used?

A $NbCl_2$ **B** $NbCl_3$ **C** $NbCl_4$ **D** $NbCl_5$

7 Which statement about bond formation is **not** correct?

A A triple bond consists of one σ bond and two π bonds.

B A π bond restricts rotation about the σ bond axis.

C Bonds formed from atomic s orbitals are always σ bonds.

D End-to-end orbital overlap results in a bond with electron density above and below the bond axis.

8 Given that both NaOH and KOH are strong mineral bases, calculate the resultant pH when 20 cm^3 of 0.300 mol dm^{-3} of NaOH is mixed with 30 cm^3 of 0.200 mol dm^{-3} of KOH.

A 11.8 **B** 12.1 **C** 13.4 **D** 13.7

9 Some data on two acid-base indicators are shown in the table below:

Indicator	Approximate working range	Colour in	
		Acid	Alkali
methyl orange	3.2 – 4.4	red	yellow
bromothymol blue	6.0 – 7.6	yellow	blue

Which one of the following conclusions can be drawn about a solution in which methyl orange is yellow and bromothymol blue is yellow?

A It is weakly basic.

B It is weakly acidic.

C It could be a solution of sodium chloride.

D It could be a solution of sodium ethanoate.

10 Which of the following 1 dm^3 acid solutions will form an acidic buffer when added to 1 dm^3 0.100 mol dm^{-3} NaOH?

A 0.200 mol dm^{-3} HCl

B 0.200 mol dm^{-3} CH_3CO_2H

C 0.050 mol dm^{-3} $(COOH)_2$

D 0.100 mol dm^{-3} H_2SO_4

11 Stomach juices have a pH of 1.0.
Aspirin is a monobasic acid represented by HA ($K_a = 10^{-4}$ mol dm^{-3}) which dissociates into H^+ and A^- ions.

What are the relative concentrations of $[H^+]$, $[A^-]$ and [HA] when aspirin from a tablet enters the stomach ?

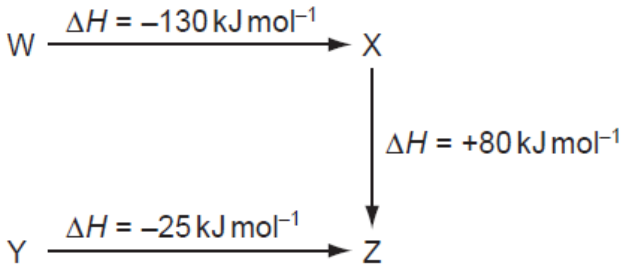
A $[H^+] > [HA] > [A^-]$

B $[HA] > [H^+] = [A^-]$

C $[H^+] > [A^-] > [HA]$

D $[H^+] = [A^-] > [HA]$

12 The diagram represents the energy changes for some reactions.



What are the natures of the conversions W → Y, Y → X and Z → W?

	W → Y	Y → X	Z → W
A	exothermic	endothermic	endothermic
B	exothermic	exothermic	endothermic
C	endothermic	exothermic	exothermic
D	endothermic	endothermic	exothermic

13 Ethanol is increasingly being used as a fuel for cars.

The standard enthalpy change of formation of carbon dioxide is –393 kJ mol^{-1}.
The standard enthalpy change of formation of water is –286 kJ mol^{-1}.
The standard enthalpy change of formation of ethanol is –277 kJ mol^{-1}.

What is the standard enthalpy change of combustion of ethanol?

A –1921 kJ mol^{-1}

B –1367 kJ mol^{-1}

C –956 kJ mol^{-1}

D – 402 kJ mol^{-1}

14 For which equation is the enthalpy change correctly described as an enthalpy change of formation?

A $C(g) + O_2(g) \rightarrow CO_2(g)$

B $C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g)$

C $2N(g) + 4O(g) \rightarrow N_2O_4(g)$

D $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

15 Which property is **not** associated with the element sodium?

A It can react with cold water to form hydrogen.

B It forms a basic oxide.

C It forms a neutral chloride.

D It is an oxidising agent.

16 Four compounds of period 3 elements are listed.

Na_2O $SiCl_4$ SO_2 $NaCl$

Water is added to each of the four compounds.
Pairs of the resulting solutions are mixed together.
From which pair of solutions is it possible to get a solution with a pH of 7?

A $NaCl$ and Na_2O

B $NaCl$ and SO_2

C Na_2O and $SiCl_4$

D $SiCl_4$ and SO_2

17 Phosphorus is an element in the third period, Na to Ar, of the Periodic Table.

What is true for phosphorus?

A Phosphorus is the only element in this period which forms two acidic oxides.

B The chlorides of phosphorus reacts with water to form two acids that are classified as strong and weak acids.

C Phosphorus exists as simple molecule with four bonds.

D Phosphorus burns in air spontaneously with a bright yellow flame.

18 Which of the following compounds are arranged in decreasing order of their solubility in water?

A $CH_3CH_2CO_2Na$, $CH_3CH_2CH_2OH$, $CH_3CH_2CH_2Cl$

B $CH_3CH_2CO_2Na$, $CH_3CH_2CH_2Cl$, $CH_3CH_2CH_2OH$

C $CH_3CH_2CH_2OH$, $CH_3CH_2CO_2Na$, $CH_3CH_2CH_2Cl$

D $CH_3CH_2CH_2Cl$, $CH_3CH_2CH_2OH$, $CH_3CH_2CO_2Na$

19 Crude oil is a mixture of many hydrocarbons ranging in size from 1 to 40 carbon atoms per molecule. The alkanes in crude oil can be separated because they have different boiling points.
The table below shows the boiling points of some alkanes.

Alkane	Boiling point/ ^oC	M_r
pentane	36	72
2-methylbutane	28	72
dimethylpropane	10	72

What is the correct explanation for the difference in the boiling points of the three isomers with M_r = 72?

A Boiling point is dependent upon the length of the carbon chain only.

B Increased branching on a carbon chain increases the boiling point.

C Increased branching reduces the packing density of molecules.

D Increased branching reduces the strength of the intermolecular van der Waals' forces.

20 Which compound cannot be oxidised by acidified potassium dichromate(VI) solution but does react with sodium metal?

A $(CH_3)_3COH$

B $CH_3COCH_2CH_3$

C $CH_3CH_2CH_2CH_2OH$

D $CH_3CH_2CH(OH)CH_3$

21 Which compound produces butan-2-ol and ethanoic acid on hydrolysis?

A $CH_3CO_2CH(CH_3)_2$

B $CH_3CO_2CH(CH_3)CH_2CH_3$

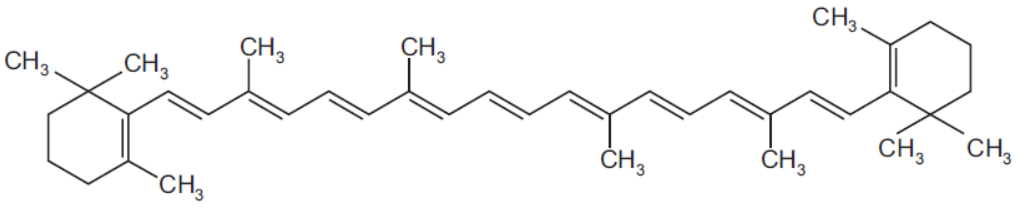
C $CH_3CH(CH_3)CO_2CH_2CH_3$

D $CH_3CH_2CO_2CH(CH_3)CH_2CH_3$

22 How many isomeric esters have the molecular formula $C_4H_8O_2$?

A 2 **B** 3 **C** 4 **D** 5

23 β-carotene is responsible for the orange colour of carrots.



β-carotene

β-carotene is oxidised by hot, concentrated, acidified $KMnO_4$.
When an individual molecule of β-carotene is oxidised in this way, many product molecules are formed.
How many of these product molecules contain a ketone functional group?

A 4 **B** 6 **C** 9 **D** 11

24 2-methylbuta-1,3-diene, $CH_2=C(CH_3)–CH=CH_2$, is used as a monomer in the manufacture of synthetic rubbers. Which compound would not produce this monomer on treatment with excess concentrated sulfuric acid at 170°C?

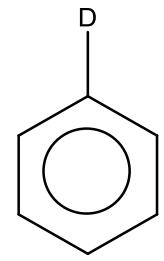
A $(CH_3)_2C(OH)CH(OH)CH_3$

B $HOCH_2CH(CH_3)CH_2CH_2OH$

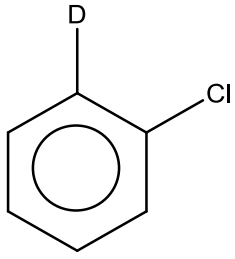
C $HOCH_2CH(CH_3)CH(OH)CH_3$

D $HOCH_2C(CH_3)(OH)CH_2CH_3$

25 Deuterium, D, is a heavy isotope of hydrogen. Deuteriobenzene is reacted with chlorine and $AlCl_3$ under controlled condition so that only monochlorination takes place.
Assuming that the carbon-deuterium bond is broken as easily as a carbon-hydrogen bond, which proportion of the chlorinated products will be 2-chlorodeuteriobenzene?



deuteriobenzene



2-chlorodeuteriobenzene

A 16% **B** 20% **C** 33% **D** 40%

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

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

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

26 The salt $NaClO_3$ is used as a non-selective weedkiller.

On careful heating, this reaction occurs: $4NaClO_3 \rightarrow NaCl + 3NaClO_4$.
On strong heating this reaction occurs: $NaClO_4 \rightarrow NaCl + 2O_2$.
The overall reaction is $2NaClO_3 \rightarrow 2NaCl + 3O_2$.

What do these equations show?

1 $NaClO_3$ can behave as an oxidising agent.

2 $NaClO_3$ can behave as a reducing agent.

3 The oxidation numbers of chlorine in the three compounds shown are +6, +8 and –1.

27 Which statements correctly describe an effect of a rise in temperature on a gas-phase reaction?

1 More particles now have energies greater than the activation energy.

2 The energy distribution profile changes with more particles having the most probable energy.

3 The activation energy of the reaction is decreased.

28 A reversible reaction is catalysed.
Which statements about the effects of the catalyst on this system are correct?

1 The catalyst alters the mechanism of the reaction.

2 The catalyst reduces the activation energy for both the forward and the backward reaction.

3 The catalyst alters the composition of the equilibrium mixture.

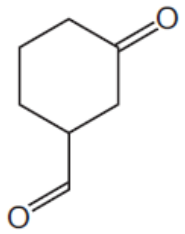
29 Each of the compounds below is treated separately with excess $NaBH_4$.

The product of each reaction is then heated with excess concentrated H_2SO_4.

In each case, one or more products are formed with molecular formula C_7H_{10}.

Which compounds give only one final product with the molecular formula C_7H_{10}?

1



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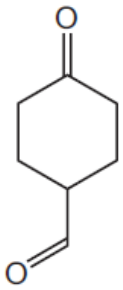

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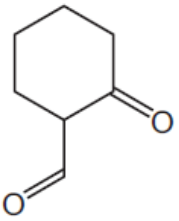
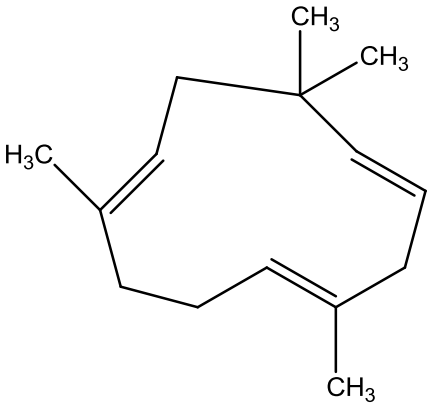


30 Humulene can be extracted from carnation flowers.



Which products are obtained from the reaction of humulene with hot acidified concentrated $KMnO_4$?

1 $CH_3COCH_2CH_2CO_2H$

2 $CH_3COCH_2CO_2H$

3 $HO_2CCH_2C(CH_3)_2CO_2H$