## YISHUN JUNIOR COLLEGE JC2 PRELIMINARY EXAMINATION 2014

# CHEMISTRY HIGHER 2

9647/01

Paper 1 Multiple Choice

1 hour

Additional materials:

Multiple Choice Answer Sheet and Data Booklet

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## **READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

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

Write your name and CTG on the Answer Sheet.

Shade your NRIC/FIN number in the space provided on the Answer Sheet.

There are **forty** 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 separate Answer Sheet.

#### Read the instructions on the Answer Sheet very carefully.

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**

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

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

The number of neutrons in 0.1 mol of <sup>17</sup>O is

- **A** 1.02 x 10<sup>22</sup>
- **B** 4.82 x 10<sup>22</sup>
- **C** 6.02 x 10<sup>22</sup>
- **D** 5.42 x 10<sup>23</sup>
- 2 A 0.0353 g sample of a volatile organic compound when vaporised completely at 100 kPa and 300 K occupied a volume of 20 cm<sup>3</sup>. When this volume of vapour was completely burnt in excess oxygen, 40 cm<sup>3</sup> of carbon dioxide and 40 cm<sup>3</sup> of water vapour were formed. All gaseous volumes were measured under identical conditions. What could be the molecular formula of the organic compound?
  - **A** C<sub>3</sub>H<sub>8</sub>
  - **B** C<sub>2</sub>H<sub>2</sub>O
  - $C = C_2H_4O$
  - $D C_2H_3N$
- **3** Which of the following species has more protons than neutrons, and more electrons than protons?

 $[H = {}^{1}H; D = {}^{2}H; O = {}^{16}O; S = {}^{32}S]$ **A** OH<sup>-</sup>

- **B** S<sup>2-</sup>
- **D** 3
- **C** D<sub>3</sub>O<sup>+</sup>
- **D** SD<sub>2</sub>

- 4 Which statement is **not** a basic assumption of the kinetic theory of gases?
  - A The gas particles have negligible size in comparison with the space they occupy.
  - **B** The kinetic energy of the gas particles increases as the temperature is raised.
  - **C** Collisions between the gas particles are perfectly elastic.
  - **D** The particles of a given gas have the same kinetic energy at a given temperature.
- 5 Which statement about molecules is correct?
  - **A** The Cl–P–Cl bond angle in  $PCl_3$  is 120°.
  - **B** Both SO<sub>2</sub> and CO<sub>2</sub> molecules are bent in shape.
  - **C** —O bond has a larger dipole moment than C—N bond.
  - **D** The carbon atoms in benzene,  $C_6H_6$  and ethyne,  $C_2H_2$  are all sp<sup>2</sup> hybridised.
- 6 Ice is the crystalline form of water. The diagram below shows part of the structure of ice.



The statement which is **not** true of ice is

- A Ice does not conduct electricity.
- **B** Ice has a giant covalent structure.
- **C** The bond angle about oxygen in ice is 109.5°.
- **D** It has a lower density than water at 0 °C due to its open structure.

7 A typical protein forms several hundreds of hydrogen bonds and several thousands of van der Waals' forces in folding from primary to tertiary structures. Which of the following thermodynamic state functions of the protein best represents the folding process at low temperature?

	ΔG	$\Delta H$	ΔS
Α	-	+	+
В	-	-	-
С	+	+	+
D	+	_	_

- **8** Hydroxylammonium ion,  $HONH_3^+$  reduces  $Fe^{3+}$  to  $Fe^{2+}$  in acid solution. 4 mol of  $Fe^{3+}$  is reduced by 1 mol of  $HONH_3^+$  ion. The nitrogen-containing product is
  - A  $NH_4^+$
  - **B** N<sub>2</sub>O
  - **C** NO<sub>2</sub><sup>-</sup>
  - D NO
- **9** Five ionisation energies, in kJ mol<sup>-1</sup>, are listed below.
  - 864 839 1008 1170 376

These values are most likely to be

- **A** the successive ionisation energies for the element of atomic number 5.
- **B** the first ionisation energies for 5 elements from Group I listed in order of increasing relative atomic mass.
- **C** the successive ionisation energies for a transition element with 4 electrons in the *d* sub-shell.
- **D** the first ionisation energies for successive elements in Group V, VI, VII, VIII and I.

**10** A fuel cell is illustrated in the diagram below. There is a common electrolyte of aqueous sodium hydroxide. One electrode in the fuel cell becomes the anode and the other the cathode.



Which statement about the above fuel cell is true?

- **A** Electrode A is the positive electrode.
- **B** Electrons flow from electrode A to electrode B.
- **C** The cell e.m.f under standard conditions is +0.40 V.
- **D** The electrode potential of B becomes more positive as the concentration of NaOH increases.

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The circuit shown in the above diagram was set up. Which electrode reactions will occur?

	Anode reaction	Cathode reaction
Α	Fe, Cu and Ag dissolve	$H_2$ is evolved
В	Fe and Cu dissolve	Cu is deposited
С	Cu dissolve	Cu is deposited
D	O <sub>2</sub> is evolved and Fe dissolves preferentially	H <sub>2</sub> is evolved

- **12** The conjugate base of  $HSO_4^-$  is
  - **A** SO<sub>4</sub><sup>2-</sup>
  - $\textbf{B} \quad H_2 SO_4$
  - C HSO<sub>2</sub><sup>-</sup>
  - $\mathbf{D}$  H<sub>2</sub>SO<sub>3</sub>
- **13** The diagram below shows the change of pH produced by gradually adding aqueous Y to a certain volume of aqueous X. The concentration of each constituent of the aqueous solutions X and Y is 0.1 mol dm<sup>-3</sup>.



What could X and Y be?

	Х	Y
Α	$H_2SO_4$	Na <sub>2</sub> CO <sub>3</sub>
В	K <sub>2</sub> CO <sub>3</sub>	HC <i>l</i>
С	NaHCO <sub>3</sub>	HC <i>l</i>
D	NaOH	CH₃COOH + HC <i>l</i>

14 Hydrogen peroxide reacts with acidified iodide ions to liberate iodine.

 $H_2O_2(aq) + 2H^+(aq) + 2I^-(aq) \rightarrow 2H_2O(l) + I_2(aq)$ 

In the investigation of this reaction, the following results were obtained.

Initial concent	Initial rate of		
[H <sub>2</sub> O <sub>2</sub> ]	[[-]	[H⁺]	/ mol dm <sup>-3</sup> s <sup>-1</sup>
0.010	0.010	0.010	2.0 x 10 <sup>−6</sup>
0.020	0.010	0.010	4.0 x 10 <sup>−6</sup>
0.030	0.020	0.010	1.2 x 10 <sup>-5</sup>
0.030	0.010	0.020	6.0 x 10 <sup>−6</sup>

Based on the given data, which of the following statements is not correct?

- A The reaction is zero order with respect to acid.
- **B** The reaction is first order with respect to iodide.
- **C** The numerical value of the rate constant is  $2.0 \times 10^{-1}$ .
- **D** The overall order of the reaction is 2.
- **15** Neon, sodium and magnesium are 3 consecutive elements in the Periodic Table. The increasing order of their radii is shown by

	smallest radius	largest radius	
Α	Ne	Na⁺	Mg <sup>2+</sup>
В	Ne	Mg <sup>2+</sup>	Na⁺
С	Ne	Na	Mg
D	Ne	Mg	Na

- **16** Which statement regarding elements in Period 3 (sodium to chlorine) and their compounds is **not** correct as atomic number increases?
  - A The oxides become increasingly acidic.
  - **B** The chlorides become increasingly covalent.
  - **C** The melting points of elements increase.
  - **D** The atomic radii of the elements decrease.

- 17 Which statement is true for the elements of Group VII or its compounds?
  - A Hydrogen fluoride is the most stable to heat, whereas hydrogen iodide decomposes easily on heating.
  - **B** Chlorine disproportionates in cold aqueous sodium hydroxide to give NaC*l* and NaC*l*O<sub>3</sub>.
  - **C** The oxidising strength of the halogens increases from fluorine to iodine.
  - **D** The volatility of the halogens increases from fluorine to iodine.
- **18** The standard electrode potentials of transition metals and its ions are given below.

 $Cu^{2+} + 2e^{-} \rightleftharpoons Cu \qquad E^{\Theta} = +0.34 \text{ V}$  $VO^{2+} + 2H^{+} + e^{-} \rightleftharpoons V^{3+} + H_2O \qquad E^{\Theta} = +0.34 \text{ V}$ 

Which statement is **not** correct?

- A The standard e.m.f. of the cell consisting of the above half-cells will be zero.
- **B** When the concentration of  $Cu^{2+}(aq)$  is increased, the  $Cu^{2+}|Cu$  half-cell will function as the cathode.
- **C** When the pH of the  $VO^{2+} | V^{3+}$  half-cell is 1,  $VO^{2+}$  will undergo reduction.
- **D** The e.m.f. of the cell is temperature dependent.
- **19** The ion most deflected when passed through an electric field is
  - **A**  ${}^{16}O^{2-}$  **B**  ${}^{27}Al^{3+}$ **C**  ${}^{24}Mg^{2+}$  **D**  ${}^{35}Cl^{-}$
- **20** A mixture of one mole of ethanoyl chloride and one mole of 2-chloromethylbenzene is heated under reflux in an inert solvent with only one mole of water. The organic compounds found in the mixture are
  - **A**  $CH_3COCl$  and  $C_7H_7OH$  **B**  $CH_3COOH$  and  $C_7H_7Cl$
  - **C**  $CH_3COOH$  and  $C_7H_7OH$  **D**  $CH_3COCl$  and  $C_7H_7OCl$

**21** Tyrian purple was a highly prized dye in the days of the Roman Empire. It has the structure shown below.



Under laboratory conditions, what type of reaction will Tyrian purple not likely to undergo?

- A Nucleophilic addition
- **B** Nucleophilic substitution
- **C** Electrophilic addition
- **D** Electrophilic substitution
- 22 Which statement does **not** suggest the presence of free radicals in the chlorination of ethane?
  - A Hydrogen chloride is present in the product mixture.
  - **B** Butane is present in small quantities in the product mixture.
  - **C** The reaction proceeds quickly in the presence of ultraviolet light.
  - **D** The main bulk of chloroethane comes from the chain-propagation stage.
- 23 The compound CH<sub>3</sub>CHC(CH<sub>3</sub>)C<sub>3</sub>H<sub>7</sub> shows
  - **A** functional group and optical isomerism only.
  - **B** optical and chain isomerism only.
  - **C** geometric and optical isomerism only.
  - **D** geometric and structural isomerism only.



- **A** 3
- **B** 4
- **C** 5
- **D** 6
- **25** The volatile liquid, Fluothane, CF<sub>3</sub>CHBrC*l*, is a widely used anaesthetic. The following statements about Fluothane are correct except for
  - A It may cause depletion of ozone layer.
  - **B** It does not undergo an elimination reaction.
  - **C** It can form hydrogen bonds between its molecules.
  - **D** It can undergo free radical substitution.
- **26** How many structural isomers with the molecular formula  $C_5H_{10}O$  gives a red precipitate with Fehling's reagent, and yellow precipitate with alkaline aqueous iodine?

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- **A** 0
- **B** 1
- **C** 2
- **D** 3

24 How many chiral carbons are present in a molecule of Nandrolone?

27 Acetaminophene is a drug used in headache remedies. It has the structure shown below.



The method that gives the best yield is







+ Cl<sub>2</sub>



28 A hexapeptide gave the following peptide residues upon partial hydrolysis:

Val-His, Leu-Ala, Val-Phe, His-Val, Phe-Leu.

What is the structure of the hexapeptide?

- A Val-His-Val-Phe-Leu-Ala
- B Ala-Leu-Phe-Val-His-Val
- C Phe-Leu-Ala-His-Val-Phe
- D His-Val-Phe-Leu-Ala-Val
- **29** Which property of benzene is reflected as a consequence of the delocalised electrons present in its molecule?
  - A Benzene is a planar molecule.
  - **B** Benzene is a good conductor of electricity.
  - C Addition reactions of benzene take place more easily than substitution.
  - **D** Substitution in benzene takes place at a carbon atom.
- **30** The interaction that best depicts a secondary protein structure is



#### **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 pick a tick against the statements that you consider to be correct).

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

Α	В	С	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.

**31** The diagram below represents the Boltzmann distribution of molecular energies at a given temperature.



As temperature increases, which of the following statements are correct?

- 1 At all energies, the proportion of molecules of a particular energy increases.
- 2 The proportion of molecules with energies above a given value increases.
- 3 The maximum of the curve is displaced to the right.
- **32** The following experiment was carried out in the laboratory:

50 cm<sup>3</sup> of 1 mol dm<sup>-3</sup>  $H_2SO_4$  was added to 25 cm<sup>3</sup> of 1 mol dm<sup>-3</sup> NaOH The pair of reactants producing the same amount of heat as the above experiment are

- 1 25 cm<sup>3</sup> of 1 mol dm<sup>-3</sup> H<sub>2</sub>SO<sub>4</sub> was added to 50 cm<sup>3</sup> of 1 mol dm<sup>-3</sup> NaOH.
- **2** 50 cm<sup>3</sup> of 1 mol dm<sup>-3</sup> HCl was added to 25 cm<sup>3</sup> of 1 mol dm<sup>-3</sup> NaOH.
- **3**  $25 \text{ cm}^3 \text{ of } 1 \text{ mol } \text{dm}^{-3} \text{ HNO}_3 \text{ was added to } 50 \text{ cm}^3 \text{ of } 1 \text{ mol } \text{dm}^{-3} \text{ NaOH}.$

**33** A 0.100 mol dm<sup>-3</sup> propanoic acid ( $K_a = 1.34 \times 10^{-5}$  mol dm<sup>-3</sup>) is titrated against a 0.100 mol dm<sup>-3</sup> NaOH solution at 25 °C. The indicators suitable for this titration will be

	Indicator	pH range and colour change			
1	Phenolphthalein	8.3 colourless	10.0 red		
2	Thymolphthalein	9.5 colourless	10.6 blue		
3	Bromothymol blue	6.0 yellow	7.6 blue		

**34** The diagram below shows the energy profile for the following reversible reaction:



 $R + S \rightleftharpoons P + Q$ 

It can be inferred from the diagram that

- 1 The backward reaction is exothermic.
- 2 Increasing temperature decreases the value of  $E_3$  and favours the forward reaction.
- **3** The addition of catalyst would alter the value of  $E_2$ .

- **35** Each element in Group II of the Periodic Table has 2 electrons in its outermost shell. The element in which these electrons are held most strongly is also
  - 1 the weakest reducing agent.
  - 2 that with the largest ionic radius.
  - 3 the most chemically reactive.
- **36** Nickel is purified by a method called the Mond Process. The equation for the first step of the purification is shown below.

Ni(s) + 4CO(g) 
$$\xrightarrow{60 \circ C}$$
 Ni(CO)<sub>4</sub>(*l*) impure

From the equation, it can be concluded that

- 1 CO is a monodentate ligand.
- 2 Ni in Ni(CO)<sub>4</sub> has a co-ordination of 4.
- 3 the oxidation state of Ni in  $Ni(CO)_4$  is zero.
- **37** Which statement correctly describes the characteristics of elements within any one particular group of the Periodic Table?
  - 1 The first ionisation energy of the elements generally decreases with increasing atomic number.
  - 2 The melting point of the elements increase with increasing atomic number.
  - 3 The elements are either all metals or all non-metals.

**38** A tripeptide, cys–ala–his, was analysed using electrophoresis. The tripeptide was hydrolysed and the resulting solution was added to a buffer solution of pH = 6.00 which was then placed at the centre of the plate. A potential difference was then applied across the plate.

Amino acid	Н   H <sub>2</sub> N—С—СООН   СН <sub>2</sub>   SH	Н   H <sub>2</sub> N—С—СООН   СН <sub>3</sub>	$H_{2}N - C - COOH$
	cysteine (cys)	alanine (ala)	histidine (his)
Isoelectric point	5.05	6.00	7.60

With reference to the information in the given table, it would be correct to conclude that

- 1 Alanine would remain at the centre of the plate.
- 2 Cysteine would migrate towards the anode.
- **3** Histidine would migrate towards the cathode.
- 39 Which of the following statements about methylbenzene and its derivatives are true?
  - 1 Methylbenzene will decolourise warm acidified potassium manganate (VII) solution.
  - **2** There are 4 aromatic isomers of molecular formula  $C_7H_7Cl$ .
  - 3 The molecule of methylbenzene is planar.

**40** Two molecules of ethanal react according to the mechanism shown below.

Step 1:

$$CH_3CHO + OH^- \longrightarrow CH_2 - CH_2 = O + H_2O$$

Step 2:

![](_page_16_Figure_4.jpeg)

Step 3:

From the equations given, one can conclude that

- 1 the final product called an aldol is both an alcohol and an aldehyde.
- 2  $OH^-$  is acting as a base as well as a catalyst.
- **3** step 1 is the rate determining step for the reaction.

#### END OF PAPER

## Answer Key

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
D	С	А	D	С	В	В	С	D	В
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
В	А	В	С	D	С	А	С	А	В
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
В	С	D	D	С	А	В	А	D	В
Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
С	С	D	D	D	A	D	A	В	В