

## JURONG JUNIOR COLLEGE JC 2 PRELIMINARY EXAMINATION Higher 1

# CHEMISTRY

Paper 1 Multiple Choice

Additional Materials:

25 August 2009 50 minutes

8872/01

Multiple Choice Answer Sheet Data Booklet

# **READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid. Write your name, class and shade your exam number on the Answer Sheet in the spaces provided.

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 you 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.

A Data Booklet is provided. Do not write anything on the Data Booklet.

This document consists of **12** printed pages and **1** blank page.

## **SECTION A**

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

**1.** Hydrogen has three isotopes – hydrogen H,  ${}^{1}_{1}$ H; deuterium D,  ${}^{2}_{1}$ H; tritium T,  ${}^{3}_{1}$ H.

Which molecule contains the same number of neutrons as HT?

- **A** D<sub>2</sub>
- **B** DT
- **c** HD
- **D** T<sub>2</sub>
- 2. Carbon disulphide vapour burns in oxygen according to the following equation.

$$CS_2(g) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$$

A sample of 10 cm<sup>3</sup> of carbon disulphide was burnt in 50 cm<sup>3</sup> of oxygen. After measuring the volume of gas remaining, the product was treated with an excess of aqueous sodium hydroxide and the volume of gas measured again. All measurements were made at the same temperature and pressure; under such conditions that carbon disulpide was gaseous.

What were the measured volumes?

	volume of gas after burning/ cm <sup>3</sup>	volume of gas after adding NaOH(aq)/ cm <sup>3</sup>
Α	30	0
В	30	20
С	50	20
D	50	40

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

The combustion of fossil fuels is a major source of increasing atmospheric carbon dioxide, with a consequential rise in global warming. Another significant contribution to carbon dioxide levels comes from the thermal decomposition of limestone,  $CaCO_3$ , in the manufacture of cement and of lime, CaO, for agricultural purposes.

Cement works roast 1000 million tonnes of limestone per year and a further 200 million tonnes is roasted in kilns to make lime.

What is the total annual mass output of carbon dioxide (in million tonnes) from these two processes?

<b>A</b> 440 <b>B</b> 527 <b>C</b> 660 <b>D</b>	880
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4. The nickel-cadmium (Ni-Cd) rechargeable battery is based upon the following reaction.

 $Cd + 2NiOOH + 4H_2O \rightarrow Cd(OH)_2 + 2Ni(OH)_2.H_2O$ 

What is the oxidation number of nickel at the beginning and at the end of the reaction?

	beginning	end
Α	+1.5	+2
в	+2	+3
С	+3	+2
D	+3	+4

- 5. Which reagent, when mixed and heated with ammonium sulphate, liberates ammonia?
  - A aqueous bromine
  - B limewater
  - **C** dilute hydrochloric acid
  - **D** potassium dichromate(VI)
- 6. Which pair of elements have bonds of the same type between their atoms in the solid state?
  - A aluminium and phosphorus
  - **B** chlorine and argon
  - **C** magnesium and silicon
  - **D** sulphur and chlorine
- 7. What is the molecular geometry and the Cl-I-Cl bond angle of  $ICl_4^-$  according to Valence Shell Electron Pair Repulsion theory?
  - A square planar, 90°
  - **B** square pyramidal, 90°
  - **C** tetrahedral, 109°
  - **D** trigonal pyramidal, 107°

**8.** In this question, the methyl group, CH<sub>3</sub>, is represented by Me.

Trimethylamine,  $Me_3N$ , reacts with boron trifluoride,  $BF_3$ , to form a compound of formula  $Me_3N.BF_3$ . Assume that  $Me_3N$  reacts in a similar manner to  $NH_3$ .

How may this reaction be written in terms of the shapes of the reactants and products?



**9.** Iodine trichloide,  $ICl_3$ , is made by reacting iodine with chlorine.

I<sub>2</sub>(s) + Cl<sub>2</sub>(g) → 2ICl(s); 
$$\Delta H$$
 = + 14 kJ mol<sup>-1</sup>  
ICl(s) + Cl<sub>2</sub>(g) → ICl<sub>3</sub>(s);  $\Delta H$  = - 88 kJ mol<sup>-1</sup>

By using the above date and the following energy cycle, what is the enthalpy change of the formation of solid iodine trichloride?



**10.** The table shows the enthalpy change of neutralisation per mole of water formed,  $\Delta H$ , for various acids and bases.

acid	base	$\Delta H$ / kJ mol <sup>-1</sup>
hydrochloric acid	sodium hydroxide	-57.0
Р	sodium hydroxide	-54.0
hydrochloric acid	Q	-52.0
nitric acid	R	-57.0

What are **P**, **Q** and **R**?

	Р	Q	R
Α	ethanoic acid	ammonia	potassium hydroxide
В	ethanoic acid	sodium hydroxide	ammonia
С	sulphuric acid	ammonia	potassium hydroxide
D	sulphuric acid	sodium hydroxide	ammonia

**11.** In an industrial process, two gases X and Y react together to form a single gaseous product Z.

$$X(g) + Y(g) = Z(g)$$

The percentage yield of product Z varies according to the pressure and the temperature as shown in the graphs.



Which statement about this equilibrium reaction is correct?

- **A** Decreasing the temperature decreases the value of the equilibrium constant.
- **B** Increasing the pressure decreases the value of the equilibrium constant.
- **C** Increasing the pressure increases the value of the equilibrium constant.
- **D** The reaction is exothermic in the forward direction.

**12.** 10 cm<sup>3</sup> of 0.01 mol dm<sup>-3</sup> barium hydroxide, Ba(OH)<sub>2</sub>, is diluted with 90 cm<sup>3</sup> of water. What is the pH of the resulting solution?

**13.** In acid solution  $BrO_3^-$  ions will slowly oxidize  $Br^-$  ions to  $Br_2$ .

$$BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$$

The variation for the initial rate of reaction with the concentrations of the reactants was investigated in four experiments.

experiment number	[BrO <sub>3</sub> <sup></sup> ]	[Br <sup>_</sup> ]	[H <sup>+</sup> ]	relative rate
1	0.10	0.10	0.30	2
2	0.10	0.20	0.15	1
3	0.10	0.20	0.30	4
4	0.20	0.20	0.30	8

What are the orders of the reaction with respect to the three reactants?

	$BrO_3^-$	Br⁻	H⁺
Α	2	1	1
В	1	2	2
С	1	1	2
D	1	2	1

14. Consecutive elements X, Y and Z are in Period 3 of the Periodic Table. Element Y has the highest ionisation energy and the lowest melting point.

What could be the identities of *X*, *Y* and *Z*?

	X	Y	Z
Α	sodium	magnesium	aluminium
В	magnesium	aluminium	silicon
С	aluminium	silicon	phosphorus
D	silicon	phosphorus	sulphur

**15.** The highest oxides of the elements sodium to sulphur are separately added to water. Which diagram best represents the pH of the solutions produced?



16. Which pair of reaction types is illustrated by the reaction sequence below?

 $\begin{array}{c} HI \text{ in } CH_3CO_2H \\ CH_3CH=CHCH_3 \xrightarrow{\text{HI in } CH_3CO_2H} CH_3CH_2CHICH_3 \xrightarrow{\text{NaOH}(aq)} CH_3CH_2CH(OH)CH_3 \\ \textbf{A} \quad \text{electrophilic addition and electrophilic substitution} \\ \textbf{B} \quad \text{electrophilic addition and nucleophilic substitution} \end{array}$ 

- C nucleophilic addition and electrophilic substitution
- D nucleophilic addition and nucleophilic substitution

**17.** Mevalonic acid, 3,5-dihydroxy-3-methylpentanoic acid, is involved in cholesterol formation in the body. It is an oil that occurs as a mixture of the two interchanging molecules shown in the diagram.



What names are used to describe the pair of interchanging reactions I and II?

- A condensation and addition
- **B** dehydrogenation and hydrogenation
- **C** esterification and hydrolysis
- D neutralisation and acidification
- **18.** Four drops of 1-chlorobutane, 1-bromobutane and 1-iodobutane were put separately into three test-tubes containing 1.0 cm<sup>3</sup> of aqueous silver nitrate at 60°C.

A hydrolysis reaction occurred. (R represents the butane chain  $C_4H_9$ - and X the halogen atom)

$$H_2O(l) + R - X(l) + Ag^{+}(aq) \rightarrow R - OH(aq) + AgX(s) + H^{+}(aq)$$

The rate of formation of cloudiness in the tubes was in the order of RCl < RBr < RI

Why is the reason for these differences in rate?

- A The R-X bond polarity decreases from RCl to RI.
- **B** The solubility of AgX decreases from AgI to AgC*l*.
- **C** The ionisation energy of the halogen decreases from *Cl* to *I*.
- **D** The bond energy of R–X decreases from RC*l* to RI.
- **19.** Compound **X** 
  - has the molecular formula C<sub>10</sub>H<sub>14</sub>O;
  - is unreactive towards mild oxidising agents

What is the structure of the compound formed by dehydration of X?



**20.** An alcohol of molecular formula  $C_4H_{10}O_2$  contains two OH groups and has an unbranched carbon atom chain.

On reaction with an excess of hot  $MnO_4^-/H^+$  this alcohol is converted into a compound of molecular formula  $C_4H_6O_4$ .

To which two carbons in the chain of the alcohol are the two OH groups attached?

- A 1st and 2nd
- B 1st and 3rd
- C 1st and 4th
- D 2nd and 3rd
- 21. Which type of reaction does the following compound not undergo?



- **A** electrophilic addition
- **B** free radical substitution
- C nucleophilic substitution
- **D** elimination
- 22. The compound hex-3-en-1-ol, Q, has a strong 'leafy' smell of newly cut grass and is used in perfumery. CH<sub>3</sub>CH<sub>2</sub>CH=CHCH<sub>2</sub>CH<sub>2</sub>OH

What is produced when **Q** is treated with an excess of hot concentrated acidic KMnO<sub>4</sub>?

- A CH<sub>3</sub>CH<sub>2</sub>CHO and OCHCH<sub>2</sub>CH<sub>2</sub>OH
- $\textbf{B} \qquad CH_3CH_2CO_2H \text{ and } HO_2CCH_2CO_2H$
- $C \qquad CH_3CH_2CH(OH)CH(OH)CH_2CH_2OH$
- **D** CH<sub>3</sub>CH<sub>2</sub>CH=CHCH<sub>2</sub>COOH
- **23.** Which of the following pairs of compounds cannot be distinguished by warming with a solution of acidified potassium manganate(VII)?
  - A CH<sub>3</sub>CH<sub>2</sub>CHO and CH<sub>3</sub>COCH<sub>3</sub>
  - **B** CH<sub>3</sub>CH<sub>2</sub>CH=CH<sub>2</sub> and CH<sub>3</sub>CH=CHCH<sub>3</sub>
  - C CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH and (CH<sub>3</sub>)<sub>3</sub>COH



24. The steroid shown is an intermediate compound obtained during the synthesis of *Formestane* which is used in the treatment of breast cancer.



Which statement about this compound is correct?

- **A** It reacts with hydrogen cyanide in a nucleophilic addition reaction.
- **B** It can be oxidised by warm acidified potassium dichromate(VI) to a carboxylic acid.
- **C** It will react with Fehling's solution.
- **D** Both carbon atoms  $\boldsymbol{x}$  and  $\boldsymbol{y}$  are sp<sup>2</sup> hybridised.
- **25.** In a preparation of ethene, ethanol is added a drop at a time to a heated reagent **Y**. The impure ethene is washed by being bubbled through a solution **Z** and then collected.

What could reagent Y and solution Z be?

	Reagent Y	solution Z
Α	acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>	dilute NaOH
В	concentrated H <sub>2</sub> SO <sub>4</sub>	dilute H <sub>2</sub> SO <sub>4</sub>
С	concentrated H <sub>2</sub> SO <sub>4</sub>	dilute NaOH
D	ethanolic NaOH	concentrated H <sub>2</sub> SO <sub>4</sub>

## **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.

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

Α	В	С	D
1, 2 and 3 are	1 and 2 only are	2 and 3 only are	1 only is
correct	correct	correct	correct

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

**26.** Boron is a non-metallic element which is placed above aluminium in Group III of the Periodic Table. It forms a compound with nitrogen known as boron nitride which has a graphite structure.

Which of the following conclusions can be drawn from this information?

- **1** Boron nitride is a conductor of electricity.
- 2 Boron nitride has a layer structure with van der Waals' forces between the layers.
- 3 The empirical formula of boron nitride is BN.
- 27. Concentrated sulphuric acid behaves as a strong acid when it reacts with water.

 $H_2SO_4(l) + aq \rightarrow H^+(aq) + HSO_4^-(aq)$ 

The  $HSO_4^-$  ion formed behaves as a weak acid.

 $HSO_{4}^{-}(aq) = H^{+}(aq) + SO_{4}^{2-}(aq)$ 

Which statements are true for 1.0 mol dm<sup>-3</sup> sulphuric acid?

- **1**  $[H^+(aq)]$  is high
- 2  $[SO_4^{2-}(aq)]$  is high
- **3**  $[HSO_4^{-}(aq)] = [SO_4^{2-}(aq)]$
- 28. The electronic structure of the outer shell of the element radium is 7s<sup>2</sup>.Which statements will be correct for radium within its group?
  - 1 The element will decompose water, liberating hydrogen.
  - 2 The element will show an oxidation number of +2 in all its compounds.
  - **3** Radium has the highest first ionisation energy.

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

A	В	С	D
1, 2 and 3 are	1 and 2 only are	2 and 3 only are	1 only is
correct	correct	correct	correct

**29.** Aspirin is a widely available pain-killer, whose properties have been known for centuries. The structure of aspirin is shown.



Which of the following functional groups are present in aspirin?

- 1 alcohol
- 2 carboxylic acid
- 3 ester
- **30.** When the apparatus below was used with compound Z, a brick-red precipitate was formed in the right-hand tube.



Which of the following compounds could be Z?

- 1 CH<sub>3</sub>CH(OH)CH<sub>3</sub>
- 2  $CH_3CH_2CH_2OH$
- 3 CH<sub>3</sub>OH