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Name _____ Class: ____ Reg Number: ____



Meridian Junior College 2009 JC2 Preliminary Examination

H1 Chemistry 8872

24 September 2009

50 minutes

Paper 1

Additional Material Data Booklet OMR Answer Sheet

INSTRUCTION TO CANDIDATES

Write your name, class and register number in the spaces provided at the top of this page.

There are **thirty** questions in this section. Answer **all** questions. For each question, there are four possible answers labelled **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in pencil on the OMR Answer Sheet.

You are advised to fill in the OMR Answer Sheet as you go along; no additional time will be given for the transfer of answers once the examination has ended.

Use of OMR Answer Sheet

Ensure you have written your name, class register number and class on the OMR Answer Sheet.

Use a **2B** pencil to shade your answers on the OMR sheet; erase any mistakes cleanly. Multiple shaded answers to a question will not be accepted.

For shading of class register number on the *OMR sheet*, please follow the given examples:

If your register number is 1, then shade $\underline{01}$ in the index number column. If your register number is 21, then shade $\underline{21}$ in the index number column.

Section A

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

- 1 Which of the following contains 4.52×10^{21} atoms?
 - **A** 0.113 g of methyl free radicals, (•CH₃)
 - **B** 0.0319 g of ammonia
 - **C** 168 cm³ of oxygen gas at standard temperature and pressure
 - **D** 1.80 dm³ of chlorine gas at room temperature and pressure
- **2** Sodium peroxide, Na₂O₂, is used in submarines for absorbing atmospheric carbon dioxide and regenerating oxygen. The reaction produces sodium carbonate as a by-product.

What is the mass of Na_2O_2 needed per day to absorb the carbon dioxide produced by 8 crew members in a submarine, each of whom exhales 600 dm³ of CO_2 per day?

[Molar volume of a gas at r.t.p. is 24 dm³ mol⁻¹]

- A 0.98 kg
- **B** 1.95 kg
- **C** 7.80 kg
- **D** 15.6 kg

3 Nitrogen oxides are a major type of air pollutants. In a reaction, 0.20 mol of an oxide, N_xO_y was reacted with 20 dm³ of hydrogen gas at room temperature and pressure and passed over a heated catalyst to produce ammonia and water as the only products. At the end of the reaction, 0.80 dm³ of hydrogen gas remained. The ammonia produced required 0.200 mol of sulphuric acid for complete neutralisation.

The reaction of the oxide with hydrogen can be represented by the following equation:

$$N_{\mathbf{x}}O_{\mathbf{y}}(g) + \frac{3\mathbf{x} + 2\mathbf{y}}{2} H_2(g) \rightarrow \mathbf{x} NH_3(g) + \mathbf{y} H_2O(I)$$

What is the molecular formula of the oxide?

- A NO
- B NO₂
- **C** N₂O
- **D** N₂O₄
- 4 Which of the following ions has more electrons than protons and more protons than neutrons? [$H = {}^{1}_{1}H$; $D = {}^{2}_{1}H$; $T = {}^{3}H$; $C = {}^{12}_{6}C$; $O = {}^{16}_{8}O$]
 - **A** CO₃²⁻
 - **B** H_2DO^+
 - с он-
 - D TCO₃⁻

5 Which of the following corresponds to the configuration of the four electrons of highest energy for the ground state of an element in Group IV?

- $\mathbf{A} \qquad 1 \mathrm{s}^2 \mathrm{2} \mathrm{s}^2$
- **B** 1s²2s¹2p¹
- **C** 2s²2p²
- **D** 3p⁴

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- **6** Which of the following statements describe a phenomenon which cannot be explained by hydrogen bonding?
 - A lce has a lower density than water at 0° C.
 - **B** The boiling point of methanol is lower than that of ethanol.
 - **C** Ethanal dissolves in water.
 - **D** Methanoic acid molecules form dimers when dissolved in benzene.
- 7 Aluminium chloride catalyses certain reactions by forming a positively-charged species known as a carbocation such as CH_3^+ as shown in the equation.

 $CH_3Cl + AlCl_3 \rightarrow CH_3^+ + AlCl_4^-$

Which property makes this reaction possible?

- **A** $AlCl_3$ is an acidic compound.
- **B** The aluminium atom in A/Cl_3 has an incomplete octet of electrons.
- **C** $AlCl_3$ exists as the dimer Al_2Cl_6 in the vapour.
- **D** The chlorine atom in CH_3Cl has a vacant p orbital.
- **8** The successive ionisation energies, in kJ mol⁻¹, of an unknown element **Z** are given below.

420 3100 4400 5900 8000 9600 11400 13300

Which of the following statements about **Z** is correct?

- **A Z** is in group II of the Periodic Table.
- **B** The oxide of **Z** is an amphoteric oxide.
- **C** The chloride of **Z** hydrolyses in water to give an acidic solution.
- **D** Element **Z** can conduct electricity in the solid and molten state.

9 The following graph shows the first ionisation energy of 8 consecutive elements from **A** to **H** in the periodic table, with atomic numbers between 3 to 20.



Which of the following statements is incorrect?

- **A** The chloride of **E** has a giant ionic structure.
- **B** The oxide of **F** has a giant molecular structure.
- **C** The chloride of **D** conducts electricity in the molten state.
- **D** Element **A** exists as discrete molecules at room temperature.
- **10** The hydrolysis of ethyl ethanoate in the presence of hydrochloric acid is first order with respect to ethyl ethanoate.

Which diagram represents the variation of concentration of ethyl ethanoate, represented as [ester], with time?



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11 Values of ionic product for water at different temperatures are given below:

Temperature / °C	0	25	100
K _w / mol ² dm ⁻⁶	1.1 x 10 ⁻¹⁵	1.0 x 10 ⁻¹⁴	5.1 x 10 ⁻¹³

	pH of pure water at different temperature			
	0 °C	25 ℃	100 °C	
Α	6.5	7.0	7.9	
В	7.0	7.0	7.0	
С	7.5	7.0	6.1	
D	15.0	14.0	12.3	

12 In the diagram, curve **X** was obtained by observing the decomposition of 100 cm³ of 1.0 mol dm⁻³ hydrogen peroxide, catalysed by manganese (IV) oxide.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$
 $\Delta H = -196.1 \text{ kJ mol}^{-1}$
volume of oxygen formed of time

Which alteration to the original experimental conditions would produce curve $\mathbf{Y}?$

- A Adding water.
- **B** Adding some 0.1 mol dm^{-3} hydrogen peroxide.
- **C** Placing the mixture in an ice-bath.
- **D** Using less manganese (IV) oxide.

13 The enthalpy change of neutralisation of aqueous sodium hydroxide by hydrochloric acid is -57.2 kJ mol⁻¹, but the enthalpy change of neutralisation of aqueous sodium hydroxide by aqueous ethanoic acid is -55.2 kJ mol⁻¹.

Which best explains the numerical difference in these values?

- **A** Aqueous ethanoic acid contains fewer hydrogen ions than hydrochloric acid of the same concentration.
- **B** The process $CH_3CO_2H(a_{\overline{q}}) \rightarrow CH_3CO_2^-$ (aq) + H⁺ (aq) is endothermic.
- **C** The process $CH_3CO_2H(aq) \Longrightarrow CH_3CO_2^-(aq) + H^+(aq)$ is exothermic.
- **D** Equal number of moles of water is produced in both reactions.
- **14** For the reaction:

$$NH_4^+(aq) + CO_3^{2-}(aq) \Longrightarrow HCO_3^-(aq) + NH_3(g)$$

Which of the following statements is correct?

- **A** CO_3^{2-} is a Bronsted acid.
- **B** NH_3 is the conjugate acid of NH_4^+ .
- **C** HCO_3^- is the conjugate base of CO_3^{2-} .
- **D** NH_4^+ is the conjugate acid of NH_3 .
- **15** The ionic radius of the elements in Period 3 (Na to C*l*) changes across the period.

Which of the following statements does **not** explain the trend of the ionic radius across the period?

- **A** Across the period, there is an increase in the nuclear charge.
- **B** The anions have greater shielding effect than the cations.
- **C** There is a constant screening effect among the cations.
- **D** The effective nuclear charge decreases from P^{3-} to Cl^{-} .

16 The hybridisation state of the carbon atoms and the number of π bonds in octane, buta-1,3-diene and carbon monoxide molecules are

	Octane	Buta-1,3-diene	Carbon monoxide
Α	sp ³ ; 0	sp ² ; 2	sp; 2
В	sp ³ ; 0	sp; 3	sp ² ; 1
С	sp ³ ; 0	sp²; 3	sp; 1
D	sp ² ; 1	sp²; 3	sp; 2

17 A compound with a molecular formula C_5H_{10} decolourises aqueous bromine in the dark. How many isomers (including both structural and geometric isomers) are possible for this compound?

Α	3	В	4
С	5	D	6

18 The structure of Compound **P** is shown below.



Compound P

Which of the following reagents will decolourise when mixed with compound **P** under suitable conditions?

- **A** 2,4-dinitrophenylhydrazine
- **B** Fehling's reagent
- **C** Potassium manganate (VII)
- **D** Tollen's reagent

19 1 mole of an organic compound **E** undergoes elimination on reaction with ethanolic sodium hydroxide to form 2 moles of HBr.



20 The compound below is used to prevent the premature dropping of fruit in tomato plants :



Which one of the following schemes provides a possible synthesis for this compound?



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21 Experiments are carried out on three compounds X, Y, and Z.



A sample of 0.01 mol of each compound is heated under reflux with 100 cm³ of 0.5 mol dm⁻³ NaOH (in excess) until hydrolysis is complete and any ammonia produced is expelled from solution. The excess NaOH is then titrated in each case and is found to require 40 cm³, 60 cm³ and 80 cm³ of 0.5 mol dm⁻³ HC*l* for neutralisation.

Which sequence of compounds matches these results?

Α	<u>40 cm³ X</u>	<u>60 cm³ Y</u>	<u>80 cm³ Z</u>
в	X	z	Y
С	Y	Х	z
D	Z	Y	Х

22 Compound **M** has the structural formula as shown below





Which of the following statement(s) regarding M is correct?

- A 1 mole of **M** reacts with hot dilute HC*l* to produce 2 moles of carboxylic acid.
- **B** M reacts with 2,4-dinitrophenylhydrazine give an orange precipitate.
- **C M** reacts with I₂ in NaOH to produce a yellow precipitate.
- **D M** is a product of an addition reaction.

23 An industrial preparation of alcohols involves the following step:



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



24 A compound **Q** gives compound **R**, C_8H_8O , on oxidation under appropriate conditions. **R** gives a precipitate on warming with Fehling's reagent.

Which of the following could be **Q**?



25 Terephthalaldehyde is used as an intermediate for manufacturing of dyes and fluorescent whitening agents. It can be synthesized from 4-methylbenzoic acid via a 3-step synthesis.



4-methylbenzoic acid

Terephthalaldehyde

Which of the following are the reagents and conditions needed for the conversion?

	Step 1	Step 2	Step 3
Α	$Cr_2O_7^{2-}/H^+$, heat to distill	LiA/H ₄ , r.t.p	Hot KMnO₄/H ⁺
В	$Cr_2O_7^{2-}/H^+$, heat to distill	NaBH₄, r.t.p	Hot KMnO₄/H⁺
С	Hot KMnO₄/H⁺	LiA/H ₄ , r.t.p	$Cr_2O_7^{2-}/H^+$, heat to distill
D	Hot KMnO₄/H⁺	NaBH₄, r.t.p	$Cr_2O_7^{2-}/H^+$, heat to distill

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 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 An enzyme, found in the stomach, operates at maximum efficiency when in an aqueous solution buffered at pH 5.

Which combination of substances, when dissolved in 10 dm³ of water, would give the necessary buffer solution?

- 1 2 mol of HCO_2H and 1 mol of NaOH.
- 2 mol of HNO_3 and 1 mol of HCO_2Na .
- **3** 2 mol of NH_3 and 1 mol of HCl.
- 27 Which of the following sequences show the bonds arranged in order of increasing polarity?
 - $1 \qquad O-Cl, O-F, O-H$
 - 2 O S, O N, O H
 - 3 O C, O N, O F

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

28 Compound L reacts with the following reagents in a sequential manner.



 $\mathsf{Compound}\; \mathbf{L}$

Step I :Concentrated H2SO4Step II:Tollens' reagent, followed by dilute H2SO4Step III:Hydrogen gas

Which of the following statements are true?

- 1 The product from step II decolourises aqueous bromine readily.
- 2 The product from step II can undergo substitution with compound L under suitable conditions.
- **3** 1 mole of the product from step **III** reacts completely with 1 mol of potassium.
- **29** *Vitamin* B_5 has the following structure.



Which of the following statements about *Vitamin* B_5 is **incorrect**?

- **1** *Vitamin* B_5 reacts with 2,4-dinitrophenylhydrazine to form an orange precipitate.
- **2** One mole of *Vitamin* B_5 completely reacts with three moles of Na₂CO₃.
- **3** One mole of *Vitamin B*⁵ completely reacts with three moles of KOH at room temperature and pressure.

- **30** The following compounds are usually used as refrigerants. Which compounds are effective in destroying stratospheric ozone?
 - 1 CCl_2FCClF_2
 - 2 CH_3CCl_2F
 - 3 CF₃CH₂Br

End of paper

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