HWA CHONG INSTITUTION

C2 PRELIMINARY EXAMINATIONS
H1 CHEMISTRY 8872
PAPER 1

16 September 2008 **50 min**

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

INSTRUCTIONS TO CANDIDATES

1. Check that there are **9** printed pages in this question booklet.

2. 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 **Optical Mark Sheet** provided.

3. Fill in your particulars on the optical mark sheet. Enter your NRIC number or FIN number and shade accordingly.

4. After the examination, you are required to submit only the optical mark sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark. Marks will not be deducted for wrong answers.

A *Data Booklet* is provided. You may use a calculator.

Any rough working should be done in this booklet.

SECTION A

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

1 A giant molecule contains a large amount of carbon of isotopes ^{12}C and ^{13}C. It was found that the relative atomic mass of carbon in the molecule is 12.20.

What is the ratio of ^{12}C to ^{13}C in the molecule?

A 4:1 **B** 3:1 **C** 3:4 **D** 1:4

2 Oxides of nitrogen are pollutant gases which are emitted from car exhausts. When a car travels one kilometer in urban traffic, it releases 0.23 g of an oxide of nitrogen N_xO_y, which occupies 120 cm^3 under room conditions.

What are the values of x and y?

A x = 1, y = 1
B x = 1, y = 2
C x = 2, y = 1
D x = 2, y = 4

3 The redox reaction between hydrogen sulphide, H_2S, and sulphur dioxide, SO_2, gives elemental sulphur as the only sulphur-containing product.

How many moles of sulphur dioxide react with one mole of hydrogen sulphide?

A $\frac{1}{3}$ **B** $\frac{1}{2}$ **C** $\frac{2}{3}$ **D** 1

4 10 cm^3 of 0.2 mol dm^{-3} K_2XO_4 will just react with 40 cm^3 of 0.1 mol dm^{-3} iron(II) sulphate solution.

If Fe^{2+} is oxidized to Fe^{3+} by K_2XO_4, what is the final oxidation state of X?

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

5 Which of the following particles would have a half-filled set of p orbitals on losing an electron?

A Si^- **B** P **C** P^- **D** S^+

6 Which of the following molecules does **not** have a permanent dipole?

A C_2Cl_4 **B** CF_2Cl_2 **C** $CHCl_3$ **D** CF_2CCl_2

7 Which of the following statements about covalent and/or ionic compounds is correct?

A A covalent compound cannot be an electrolyte.
B Compared to ionic compounds, covalent compounds are generally more soluble in polar solvents.
C A covalent compound that contains both hydrogen and oxygen in its molecule necessarily forms intermolecular hydrogen bonds.
D Both covalent and ionic bonds may be present in the same compound.

8 Which of the following will have a positive ΔH value?

A $O^{2-}(g) \rightarrow O^{2-}(aq)$
B $\frac{1}{2}O_2(g) \rightarrow O(g)$
C $2Na^+(g) + O^{2-}(g) \rightarrow Na_2O(s)$
D $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

9 In an experiment, a student placed 20 cm^3 of a solution containing 0.040 mol of HCl in a plastic cup and added 20 cm^3 of a solution containing 0.040 mol of Na_2CO_3. The highest temperature rise was 15 K.

If the heat capacity per unit volume of the final solution is 4.2 J K^{-1} cm^{-3}, what is the enthalpy change of reaction in J mol^{-1}?

A $-\frac{20 \times 4.2 \times 15}{0.020}$ **B** $-\frac{20 \times 4.2 \times 15}{0.040}$
C $-\frac{40 \times 4.2 \times 15}{0.020}$ **D** $-\frac{40 \times 4.2 \times 15}{0.040}$

10 Consider the following equilibrium reaction:

$$3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2(g)$$

Which of the following gives the units for the equilibrium constant, K_c?

A mol dm^{-3} **B** mol^{-2} dm^6 **C** mol^4 dm^{-12} **D** no units

11 At 298 K, the numerical values for the dissociation constant of the aliphatic carboxylic acids, RCO_2H and R_1CO_2H in aqueous solution are 2.1 x 10^{-8} and 2.2 x 10^{-4} respectively.

Which of the following can be inferred from the given information?

A The pH of 1 mol dm^{-3} RCO_2H is lower than the pH of 1 mol dm^{-3} R_1CO_2H.
B The value of K_b for RCO_2^- is greater than that for $R_1CO_2^-$.
C RCO_2H is a stronger acid than R_1CO_2H.
D RCO_2H is more soluble in water than R_1CO_2H.

12 20.0 cm^3 of 0.10 mol dm^{-3} sulphuric acid was mixed with 22.0 cm^3 of 0.12 mol dm^{-3} aqueous ammonia. What is the pH of the resulting solution?

A 1
B approximately 1.79
C slightly less than 7
D greater than 7

13 The hydrolysis of sucrose in aqueous solution is catalysed by hydrogen ions, such as from hydrochloric acid.

Which of the following procedures can be used to determine the order of the reaction with respect to hydrogen ions?

A Measure the rate of the reaction several times, but with a different concentration of hydrochloric acid each time.
B Add a suitable indicator and watch for the time when the colour changes.
C Remove samples at various time intervals and titrate against a standard solution of sodium hydroxide.
D Measure the change in pH during the reaction.

14 A radioactive element has two isotopes, **G** and **H**, with half-lives of 5 min and 15 min respectively. An experiment starts with 4 times as many atoms of **G** as of **H**. Radioactive decay is a first-order reaction.

How long will it be before the number of atoms of **G** left equals the number of atoms of **H** left?

A 5 min **B** 10 min **C** 15 min **D** 30 min

15 Consider the oxides of the Period 3 elements.

Which property decreases from Na_2O to SiO_2 and also from SiO_2 to P_4O_{10}?

A covalent character
B melting point
C pH when mixed with water
D solubility in aqueous alkali

16 Aluminium is the third most abundant element in the Earth's crust.

Which of the following statements is **not** true of the element and its compounds?

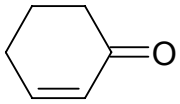
A Aluminium oxide dissolves in aqueous acids but not aqueous alkalis.
B A solution of aluminium chloride turns blue litmus red.
C Aluminium chloride can be prepared by passing chlorine gas over heated aluminium metal.
D Aluminium fluoride has a much higher melting point than aluminium bromide.

17 Which statement about the reactant Bi_2O_3 is true based on the reaction below?

$$Bi_2O_3 + 6HNO_3 \rightarrow 2Bi(NO_3)_3 + 3H_2O$$

A It acts as an oxidising agent.
B It acts as a reducing agent.
C It is an amphoteric oxide.
D It acts as a base.

18 How many σ and π bonds are there in a molecule of the following compound?

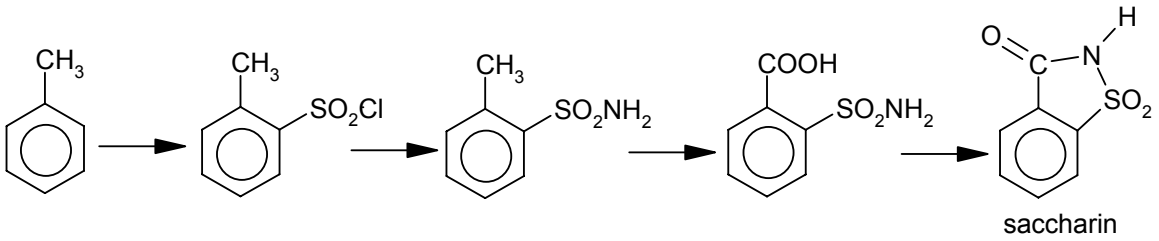


	σ	π
A	5	4
B	7	2
C	8	1
D	15	2

19 How many structural and geometric isomers are there altogether for dibromoethene, $C_2H_2Br_2$?

A 1 **B** 2 **C** 3 **D** 4

20 Saccharin is an artificial sweetening agent used in some soft drinks and is manufactured from methylbenzene by the following series of reactions:



saccharin

Which of the following types of reactions is **not** involved in the series?

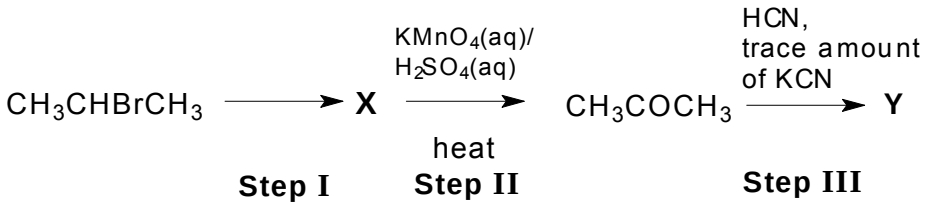
A reduction
B condensation
C oxidation
D substitution

21 Chlorofluoroalkanes are commonly used as aerosol propellents. However, they cause depletion to the ozone layer when they rise into the stratosphere. It has thus been suggested that fluoroalkanes should be used instead.

Which of the following could be a possible reason for the suggestion?

A Fluoroalkanes are less volatile than chlorofluoroalkanes and do not reach the stratosphere as easily.
B Fluorine radicals are not produced as the C-F bonds are stronger than the C-C*l* bonds.
C Fluorine radicals may be produced, but unlike chlorine radicals, do not react with ozone.
D Fluorine radicals may be produced, but unlike chlorine radicals, are not regenerated after reaction with ozone.

22 The reaction scheme below shows the formation of compound **Y**:



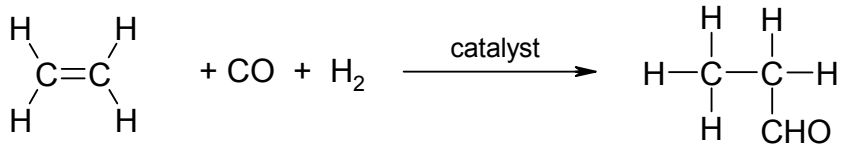
The reagent and condition required in **step I** and the structure of **Y** are:

	Reagent and condition in **Step I**	Structure of **Y**
A	aqueous KOH, heat	$(CH_3)_2COHCN$
B	alcoholic KOH, heat	$(CH_3)_2COHCN$
C	alcoholic KOH, heat	$(CH_3)_2CHCN$
D	aqueous KOH, heat	$(CH_3)_2CHCN$

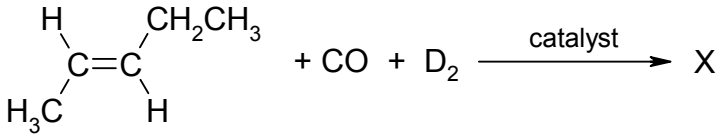
23 Which of the following pairs of compounds on reaction will **not** produce ethanoic acid?

A CH_3COOCH_3 and hot dilute HC*l*
B CH_3CN and hot dilute HC*l*
C $CH_3CH=CH_2$ and hot acidified $KMnO_4$
D CH_3CH_2CHO and hot acidified $KMnO_4$

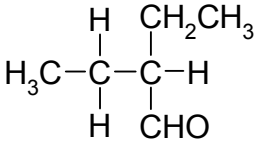
24 An industrial preparation of alcohols involves the following step:



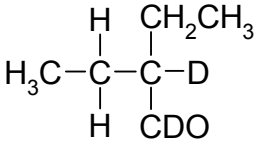
What is the likely structure of compound X produced by the reaction below? (D = $^{2}_{1}H$)



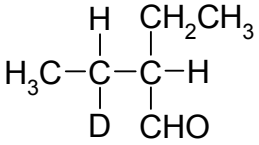
A



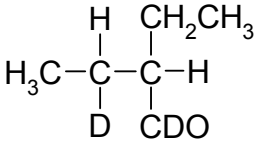
B



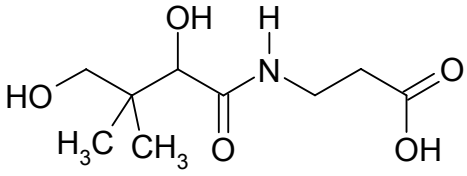
C



D



25 Vitamin B_5 has the following structure.



Which of the following statements about Vitamin B_5 is true?

A It reacts with 2,4-dinitrophenylhydrazine to give an orange precipitate.
B It reacts with alkaline aqueous iodine to give a yellow precipitate.
C It is insoluble in water.
D There are 2 sp^2-hybridised carbon atoms in a molecule of Vitamin B_5.

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 response **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 first eight ionization energies of an element **R** (in kJ mol^{-1}) are as follows:

966, 1950, 2730, 4850, 6020, 12300, 15400, 18900

Which of the following statements about element **R** are correct?

1 It has an odd number of protons in its atoms.
2 It can form an oxide with the formula $\mathbf{R}_2O_5$.
3 It can form a chloride that is trigonal planar in shape.

27 For a reaction **X** $\rightarrow$ products, the rate equation can be written as follows:

Rate = k $[\mathbf{X}]^n$

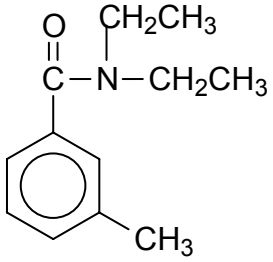
Which of the following quantities would increase when the reaction is carried out at a higher temperature?

1 Rate
2 k
3 n

28 In which of the following pairs do **both** species possess the same shape?

1 NH_4^+ and SO_4^{2-}
2 CO_3^{2-} and SO_3^{2-}
3 BF_3 and IF_3

29 *N,N*-diethyl-3-methylbenzamide, commonly known as **DEET**, is used in insect repellants which can be applied on human skin and clothing. The structure of **DEET** is shown below:



Which of the following reagents will react with **DEET**?

1 cold, dilute $KMnO_4$
2 hot, concentrated $KMnO_4$
3 bromine with $FeBr_3$

30 Malic acid, $HO_2CCH(OH)CH_2CO_2H$, is found in some fruits.

Which of the following statements about malic acid are true?

1 Its molecule contains a primary alcohol group.
2 It can form esters with both ethanoic acid and with ethanol.
3 1 mole of malic acid will react completely with 3 moles of sodium metal.

- END OF PAPER -