

NANYANG JUNIOR COLLEGE JC 2 PRELIMINARY EXAMINATION Higher 2

CHEMISTRY

Paper 1 Multiple Choice

9746/01 25 September 2009 1 hour

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 tutor's name 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** 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.

Section A

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

¹ When 15 cm³ of a gaseous hydrocarbon **X** were burned in 100 cm³ of oxygen, the final gaseous mixture contained 60 cm³ of carbon dioxide and 10 cm³ of unreacted oxygen. [All gaseous volumes measured under identical conditions.]

What is the formula of hydrocarbon X?

Α

A $C_{3}H_{6}$ **B** $C_{4}H_{10}$ **C** $C_{4}H_{8}$ **D** $C_{3}H_{8}$

2 Magnesium nitride is a yellow-green powder and it reacts with water according to the following equation :

 Mg_3N_2 (s) + 6 H_2O (l) \rightarrow 2 NH_3 (aq) + 3 $Mg(OH)_2$ (s)

If 20 g of water are mixed with an excess of powder and any solids are filtered away, what is the approximate volume (in cm^3) of 0.82 mol dm^{-3} of HCl that is required to neutralize the ammonia produced ?

A 150 **B** 300 **C** 450 **D** 900

3 Which one of the species has less electrons than neutrons and less neutrons than protons ?

Particles	<u>Neutrons</u>	<u>Nucleons</u>
A⁻	18	37
B ²⁺	17	34
C ³⁺	16	33
D ³⁻	16	31
	0.	2.
A - B	B ²⁺ C	C^{3+} D D^{3-}

4 Which one of the following corresponds to the configuration of the three electrons of the highest energy for one of the elements in Group **III**?

A
$$1s^{2}2s^{1}$$
 B $2s^{1}2p^{2}$ **C** $3p^{3}$ **D** $4s^{2}4p^{1}$

5 Which of the following pairs have different types of bonding and structure?

Α	BeCl ₂	AICI3
В	SiO ₂	SiC
С	NaF	AIF ₃
D	ScCl ₃	AICI3

6 Which of the following pairs does Species X have a larger bond angle than Species Y

	Species X	Species Y
Α	SO ₂	PI3
В	SF ₆	XeF ₄
С	CH ₄	SiCl ₄
D	H ₂ S	NH ₃

7 Pure nitrosyl chloride, NOCl gas was heated at 300^oC in a 1.0 dm³ container.

At equilibrium, the total pressure was 1.23 atm and the NOCI gas pressure was 0.810 atm.

$$2NOCI(g) \implies 2NO(g) + CI_2(g)$$

What is the equilibrium constant, K_p at 300^oC?

A 0.00418 atm B 0.0167 atm C 0.0597 atm D 0.0915 atm

8 The value of pV is plotted against p for 2 gases, *A* and *B*, where p is the pressure and V is the volume of the gas.



Which of the following could be the identities of the gases?

	Gas X	Gas Y
Α	0.5 mol of H₂ at 25 ℃	0.5 mol of H ₂ at 50 °C
В	0.5 mol of H ₂ at 25 °C	1 mol of SO ₂ at 25 °C
С	0.25 mol of SO ₂ at 25 °C	0.5 mol of H ₂ at 25 °C
D	1 mol of SO ₂ at 25 °C	0.5 mol of H2 at 25 °C

- **9** For the hypothetical ionic compound CaH, which value is needed to estimate its lattice energy?
 - A electron affinity of hydrogen
 - B first electron affinity of calcium
 - **C** Ca-H bond energy
 - **D** standard enthalpy change of formation of CaH₂

10 Consider the equation: 2SO₂ (g) + O₂ (g) → 2SO₃(g) ΔH = -199 kJ mol⁻¹, ΔS = -190 J K⁻¹ mol⁻¹

- A In formation of products, the system becomes more disordered
- **B** The products are energetically less stable than the reactants
- **C** As temperature increases, the reaction becomes more spontaneous
- **D** The reaction is spontaneous under standard conditions

11 The kinetics of the reaction between iodide and peroxodisulphate can be investigated by varying the volume of the reactants used. The two reactants are mixed in the presence of a known amount of Na₂S₂O₃ and a little starch. The time taken for an intense blue colour to be observed is then determined.

Experiment	Vol used / cm ³			Time
	1.0 mol dm ⁻³	0.040 mol dm ⁻³	H ₂ O (I)	t/s
	KI	$Na_2S_2O_8$		
1	10.0	5.0	25.0	170
2	15.0	5.0	20.0	113
3	15.0	10.0	15.0	56.5
4	20.0	20.0	0.0	X

What is the value of **x** in Experiment 4?

Α	11	В	21	С	85	D	1360

12 Given that a reaction has the overall equation and proceeds via the following mechanism shown below :

$2\mathbf{P} + \mathbf{Q} \rightarrow \mathbf{R} + \mathbf{S}$

Step 1 :	$P + Q \rightarrow R + T$	(fast)	$\Delta H = +45 \text{ kJ mol}^{-1}$
Step 2 :	$P + T \rightarrow S$	(slow)	ΔH = -98 kJ mol ⁻¹

Which of the following statement is true?

- **A** The overall order of reaction is 2
- **B** The enthalpy change for the reaction is -53 kJ mol⁻¹
- **C** The activation energy needed for Step 1 is + 45 kJ mol⁻¹
- **D** Compound T is acting as a catalyst

13 The electrochemical cells are set up as shown below. The e.m.f in volts is shown on each voltmeter.



These e.m.f's indicate that the order of reactivity of the metals, from weakest reducing agent to strongest reducing agent is

- A X, Cu, Y, Z
- **B** Cu, Z, X, Y
- **C** Z, Cu, X, Y
- **D** Y, X, Z, Cu
- ¹⁴ The following reaction has a negative E_{cell}^{θ} so that it does not occur under standard conditions.

 $2NO_3^{-}(aq) + 8H^+(aq) + 6CI^-(aq) \square 2NO(g) + 4H_2O(I) + 3CI_2(g)$

Nevertheless, the reaction may be made to proceed under non-standard conditions.

Which of the following would **NOT** help the reaction to proceed?

- **A** Increase in acidity
- **B** Addition of potassium nitrate
- C Addition of potassium iodide
- **D** Addition of bromine

- ¹⁵ Given the numerical value for the K_{sp} of calcium phosphate, $Ca_3(PO_4)_2$ is 2.07 x 10⁻³³, its solubility in water at 25 °C is
 - **A** $1.03 \times 10^{-6} \text{ mol dm}^{-3}$
 - **B** $3.42 \times 10^{-7} \text{ mol dm}^{-3}$
 - **C** 2.28 x 10^{-7} mol dm⁻³
 - **D** $1.14 \times 10^{-7} \text{ mol dm}^{-3}$
- **16** For the oxides of Period 3 elements (Na to P), which property decreases from Na₂O to SiO₂ and also from SiO₂ to P_4O_{10} ?
 - A Covalent character
 - B Melting point
 - **C** pH when mixed with water
 - **D** Solubility in aqueous alkali
- 17 Concentrated sulphuric acid is added to separate samples of sodium chloride, sodium bromide and sodium iodide.What are the halogen-containing substances produced?
 - **A** CI_2 , Br_2 and I_2 only
 - **B** HC*I*, Br_2 and I_2 only
 - **C** HC*I*, HBr and HI only
 - **D** HC*I*, HBr, HI, Br_2 and I_2 only
- **18** Group VII elements and their hydrogen compounds exhibit trends in properties. Which of these properties increases down the group from $CI \rightarrow Br \rightarrow I$?
 - A the hydrogen-halogen bond dissociation energy
 - **B** the oxidizing power of the elements
 - C the strength of the van der Waals' forces between halogen molecules
 - **D** the thermal stability of hydrogen halides

- **19** Which statement concerning the transition metals is correct?
 - A They are the only metals of which the anhydrous chlorides have covalent bonds
 - **B** They are the only metals which give coloured ions in an aqueous solution
 - **C** They are the only metals which have which have more than one valency (oxidation state)
 - **D** They are the only metals with a complete 4s orbital in their atoms
- **20** Which factors help to explain the increase in thermal stability of the carbonates of Group II metals from magnesium to barium?

	charge density of cation	relative polarisability of carbonate and oxide ions
Α	Decreases	${\rm CO_3}^{2-}$ less than ${\rm O}^{2-}$
в	Decreases	O^{2-} less than CO_3^{2-}
С	Increases	${\rm CO_3}^{2-}$ less than ${\rm O}^{2-}$
D	Increases	0^{2} less than CO_3^{2}

21 The following statements were made about the structure and functional groups of compound P



- I. It has cis-trans isomers
- II. It is optically active
- III. It has three chiral centres

Which of the above statement(s) about compound **P** is/are correct?

- A I, II and III
- B I and II only
- C II and III only
- D II only

- **22** Which of the following isomers of $C_5H_{11}Br$ gives the greatest number of different alkenes on treatment with hot ethanolic sodium hydroxide?
 - A CH₃CH₂CH(CH₃)CH₂Br
 - **B** CH₃CH₂CH₂CHBrCH₃
 - **C** CH₃CH₂CHBrCH₂CH₃
 - D CH₃CH(CH₃)CH₂CH₂Br
- 23 Which one of the following reagents will distinguish X and Y?



- A aqueous bromine
- B Fehling's reagent
- **C** phosphorus pentachloride
- D alkaline aqueous iodine

24 Vanillin is the main constituent of vanilla flavouring.



What is the product of its reaction with KMnO₄ in aqueous KOH?



25 The 1st stage of the cumene process for the industrial production of phenol is as follows:



Which one of the following would be the product of the reaction under similar conditions between benzene and cyclohexene?



H2 Chemistry 9746/01/NYJC J2/09PX

[Turn Over

- **26** The reddish brown colour of aqueous bromine is discharged when a solution of phenylamine is added to it. Which statement explains this observation?
 - A Bromine displaces hydrogen in the benzene ring
 - **B** The NH₂ group of phenylamine is substituted by bromine
 - **C** Bromine forms a colourless complex with phenylamine
 - D Phenylamine oxidizes Br₂ to Br
- 27 Which one of the following is a product of the reaction between phenylmethanol, and ethanoyl chloride, CH_3COCI ?



H2 Chemistry 9746/01/NYJC J2/09PX

28 One industrial preparation of ethanoic acid is the direct carbonylation of methanol using a rhodium catalyst



Which compound could be expected to produce CH₂CO₂H

А ОН | HC—CO₂H | CH₂OH

С ОН НС----СН₂СО₂Н СО₂Н

29 It has been reported that some cases of acute liver failure could have been caused by an overdose of Paracetamol. Which of the following statements about Paracetemol is **incorrect**?



- A It reacts with hot, aqueous sodium hydroxide to give sodium ethanoate
- B There is no yellow precipitate observed on adding aqueous, alkaline iodine
- **C** The colourless gas evolved on adding sodium metal extinguished a lighted splinter with a "pop" sound.
- **D** An aqueous solution of Paracetamol is alkaline



- **A** II, I, III, IV
- B IV, III, I, II
- **C** III, IV, II, I
- **D** III, IV, I, II

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 which 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	only are	only are	is
correct	correct	correct	correct

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

- **31** Acidified manganate(VII) ions react with hydrogen peroxide. Which of the following are correct statements about the reaction ?
 - 1 The oxidation number of manganese changes by 5
 - 2 Hydrogen peroxide is oxidized to water
 - **3** Hydrogen ions are oxidized to water

30 What is the order of increasing pK_b for the following compounds?

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

32 Bromine and methanoic acid reacts as follows in an elementary (single step) reaction.

 $Br_2(aq) + HCO_2H(aq) \rightarrow 2 Br^{-}(aq) + 2 H^{+}(aq) + CO_2(g)$

Which of the following deductions can be made from this information ?

- **1** The overall order is two
- 2 Doubling the concentration of methanoic acid doubles the rate of evolution of gas
- **3** Halving the concentration of both reactants simultaneously will halve the reaction rate
- **33** Which of the following solution's pH will not change significantly when some acid is added
 - 1 20 cm³ of 0.100 mol dm⁻³ ethanoic acid mixed with 15 cm³ of 0.100 mol dm⁻³ aqueous sodium hydroxide
 - **2** 20 cm³ of 0.100 mol dm⁻³ aqueous ammonia mixed with 15 cm³ of 0.100 mol dm⁻³ ammonium chloride solution



- 34 In the electrolysis of a nitrate solution of metal X, 0.76 g of the element was formed at the cathode by the passage of 0.5 A of current for 1930 seconds. Metal X has a relative atomic mass of 152. Which of the following statements about the above electrolysis are correct?
 - 1 The charge on an ion of **X** is $\frac{0.5 \times 1930 \times 152}{96500 \times 0.76}$ coulombs
 - 2 When the gas at the anode was collected and a lighted splinter was inserted into it, it bursts into flame
 - **3** The mass of X obtained in 1930s can be increased by using a more concentrated solution of the nitrate solution of metal X

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

- **35** What are the conditions usually quoted for the standard electrode potential of hydrogen to be 0.00 V?
 - **1** The concentration of H^+ (aq) is 1 mol dm⁻³
 - 2 The atmospheric pressure is exactly 1 atm
 - **3** The temperature is 0 ^oC
- **36** Which of the following statements explain why silver chloride is soluble in aqueous ammonia, but silver iodide is not?
 - **1** The solubility product of silver chloride is numerically larger than that of silver iodide
 - 2 The equilibrium constant for the reaction AgX(s) + 2 NH₃(aq) □ Ag(NH₃)₂X(aq) is numerically greater for X = C/ than for X = I
 - **3** The lattice energy of silver chloride is numerically greater than that of silver iodide
- **37** Pentaerythritol is an intermediate in the manufacture of paint.



Which of the following statements about pentaerythritol are correct?

- 1 It decolourises acidified potassium manganate(VII) on warming
- 2 It reacts with metallic sodium
- 3 It is formed via the reaction of 1,4-pentadiene, $H_2C = CH CH_2 CH = CH_2$ with cold dilute potassium manganate (VII)

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

- **38** Which of the following statements is true of the nitration of benzene?
 - 1 Concentrated H_2SO_4 acts as an acid to generate the NO_2^+ ion
 - 2 Concentrated H₂SO₄ acts as a catalyst
 - 3 The organic intermediate has five carbon atoms which are sp^2 hybridised
- **39** Which of the following statement(s) is/are true for both methylbenzene and phenol?
 - 1 Both can react with nitric acid via the same mechanism
 - 2 Both reacts with aqueous bromine at room temperature to form at white precipitate
 - **3** Both reacts with hot acidified KMnO₄ to form the same organic product
- 40 Capsaicin, the active component of chilli peppers, has the following structure:



Which of the following statements about capsaicin are correct?

- 1 It contains a total of nine sp^2 hybridised carbon atoms
- 2 It reacts with dilute hydrochloric acid under room temperature
- 3 It has only one chiral centre