HWA CHONG INSTITUTION
Preliminary Examinations
Higher 1

NAME _____ **CT GROUP** 16S

CHEMISTRY 8872/01

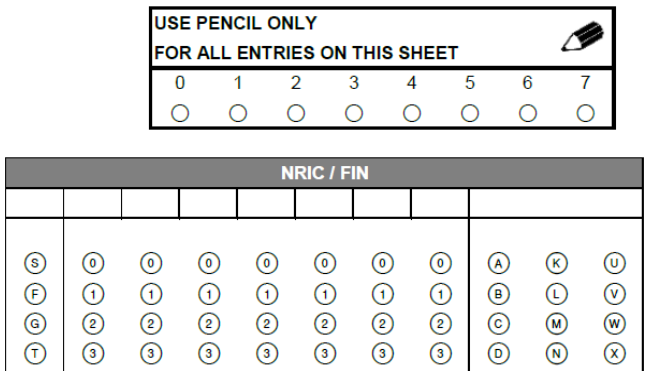
Paper 1 Multiple Choice **20 September 2017**

Additional Materials: Data Booklet **50 minutes**
Optical Mark Sheet (OMS)

INSTRUCTIONS TO CANDIDATES:

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number and index number on the Answer Sheet in the spaces provided.
Complete the information on the optical mark sheet (OMS) as shown below.

1. Enter your **NAME** (as in NRIC). _____
2. Enter the **PAPER NUMBER.** _____
3. Enter your **CT GROUP.** _____
4. Enter your **NRIC NUMBER** or **FIN Number**
5. Now **SHADE** the corresponding circles in the grid for **EACH DIGIT** or **LETTER**



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.
The use of an approved scientific calculator is expected, where appropriate.

Section A

For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

1 *Use of the Data Booklet is relevant to this question.*

Which one of the following has the same number of particles as one mole of magnesium atoms?

A the number of ions in 2 dm^3 of 0.25 mol dm^{-3} of aqueous hydrochloric acid

B the number of delocalised electrons in one mol of copper metal

C the number of atoms in 71 g of chlorine gas

D the number of ions in 58.5 g of sodium chloride

2 What mass of carbon dioxide will be formed by the complete combustion of 4.00 g of butan-1-ol?

A 2.38 g **B** 3.03 g **C** 9.51 g **D** 12.1 g

3 The percentage by mass of water in a hydrated manganese(II) chloride salt is 36.4%.

What is the empirical formula of the hydrated salt?

A $MnCl_2.2H_2O$

B $MnCl_2.3H_2O$

C $MnCl_2.4H_2O$

D $MnCl_2.5H_2O$

4 Which of the following has the same electronic configuration as the chloride ion, Cl^-?

A Ca^{2+} **B** Na^+ **C** Ne **D** F^-

5 In which of the following reactions is the underlined element being reduced?

A $\underline{N}H_3 + HCl \rightarrow \underline{N}H_4Cl$

B $H_2\underline{O}_2 + 2I^- + 2H^+ \rightarrow 2H_2\underline{O} + I_2$

C $2\underline{V}^{3+} + H_2O_2 \rightarrow 2\underline{V}O^{2+} + 2H^+$

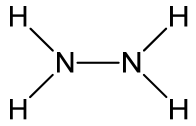
D $Ca\underline{C}O_3 \rightarrow CaO + \underline{C}O_2$

6 When heated, solid iodine forms iodine vapour.

What does this information suggest about the nature of the particles in these two physical states of iodine?

	solid	vapour
A	ionic	atomic
B	ionic	molecular
C	molecular	atomic
D	molecular	molecular

7 Hydrazine, N_2H_4, is useful as a rocket fuel. It has some properties that are similar to those of ammonia, NH_3.



hydrazine

Why are hydrazine molecules more soluble in water than ammonia molecules?

A There are more van der Waals' forces between hydrazine and water than between ammonia and water.

B There are more hydrogen bonds between hydrazine and water than between ammonia and water.

C There are stronger permanent dipole interactions between hydrazine and water than between ammonia and water.

D The covalent bonding in hydrazine is stronger than that in water.

8 Which of the equations correctly define the standard enthalpy change of formation of a compound?

A $2C(s) + 3H_2(g) + \frac{1}{2}O_2(g) \longrightarrow C_2H_5OH(l)$

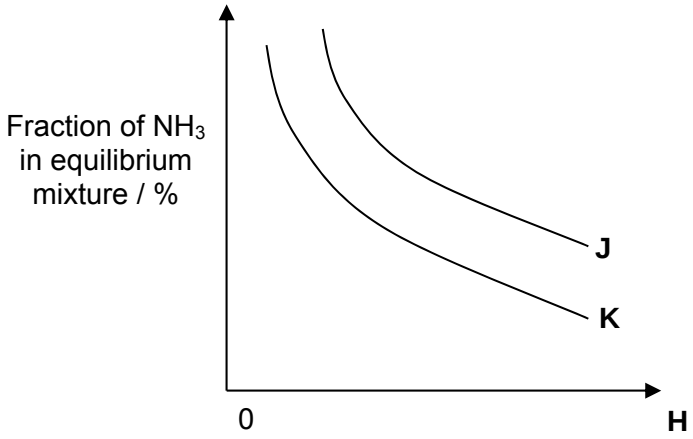
B $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$

C $Na(s) + Cl(g) \longrightarrow NaCl(s)$

D $C(g) + 2O(g) \longrightarrow CO_2(g)$

9 The graph below shows the fraction of ammonia in the equilibrium mixture obtainable if equilibrium was established under different temperature and pressure conditions during the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H < 0$$



What do **H**, **J** and **K** represent and what is the relative magnitude of **J** and **K**?

	H	**J** and **K**	relative magnitude
A	pressure	temperature	**J** > **K**
B	pressure	temperature	**K** > **J**
C	temperature	pressure	**J** > **K**
D	temperature	pressure	**K** > **J**

10 The table shows some data on two acid-base indicators.

indicator	approximate pH range of colour change	colour change	
		acid	alkali
thymolphthalein	9 – 10	colourless	blue
chlorophenol red	6 – 7	yellow	red

Which conclusion can be drawn about a solution in which thymolphthalein is colourless and chlorophenol red is red?

A It is weakly acidic.

B It is weakly alkaline.

C It is neutral.

D It is strongly alkaline.

11 10 cm^3 of 0.01 mol dm^{-3} solution of H_2SO_4 is diluted with 90 cm^3 of water.

What is the pH of the resulting solution?

A 1.7 **B** 2.0 **C** 2.7 **D** 3.0

12 An enzyme required in laboratory process operates at maximum efficiency when placed in an aqueous solution buffered at pH 5.6.

Which combination of substances when dissolved in water would give the appropriate buffer solution?

A 0.5 mol of HC*l* and 1 mol of CH_3COONa

B 0.5 mol of HC*l* and 1 mol of CH_3COOH

C 1 mol of CH_3COOH and 1 mol of NaOH

D 1 mol of CH_3COONH_4

13 Which statement about the order of reaction is correct?

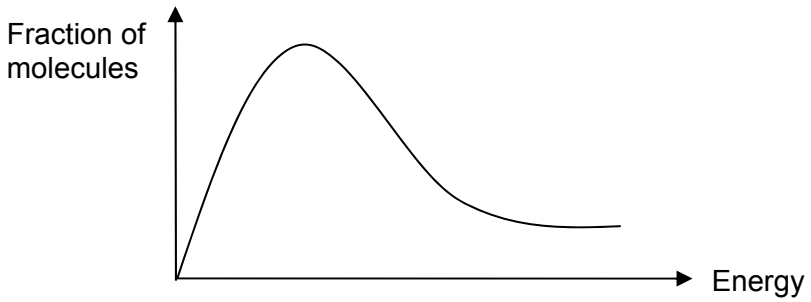
A It is the sum of the powers of the concentrations of the species included in the rate equation.

B It is the sum of the powers of the concentrations of the reactants and products.

C It is the sum of the number of species included in the rate equation.

D It is the sum of the number of moles on the left-hand side of the balanced chemical equation.

14 The diagram represents the Boltzmann distribution of molecular energies at a given temperature.



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

A The total number of molecules is constant at all temperatures.

B When temperature decreases, the maximum of the curve is displaced to the left.

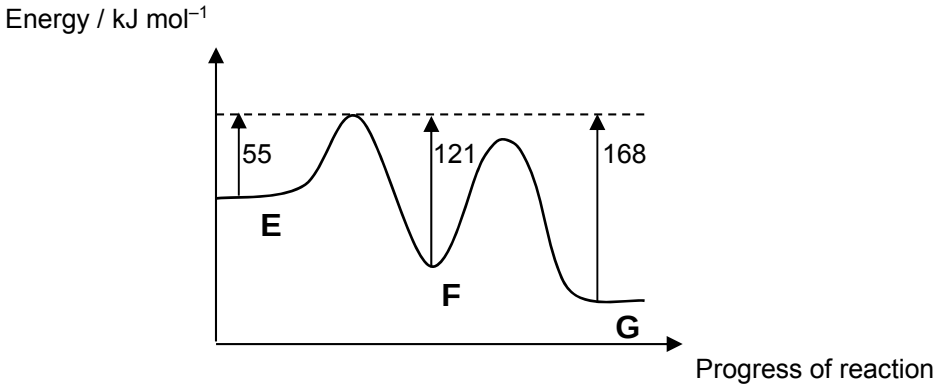
C When temperature increases, the fraction of molecules with any given energy also increases.

D When temperature increases, the fraction of molecules with energies greater than the activation energy increases.

15 The reaction pathway diagram for a two–step reaction is shown below.

Step 1: **E** ⇌ **F**

Step 2: **F** ⟶ **G**



Which statement about the reaction is correct?

A Step 2 is more exothermic than step 1.

B The enthalpy change of reaction for both the forward and backward reaction of step 1 is the same.

C The activation energy for the backward reaction of step 1 is 66 kJ mol^{-1}.

D The enthalpy change of reaction for the conversion of **E** to **G** is the sum of the enthalpy changes of step 1 and step 2.

16 The ions P^{3-}, S^{2-} and Cl^- have radii 0.212nm, 0.184nm and 0.181 nm respectively.

Which one of the following correctly explains the decrease in radius from P^{3-} to Cl^-?

A increase in both the total number of electrons and nuclear charge

B total number of electrons remaining constant with an increase in nuclear charge

C increase in the total number of electrons with nuclear charge remaining constant

D decrease in the total number of electrons with nuclear charge remaining constant

17 Which of the following statements about the electrical conductivity of elements across Period 3 is **incorrect**?

A Electrical conductivity increases from sodium to aluminium as the number of delocalised cations and electrons increases.

B Sodium, magnesium and aluminium are good electrical conductors as their metallic lattices contain delocalised electrons.

C Silicon is a semiconductor as the electrons within the covalent bonds are held tightly and are not easily delocalised.

D Phosphorous, sulfur, chlorine and argon are non–conductors as there are no mobile charge carriers in their simple molecular structures.

18 Phosphorus can form PCl_3 and PCl_5. However, nitrogen can only form NCl_3.

Which statement is a correct explanation of this?

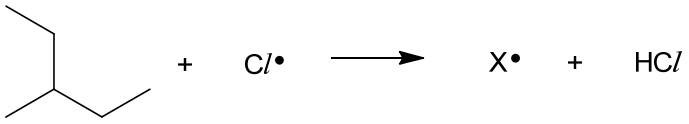
A Nitrogen can attain an oxidation state of +5.

B The N–C*l* bond is weaker than the P–C*l* bond.

C The valence orbitals of P are higher in energy than that of N.

D The n = 2 principal quantum shell can contain a maximum of 8 electrons.

19 When heated with chlorine, the following hydrocarbon undergoes free radical substitution. In the propagation step, the free radical X• is formed by the loss of one hydrogen atom.



How many different forms of X• are theoretically possible?

A 3 **B** 4 **C** 5 **D** 6

20 Dichlorodifluoromethane, CCl_2F_2, is widely used in aerosol propellants and as a refrigerant.

Which statement helps to explain why dichlorodifluoromethane is chemically inert?

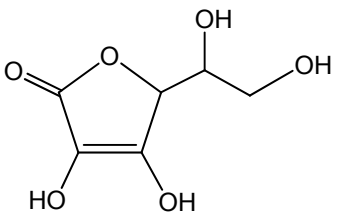
A The carbon–fluorine bond energy is large.

B Fluorine atoms have high electronegativity.

C The carbon–fluorine bond has a high polarity.

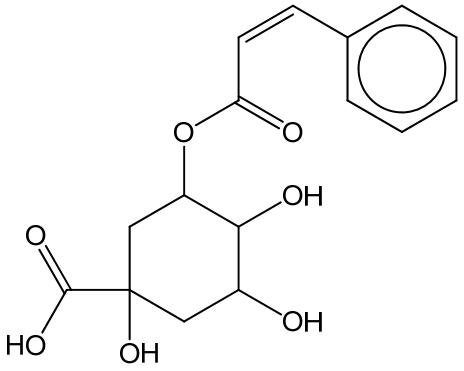
D Van der Waals' forces between CCl_2F_2 molecules are weak.

21 What is the total number of sigma bonds in a molecule of vitamin C as shown below?



A 12 **B** 14 **C** 16 **D** 20

22 Compound **Q** below is a derivative of chlorogenic acid which is found in coffee beans.



compound **Q**

Which of the following statements is correct?

A 1 mol of **Q** will react with 2 moles of NaOH(aq) on heating.

B 1 mol of **Q** will react with 4 moles of NaOH(aq) in the cold.

C When 1 mol of **Q** reacts with an excess of sodium carbonate, 1 mol of carbon dioxide gas and 1 mole of water will be formed.

D When 1 mol of **Q** reacts with an excess of sodium metal, 4 moles of hydrogen gas will be evolved.

23 Which of the following pairs of reagents can **both** be used separately to distinguish $CH_3COCH_2CH_3$ and $CH_3CH(OH)CH{=}CH_2$?

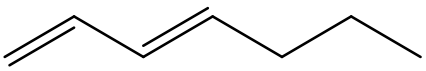
A alkaline aqueous iodine and sodium metal

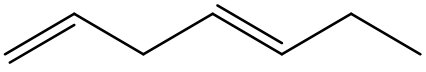
B 2,4-dinitrophenylhydrazine and hot acidified potassium manganate(VII)

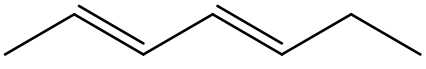
C Tollens' reagent and bromine in tetrachloromethane

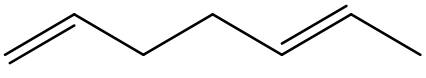
D H_2, nickel catalyst, heat and hot acidified potassium manganate(VII)

24 Which of the following will **not** be produced when 2,4–dibromoheptane reacts with hot ethanolic sodium hydroxide?

A 

B 

C 

D 

25 A sample of ethanal is treated with HCN in the presence of a little KCN. The organic product is then heated under reflux with dilute sulfuric acid.

What will be the final organic product?

A CH_3COCO_2H

B $CH_3CH_2CONH_2$

C $CH_3CH(OH)CO_2H$

D $CH_3CH(OH)CH_2NH_2$

Section B

For **questions 26-30**, one or more of the numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not 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 to be used as a correct response.

26 Which pairs of compounds contain one that is giant ionic and one that is simple molecular?

1 NaF and BH_3

2 HC*l* and I_2

3 Al_2O_3 and SiO_2

27 Which particles have the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$?

1 $_{24}Cr$

2 $_{25}Mn^+$

3 $_{26}Fe^{2+}$

28 Which statements containing the third period elements (sodium to argon) and their compounds are correct?

1 Electronegativity increases across Period 3 elements.

2 Aluminium oxide is the only oxide which is amphoteric.

3 The maximum oxidation state is shown by silicon.

29 An organic compound has the formula $C_4H_6Cl_2$.

Which are correctly named isomers of this compound?

1 3,4-dichlorobut-3-ene

2 1,4-dichlorobut-2-ene

3 1,1-dichlorobut-1-ene

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 to be used as a correct response.

30 Which alcohols can be formed by the reduction of a ketone?

1 2-methylbutan-2-ol

2 2-methylpentan-3-ol

3 hexan-2-ol