

JURONG JUNIOR COLLEGE 2013 JC 2 PRELIMINARY EXAMINATION Higher 2

CHEMISTRY

9647/01

Paper 1 Multiple Choice

19 September 2013 1 hour

Candidates answer on separate paper.

Additional Materials: 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 exam index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** or **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 on mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet. 583

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 sample of cyclohexene is completely burnt in dry oxygen and the gaseous products are collected as shown.



The increase in mass of the collecting vessels **A** and **B** of the apparatus are m_A and m_B respectively.

What is the ratio of $\frac{m_{\rm A}}{m_{\rm B}}$?

Α	0.34	В	0.41
С	2.43	D	2.94

Some isotopes are unstable and undergo nuclear reactions. In one type of reaction, an unstable nucleus accepts an electron from an inner orbital of its electron cloud.
 The net effect is the conversion of a proton and an electron into a neutron.

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Which of the following describes this type of reaction?

Α	$^{11}C \rightarrow ^{12}C$	В	$^{111}\text{I} \rightarrow ^{111}\text{Te}$
С	$^{76}\text{Br} \rightarrow ^{75}\text{Br}$	D	$^{76}\mathrm{Kr} ightarrow ^{75}\mathrm{Br}$

3. Given the information:

 $\Delta H_{c}(\text{graphite}) = -394 \text{ kJ mol}^{-1}$ $\Delta H_{f}(H_{2}O) = -286 \text{ kJ mol}^{-1}$ $\Delta H_{f}(CH_{3}OH) = -239 \text{ kJ mol}^{-1}$

Which one of the following is the correct enthalpy change of combustion of methanol, CH_3OH , in kJ mol⁻¹?

Α	-441	В	-727
С	-919	D	-1205

4. An experiment was conducted to determine the efficiency of the heating of a can of water using a spirit burner.

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The following data were recorded:	
Mass of ethanol burnt	= <i>m</i> g
Change in temperature of water	$= \Delta T^{\circ}C$
You are also given that:	
Relative molecular mass of ethanol	= 46.0
Enthalpy change of combustion of ethanol	= -1371 kJ mol ⁻¹
Specific heat capacity of water	$= c J g^{-1} K^{-1}$

Which expression below gives the efficiency of this heating process?

Α	$\frac{m \times 1371 \times 1000}{300 \times c \times \Delta T \times 46.0} \times 100\%$	В	$\frac{m \times c \times \Delta T \times 46.0}{300 \times 1371 \times 1000} \times 100\%$
С	$\frac{300 \times c \times \Delta T \times 46.0}{m \times 1371} \times 100\%$	D	$\frac{300 \times c \times \Delta T \times 46.0}{m \times 1371 \times 1000} \times 100\%$

5. The radius and charge of six ions are given in the table below:

ion	J+	L+	M ²⁺	Χ-	Y ⁻	Z ^{2–}
radius / nm	0.14	0.18	0.15	0.14	0.18	0.15

Given that the ionic solids, JX, LY and MZ are of the same lattice type, what is the order of their lattice energies (placing the most exothermic first)?

Α	MZ > JX > LY	В	MZ > LY > JX
С	JX > MZ > LY	D	LY > MZ > JX

6. Consider the reaction:

 $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ $\Delta H = -198 \text{ kJ mol}^{-1}; \Delta S = -188 \text{ J K}^{-1} \text{ mol}^{-1}$

What conclusion can be drawn about this reaction?

- A The products are more disordered than the reactants.
- **B** The reaction is spontaneous under standard conditions.
- **C** As the reaction proceeds, the temperature will decrease.
- **D** As temperature increases, the reaction becomes more spontaneous.

7. At 350 °C, 50 % of X decomposes according to the equation:

$$\boldsymbol{X}(g) = \boldsymbol{Y}(g) + \boldsymbol{Z}(g)$$

If the equilibrium pressure is $\frac{1}{3}p$, what is the equilibrium constant, K_p , for the reaction at 350 °C?

A

$$\frac{1}{9}p$$
 B
 $\frac{1}{6}p$

 C
 $\frac{1}{3}p$
 D
 p

8. Dinitrogen tetraoxide dissociates into nitrogen dioxide as follows:

$$N_2O_4(g) = 2NO_2(g)$$
 $\Delta H = +57 \text{ kJ mol}^{-1}$

If the temperature of an equilibrium mixture of the gases is increased at constant pressure, how would the volume of the mixture be affected?

- A The volume will increase, but only because of a shift of equilibrium towards the right.
- **B** The volume will increase, both because of a shift in equilibrium towards the right and also because of thermal expansion.
- **C** The volume will stay the same, because any thermal expansion could be exactly counteracted by a shift of equilibrium towards the left.
- **D** The volume will decrease, because a shift of equilibrium towards the left would more than counteract any thermal expansion.
- **9.** A 0.100 mol dm⁻³ solution of lead(II) nitrate is added, with stirring, into an equal volume of a solution containing a mixture of Cl^{-} , Br⁻, and I⁻ ions, each with the same concentration of 0.0100 mol dm⁻³.

Given the following data:

Compound	Numerical value of <i>K</i> _{sp} (at 25 °C)
Lead(II) chloride	1.7 x 10 ^{−5}
Lead(II) bromide	6.6 x 10 ⁻⁶
Lead(II) iodide	9.8 x 10 ⁻⁹

Which one of the following statements is correct?

- A No precipitate will form.
- **B** Only PbI₂ precipitate will form.
- **C** A mixture of PbI_2 and $PbBr_2$ precipitates will form.
- **D** All three precipitates, PbI_2 , $PbBr_2$, and $PbCl_2$, will form.

10. X and Y, with half-lives of 5 min and 15 min respectively, are two isotopes of a radioactive element. An experiment begins with 4 times as many atoms of X as of Y. Given that radioactive decay is a first-order reaction, how long will it take for the number of atoms of X left to become equal to the number of atoms of Y left?

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Α	5 min	В	10 min
С	15 min	D	20 min

11. Which of the following statements about the rate constant, *k*, of the chemical reaction given is true?

$$P + Q \xrightarrow{k_f} R$$

- A The rate constant is only dependent on temperature.
- **B** The forward and backward rate constants can have different units.
- **C** When a catalyst is added, the forward rate constant increases and the backward rate constant decreases.
- **D** When dynamic equilibrium is established, the rate constant for the forward and backward reaction is the same.
- The use of the Data Booklet is relevant to this question.
 A cell is set up by connecting a Pb²⁺/Pb half–cell and an acidified MnO₄⁻/Mn²⁺ half-cell.



Which of the following is a correct description of the effect on the e.m.f of the cell when the corresponding change is made?

	Change	Effect on e.m.f
Α	Addition of $NH_3(aq)$ into oxidation half-cell	Increases
В	Addition of $H_2SO_4(aq)$ into reduction half-cell	Decreases
С	Addition of NaOH(aq) into reduction half-cell	Increases
D	Replace lead with an alloy of lead and zinc	Remains the same

- 13. For the elements sodium to sulfur, which property would continuously increase numerically?
 - A atomic radius
 - **B** first ionisation energy
 - c melting point
 - D maximum oxidation number of the element in its oxide

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14. To remove acidic impurity, the gaseous emissions of a coal-fired power station are passed through an aqueous suspension of a mineral followed by oxidation. Which of the following satisfies the above description?

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	Acidic impurity	Mineral	Oxidised product
Α	NO ₂	MgCO ₃	Mg(NO ₃) ₂
В	P_4O_{10}	Ca(OH) ₂	$Ca_3(PO_4)_2$
С	SiO ₂	CaO	CaSiO ₃
D	SO ₂	CaCO ₃	CaSO ₄

- **15.** Which of the following properties of the Group II elements (Mg to Ba) and their compounds increases with increasing proton number?
 - A magnitude of the enthalpy change of hydration of the metal ion
 - **B** pH of the aqueous chloride
 - **C** solubility of the sulfate in water
 - **D** decomposition temperature of the carbonate
- **16.** Which of the following explains why the solubility of silver halides in aqueous ammonia decreases from AgC*l* to AgI?
 - **A** As a stronger ligand, NH_3 can displace Cl^- ions and Br^- ions, but not I^- ions.
 - **B** Ag⁺ from AgC*l* and AgBr form complexes with $NH_3(aq)$, but not that of AgI.
 - **C** The value of the solubility product of the silver halides decreases from AgC*l* to AgI.
 - **D** The covalent bonding between Ag and the halogen atom increases in strength from AgC*l* to AgI.
- **17.** In black and white photographic film, light converts silver chloride into metallic silver. After the film has been developed, the unreacted silver chloride is removed by reaction with sodium thiosulfate to produce a 'fixed' negative.

$$AgCl + 2Na_2S_2O_3 \rightarrow 4Na^+ + Cl^- + [Ag(S_2O_3)_2]^{3-}$$

What is the function of the thiosulfate ion?

- A to oxidise the silver metal
- **B** to oxidise the silver ions
- **C** to reduce the silver ions
- **D** to dissolve the silver ions
- **18.** Which of the following features of transition metals or their compounds make them suitable as heterogeneous catalysts for chemical reactions?
 - A They have variable oxidation states.
 - **B** They have available 3d and 4s orbitals.
 - **C** They form stable complexes.
 - **D** They can undergo ligand exchange reactions.

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19. Nickel(III) chloride forms a hexa–coordinated compound with ammonia. One mole of the compound reacts with 2 moles of silver nitrate to form a precipitate.Which of the following correctly shows the formula of this compound?

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- A Ni(NH₃)₃C l_3
- **B** Ni(NH₃)₄C l_3
- **C** Ni(NH₃)₅C l_3
- **D** Ni(NH₃)₆C l_3
- **20.** Carvone is the principal constituent of the oil from caraway seeds that gives the seeds their unique odour.



Which of the following products can be formed when Carvone is reacted with aqueous bromine in the presence of sodium chloride?





21. Deuterobenzene is reacted with a mixture of nitric acid and sulfuric acid such that only mononitration occurs. [Deuterium, D, is a heavy isotope of hydrogen.]

If the C–D bond is broken as easily as a C–H bond, what is the proportion of 3–nitrodeuterobenzene in the nitrated products?



22. Compound X does not give a precipitate immediately when shaken with aqueous silver nitrate at room temperature. However, a white precipitate readily forms when aqueous silver nitrate is added after X is boiled under reflux with aqueous sodium hydroxide, cooled and acidified with dilute nitric acid.

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Which one of the following compounds could be X?

Α	$CH_3CH_2CH_2CH_2Cl$	В	$CH_3CH_2CH_2CH_2Br$
С	CH ₃ COC <i>l</i>	D	C_6H_5Cl

23. Under identical conditions, reaction 1 proceeds faster than reaction 2 even though the mechanisms for both reactions are the same.

Which of the following explains this result?

- A The cyanide ion is a stronger nucleophile than the iodide ion.
- **B** The cyanide ion is a weaker nucleophile than the iodide ion.
- **C** The C–I bond is a stronger bond than the C–Br bond.
- **D** The C–N bond is a stronger bond than the C–I bond.
- **24.** Which of the following alcohol, with molecular formula of $C_5H_{11}OH$, would give the largest number of isomers upon heating with concentrated H_2SO_4 ?

Α	CH ₃ CH ₂ CH(CH ₃)CH ₂ OH	В	CH ₃ CH ₂ CH ₂ CH(OH)CH ₃
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- **C** $CH_3CH_2CH(OH)CH_2CH_3$ **D** $(CH_3)_2CHCH_2CH_2OH$
- **25.** Which of the following reacts with phenol to give a colourless homogeneous solution?
 - **A** Br₂(aq) **B** Na₂CO₃(aq)
 - **C** NaOH(aq) **D** NaOH(aq) followed by C_6H_5COCl
- 26. Which compound cannot be prepared from ethanoyl chloride in one step?
 - **A** CH_3CO_2Na **B** CH_3CO_2H

27. Compounds **N** and **P** are first reacted with hot aqueous NaOH followed by aqueous HC*l* at room temperature.



Which set of reagents and conditions can be used to distinguish the final products of N and P?

- A Neutral FeCl₃
- **B** I₂, aqueous NaOH, heat
- **C** PCl_5
- D Na
- **28.** In the Wurtz reaction, two halogenoalkanes react with sodium metal to form a new carbon–carbon bond, resulting in the formation of a new alkane:

R-X + R'-X + 2Na → R-R' + 2NaX

Which of the following does not show the correct product when the stated reactants are reacted together in a Wurtz reaction?



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29. GABA has the structural formula, H₂NCH₂CH₂CH₂CO₂H. It is a neuro–transmitter released by red algae to encourage shellfish larvae to settle on the ocean bed.

How does GABA differ from amino acids obtained by the hydrolysis of protein in the human body?

- A It does not form a zwitterion.
- **B** It is not soluble in water.
- **C** It cannot form an amide linkage.
- **D** It is not an α -amino acid.
- **30.** Aspartic acid was first discovered in 1827 by Plisson. It is found in animal sources such as luncheon meats and sausages as well as vegetable sources such as sprouting seeds, oat flakes, avocado and asparagus.



Aspartic acid

There are three pK_a values associated with aspartic acid: 2.10, 3.86, 9.82. Using the pK_a values, what is the major species present in solutions of aspartic acid at pH 3?



Section B

For each 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

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

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

31. A titration is carried out between 0.05 mol dm⁻³ potassium manganate(VII) in alkaline solution and 0.05 mol dm⁻³ potassium methanoate. The following reaction occurs.

$$2KMnO_4 + 3KOH + HCO_2K \rightarrow 2K_2MnO_4 + K_2CO_3 + 2H_2O$$

Which of the following statements are correct about the reaction?

- 1 The potassium methanoate acts as a reducing agent.
- 2 The volume of aqueous potassium methanoate solution required is half that of the aqueous potassium manganate(VII).
- **3** The oxidation number of the carbon is increased by 2.
- **32.** The electronic configuration of elements **X**, **Y**, and **Z** are as follows:
 - **X**: [Ar] 3d¹⁰4s²4p¹
 - **Y**: [Ar] 3d¹⁰4s²4p⁴
 - **Z**: [Ar] 3d¹⁰4s¹

Which of the following statements are correct?

- 1 Compared to Y^+ and Z^{2+} , X^{3+} shows the greatest deflection towards the negatively charged plate with constant electric field.
- 2 The ions, X^{2+} , Y^{2+} and Z^{2+} , each contain at least one unpaired electron.
- 3 Compounds X_2Y_3 , ZY and XZ_3 are likely to be formed.
- **33.** For which of the following pairs does the first ion have a smaller bond angle than the second ion?
 - 1 SO₄²⁻, SO₃²⁻
 - 2 NO₂⁻, NO₃⁻
 - **3** IF₄⁻, BF₄⁻
- **34.** Which of the following suggestions concerning the element astatine (atomic number 85) are consistent with its position in Group VII?
 - **1** Astatine is a solid at room temperature.
 - 2 Silver astatide is insoluble in aqueous ammonia.
 - **3** Hydrogen astatide is less stable to heat than hydrogen iodide.
- **35.** Cobalt has the electronic structure $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^2$. Which of the following cobalt compounds are unlikely to exist?
 - 1 K₂Co₂O₉
 - **2** Co₃O₄
 - 3 K₂CoF₆

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36. Compound **X** is a synthetic precursor of *meloscine*, an alkaloid isolated from the New Caledonian plant *Melodinus Scandens Forst*.



compound X

Which of the following statements about its reactions are correct?

- 1 1 mol of **X** reacts with 2 mol of HBr(g) when heated.
- **2** 1 mol of **X** reacts with 4 mol of $Br_2(aq)$ at room temperature.
- **3** 1 mol of **X** reacts with 2 mol of CH_3COCl at room temperature.
- **37.** Which of the following properties of benzene may be directly attributed to the stability associated with the delocalised electrons?
 - 1 Its susceptibility to be attacked by nucleophilic reagents.
 - 2 It tends to undergo substitution rather than addition reactions.
 - **3** The carbon–carbon bond lengths are between those of C–C bonds and C=C bonds.
- 38. Which of the following reactions give products that rotate the plane of polarised light?
 - 1 2–bromobutane refluxed with aqueous KOH
 - 2 Butanone reacted with HCN, trace amount of NaOH
 - **3** But–1–ene reacted with bromine dissolved in organic solvent
- **39.** Which of the following statements are likely to be true for the reaction below? $(CH_3)_3SiCl + CH_3CH_2O^- \rightarrow (CH_3)_3SiOCH_2CH_3 + Cl^-$
 - 1 It involves nucleophilic attack by $CH_3CH_2O^-$.
 - 2 Cl^{-} is displaced by $CH_3CH_2O^{-}$.
 - **3** The oxygen–carbon bond is not broken.
- 40. Which of the following could result in the loss of the tertiary structure of a protein?
 - 1 Addition of weak acid
 - 2 Addition of alcohol
 - **3** Addition of AgNO₃ solution