Calculator Model / No.	
Class	Reg Number

Candidate Name _



MERIDIAN JUNIOR COLLEGE JC 2 Preliminary Examination Higher 2

CHEMISTRY

9647/01 26 September 2014

Paper 1 Multiple-Choice Questions

1 hour

Additional Materials: Data Booklet and OMR answer sheet

INSTRUCTIONS TO CANDIDATES

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

There are **forty** 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 soft pencil on the OMR answer sheet.

Read very carefully the instructions 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 <u>01</u> in the index number column.

If your register number is 21, then shade 21 in the index number column.

This document consists of 16 printed pages (including 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 A 0.70 g impure sample of ammonium hydrogen sulfate, NH_4HSO_4 , is titrated with 0.200 mol dm⁻³ sodium hydroxide. 24.80 cm³ of aqueous sodium hydroxide is required for complete reaction. (M_r of $NH_4HSO_4 = 115$)

What is the percentage purity of the sample?

A 40.7% **B** 61.1% **C** 81.5% **D** 98.3%

2 20.00 cm³ of 0.0200 mol dm⁻³ bromate(V), BrO₃⁻, was found to react completely with 80.00 cm³ of 0.0100 mol dm⁻³ hydroxylamine, NH₂OH.

BrO₃⁻ ions are reduced as follows:

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

Which of the following could be the half-equation for the oxidation of hydroxylamine?

3 Which of the particles would, on losing an electron, have a half-filled set of p orbitals?

A N^+ **B** O^- **C** P^- **D** Cl^{2+}

At 1.5 atm and 27 °C, 1 mole of gas E occupies a volume of 16.7 dm³ while 1 mole of gas F occupies a volume of 20.0 dm³. Which one of the following gives a

A Gas E could be He while gas F could be CO₂.

possible explanation for the observation?

- **B** Gas **E** could be NH₃ while gas **F** could be H₂.
- **C** Gases **E** and **F** are ideal.
- **D** Gases **E** and **F** have intermolecular van der Waals' forces of attraction.

Comment [A1]: A to D on one line

2

3

5 A student used the apparatus below to heat a can containing 300 g of water.



The following data were recorded:

Mass of propan-1-ol burnt	= <i>m</i> g
Change in temperature of water	$= \Delta T^{\circ}C$

You are given that:

Relative molecular mass of propan-1-ol = 60.0

Enthalpy change of combustion of propan-1-ol = $-2021 \text{ kJ mol}^{-1}$

Specific heat capacity of water = $c J g^{-1} K^{-1}$

What is the efficiency of this heating process?

A	(300 + m) x 2021 x 1000 c x ∆T x 60.0 x 100%	Comment [A2]: Change mass to 200
в	$\frac{m \ x \ c \ x \ \Delta T \ x \ 60.0}{300 \ x \ 2021 \ x \ 1000} \ x \ 100\%$	
С	$\frac{300 \text{ x c x } \Delta \text{T x 60.0}}{\text{m x 2021}} \text{ x 100\%}$	
D	$\frac{300 \text{ x c x } \Delta \text{T x 60.0}}{\text{m x 2021 x 1000}} \text{ x 100\%}$	

6 The reaction between ammonia gas and hydrogen chloride is often used in schools to teach the concept of diffusion. A typical setup, where ammonia and hydrogen chloride gas are introduced on the opposite ends of a glass tube, is shown below.



An equilibrium reaction can be established at a fixed temperature, where the dense white fumes formed are ammonium chloride.

 $NH_3(g) + HCl(g) \implies NH_4Cl(s)$

At T °C, when equimolar amounts of ammonia and hydrogen chloride were used, the K_p value of this equilibrium is found to be 1.

Which of the following statements is true?

- A Increasing the partial pressure of either gas would cause K_p to increase to a value that is greater than 1.
- **B** The K_p value of the equilibrium, NH_4Cl (s) \implies NH_3 (g) + HCl (g), is 1.
- **C** The partial pressure of each gas at equilibrium is 0.50 atm.
- **D** There would be no change in the equilibrium position if the partial pressure of each gas was doubled at the same time.
- 7 Hypochlorous acid, HClO ($pK_a = 7.46$), and chlorous acid, HClO₂ ($pK_a = 1.46$), are examples of oxoacids related to the element chlorine.

A solution was formed by mixing equal volumes of hypochlorous acid and chlorous acid, each made up separately to the same concentration.

Which of the following statements about the species present in the resulting solution is likely to be true??

- $\mathbf{A} \qquad [\mathsf{H}^+] < [\mathsf{H}\mathsf{C}l\mathsf{O}] < [\mathsf{H}\mathsf{C}l\mathsf{O}_2]$
- **B** $[H^+] < [HC/O] = [HC/O_2]$
- **C** [H⁺] < [HC*l*O₂] < [HC*l*O]
- **D** $[H^+] = [HClO_2] < [HClO]$

Comment [A3]: Change order of ABCD

8 The standard electrode potential for the following electrode reaction is +1.69 V.

 $Pb^{4+}(aq) + 2e^{-} \implies Pb^{2+}(aq)$

Which of the following may be deduced from this information?

- A Lead(II) compounds can act as oxidising agents.
- **B** Lead(IV) ion is a strong reducing agent.

C Lead is more stable in the +2 than in the +4 oxidation state.

D Lead electrode is the positive electrode when connected to the standard hydrogen electrode half-cell.

Comment [A4]: rephrase

9 A student set up the cell as shown.



The following values for the cell potential were determined as a change was continuously made.

Reading number	Cell potential / V
1	+0.480
2	+0.300
3	+0.250
4	+0.130
5	+0.064

What continuous change in the tin half-cell could produce these results?

- A Add NaOH (aq) to the solution to form insoluble Sn(OH)₂.
- **B** Decrease the surface area of the salt bridge immersed in the solution.
- **C** Increase the concentration of Sn²⁺(aq) in the solution.
- **D** Increase the surface area of copper electrode immersed in the solution.

- 6
- 10 The circuit shown in the diagram was set up.



Which electrode reactions will occur on closing the switch?

	anode reaction	cathode reaction
Α	Hydrogen is evolved.	Copper dissolves preferentially.
B	Zinc dissolves preferentially.	Hydrogen is evolved.
С	Copper and zinc both dissolve.	Hydrogen is evolved.
D	Oxygen is evolved.	Copper and zinc both dissolve.

G, **H** and **J** are three elements found in Period 3 of the Periodic Table.

Among the elements in Period 3,

- the melting point of G is the highest.
- the electrical conductivity of **H** is the highest.
- the melting point of the oxides of J is the highest.

Which of the following elements is not represented by G, H or J?

<mark>A Na</mark>	ΒN	Иg	С	Al	D	Si
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12 In each of the following pairs, one mole of each oxide is reacted separately with aqueous sodium hydroxide. Which of the following pair of oxides shows that each oxide requires a different number of moles of sodium hydroxide for complete reaction?

A P_4O_6 and P_4O_{10}

- B SO₂ and SO₃
- \mathbf{C} Al₂O₃ and SO₂
- **D** BeO and Al₂O₃

- **13** Which property of Group II elements (magnesium to barium) or their compounds increases with increasing proton number?
 - **A** the magnitude of the enthalpy change of hydration of the metal ions
 - **B** the acidity of aqueous solutions of the chlorides
 - **C** the melting points of the elements
 - D the solubility of oxide
- 14 When a white solid **K** reacted with concentrated sulfuric acid in an enclosed container, the products included a pungent-smelling gas and a mixture of white and reddish-brown fumes. When the products are being bubbled into water, a yellow solution is observed.

Which of the following statements is correct?

- **A** The reddish-brown fumes produced are iodine gas.
- **B** The solid **K** acts as a base as well as an oxidising agent.
- **C** The white fumes act as a reducing agent.
- **D** The yellow solution is aqueous chlorine.
- **15** Which of the following statements about the hydrogen halides HC*l*, HBr and HI is true?

A HCl has the most exothermic enthalpy change of formation.

- **B** HC*l* is the strongest acid.
- **C** HI is the most thermally stable hydrogen halide.
- **D** HI is the weakest reducing agent.
- **16** Vanadium has the electronic structure $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$.

Which of the following compounds is not likely to exist?

A VO_2 **B** V_2O_5 **C** NH_4VO_3 **D** K_2VO_4

17 How many non-cyclic compounds, including stereoisomers, with the molecular formula C₅H₁₀ will not produce a white precipitate with Ca(OH)₂ when reacted with hot KMnO₄?

A 2 B 3 C 4 D 5

Comment [A5]: Rephrase options: HCI has the most exo ...

7

18 In the free radical substitution of alkanes with bromine, the hydrogen atoms in the alkane do not react at the same rate with bromine radicals. The following table provides the relative rates of reaction of the different types of hydrogen atoms in an alkane with bromine radicals.

Type of H atom	Primary, -CH ₃	Secondary, -CH ₂	Tertiary -CH
Relative rate of reaction with Br radical	1	4	6

When 2-methylbutane reacts with bromine in the presence of sunlight to give monosubstituted products, what is the expected ratio of primary to secondary to tertiary bromoalkanes formed?

- **A** 6:2:1
- **B** 6:8:6
- **C** 9:2:1
- **D** 9:8:6
- **19** A compound used as optical brightener in detergents has the following formula:



Which of the following is likely to be a property of this compound?

- A It reacts with hydrogen bromide to give a compound containing four bromine atoms.
- B It reacts with steam to produce a compound with two chiral carbon atoms.
- **C** It is hydrolysed by hot dilute sulfuric acid to give an amine.
- **D** It reacts with four moles of hydrogen gas for reduction.
- **20** Which one of the following, in alcoholic solution, produces a precipitate fastest when warmed with aqueous silver nitrate?
 - A 1-bromobut-1-ene
 - B 1-bromobut-2-ene
 - C 1-chlorobut-1-ene
 - D 1-chlorobut-2-ene

21 2-Methylpropan-1-ol can be converted into 2-methylpropan-2-ol as follows:



Which of the following sequences may be used for the conversion?

- A Alcoholic KCN followed by dilute H₂SO₄, reflux
- **B** Concentrated H₂SO₄ followed by cold alkaline KMnO₄
- **C** Al_2O_3 , heating followed by H_2O with H_3PO_4 , high temperature & pressure
- **D** Alcoholic NaOH followed by H_2O with H_3PO_4 , high temperature & pressure
- 22 Acetaminophen is a drug used in headache remedies. It has the following structure:



Which of the following reagents reacts with Acetaminophen?

- A sodium carbonate
- B cold sodium hydroxide
- **C** alkaline aqueous iodine
- D 2,4-dinitrophenylhydrazine
- 23 Which statement about ethanal and propanone is not correct?
 - **A** Both give a positive tri-iodomethane test.
 - **B** Both react with 2,4-dinitropheylhydrazine reagent.
 - **C** Both may be prepared by the oxidation of an alcohol.
 - D Both react with warm acidified sodium dichromate(VI).

24 One industrial preparation of ethanoic acid is the direct carbonylation of methanol, using a rhodium catalyst.



- 25 Which of the following procedures gives the best yield of phenylbenzoate, $C_6H_5CO_2C_6H_5$?
 - A Reacting $C_6H_5CO_2H$ with SOC l_2 , then adding C_6H_5OH .
 - **B** Reacting C_6H_5OH with NaOH, then adding $C_6H_5CO_2H$.
 - **C** Reacting a hot mixture of $C_6H_5CO_2H$ and C_6H_5OH with conc H_2SO_4 .
 - **D** Reacting C_6H_5OH with $SOCl_2$, then adding $C_6H_5CO_2H$.
- 26 Nitrobenzene reacts with tin in concentrated hydrochloric acid followed by aqueous sodium hydroxide to form phenylamine.

Which of the following statements is not correct for the above reaction?

A Tin is used as a catalyst in this reaction.

- **B** Nitrobenzene is being reduced in this reaction.
- **C** LiA*l*H₄ is not a suitable alternative to carry out this conversion.
- **D** NaOH is required to form phenylamine from phenylammonium chloride.

27 The following table shows the pK_b values and boiling points of propylamine, $CH_3CH_2CH_2NH_2$, and trimethylamine, $(CH_3)_3N$.

Compound	$CH_3CH_2CH_2NH_2$	(CH ₃) ₃ N
р <i>К</i> _b	3.11	4.19
boiling point / °C	50	3

Which of the following statements about propylamine and trimethylamine is correct?

- A (CH₃)₃N has a lower boiling point due to its spherical shape which reduces the extent of intermolecular forces.
- **B** $(CH_3)_3N$ is less basic than $CH_3CH_2CH_2NH_2$ due to steric hindrance that reduces the availability of the lone pair on N atom to accept proton.
- **D** $CH_3CH_2CH_2NH_2$ is less basic than NH_3 due to the increase in stability caused by the electron-donating $CH_3CH_2CH_2$ group.
- **28** Which of the following arrangement of compounds shows a decreasing order of pK_b values?



29 Electrophoresis is used to separate and identify the following four amino acids. Using a buffer solution at pH 2, which amino acid would be furthest away from the anode?



30 A particular enzyme can hydrolyse the peptide bond between the carboxyl group of cysteine (cys) and amino group of alanine (ala) of a pentapeptide to give the amino acid, cys, and two similar dipeptides, ala-cys.

Which of the following is the primary structure of this pentapeptide?

- A cys-ala-cys-cys-ala
- B cys-ala-cys-ala-cys
- **C** ala-cys-ala-cys-cys
- D ala-ala-cys-ala-cys

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	B C		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.

- **31** Which of the following contains approximately the same number of the stated particles as there are atoms in 18.0 g of water?
 - 1 number of ions in 158.2 g of sodium thiosulfate, Na₂S₂O₃
 - 2 number of molecules in 6.0 g of hydrogen
 - 3 number of neutrons in 6.0 g of carbon
- **32** Use of the Data Booklet is relevant to this question.

Consider the following enthalpy changes related to magnesium, in kJ mol⁻¹:

$Mg(s) \rightarrow Mg(g)$	ΔH_1
$Mg(s) \rightarrow Mg^{2+}(g)$ + 2e	ΔH_2
$Mg(g) \rightarrow Mg^{+}(g) + e$	ΔH_3
$Mg^+(g) \rightarrow Mg^{2+}(g)$ + e	ΔH_4
$Mg(g) \rightarrow Mg^{2+}(g) + 2e$	ΔH_5

Which of the following statements is not correct?

- 1 ΔH_5 is equal to the 2nd ionisation energy of Mg.
- 2 $\Delta H_3 + \Delta H_4$ is numerically smaller than ΔH_5 .
- **3** All of ΔH_1 to ΔH_5 are endothermic.

13

33 When 193 C of electricity are passed through a molten compound of a metal, 2.00×10^{-3} mol of atoms of the metal is deposited at the cathode.

What could the metal be?

1	lithium
2	silver
3	zinc

34 The Maxwell-Boltzmann distribution below shows the distribution of molecular kinetic energies within a gas at two different temperatures, T_1 and T_2 .



Which of the following statements about a reaction and its reacting molecules are true, when the temperature is increased from T_1 to T_2 ?

- 1 The frequency of effective collisions between molecules increases, causing the reaction to occur more quickly.
- 2 The frequency of collisions between molecules at a particular value of kinetic energy increases.
- 3 The frequency of collisions between molecules that have energy greater than or equal to E_a increases, causing more products to be obtained.

35 The exhaust systems of most new cars are fitted with catalytic converters that contain transition metals as catalysts to reduce emission of atmospheric pollutants.

Which of the following statements help explain the use of the transition metals in the catalytic converters?

- 1 Transition metals have 3d and 4s electrons that can be used for bonding with atmospheric pollutants.
- 2 Transition metals can exist in various oxidation states, thus facilitating the formation of reaction intermediates with atmospheric pollutants.
- **3** Transition metals can be easily interconverted from one oxidation state to another, which aids recovery of these precious metals after catalysis.
- **36** A compound **U** exhibits structural isomerism, the isomers being members of different homologous series.

To which homologous series could the pair of isomers of U belong to?

1 carboxylic acids and esters

- 2 amides and amino acids
- 3 halogenoalkanes and acyl halides
- 37 Compound W can be synthesised from benzene.



Which of the following synthesis routes will yield compound **W**?

1	bromination \longrightarrow alkylation —	\rightarrow oxidation \longrightarrow nit	$ration \longrightarrow reduction$

- 2 nitration —> alkylation —> reduction —> bromination —> oxidation
- 3 alkylation \longrightarrow bromination \longrightarrow nitration \longrightarrow oxidation \longrightarrow reduction
- **38** Which of the following isomeric pairs of compounds can be distinguished by warming with a solution of acidified potassium manganate(VII)?
 - 1 CH₃CH₂CH₂OH and (CH₃)₃COH
 - 2 CH₃CH₂CHO and CH₃COCH₃
 - 3 CH₃CH₂CO₂CH₂CH₃ and CH₃CO₂C(CH₃)₃

16

39 Terfenadine is a drug that alleviates seasickness and asthma.



Terfenadine

What deductions about *Terfenadine* can be made from this structure?

- 1 *Terfenadine* reacts with concentrated sulfuric acid at 180 °C to form a product that decolourises Br₂(aq) at room conditions.
- 2 *Terfenadine* reacts with dilute aqueous HC*l* to form a salt.
- 3 One mole of *Terfenadine* will liberate two moles of $H_2(g)$ on reaction with excess Na.
- 40 Which of the following statements regarding the denaturation of proteins is correct?
 - 1 Adding a reducing agent will restore the disulfide bonds to –SH groups.
 - 2 Adding an acid will disrupt ionic bonds present in proteins.
 - **3** Adding an alcohol-containing disinfectant will break the inter-chain hydrogen bonds of the tertiary structure only.

END OF PAPER

Qn	Ans	Qn	Ans
1	A	21	С
2	С	22	В
3	С	23	D
4	A	24	D
5	D	25	A
6	В	26	A
7	С	27	В
8	С	28	С
9	С	29	A
10	В	30	В
11	A	31	A
12	A	32	В
13	D	33	В
14	С	34	D
15	A	35	D
16	D	36	D
17	В	37	В
18	D	38	A
19	В	39	В
20	В	40	В

<u>Answer Key</u>

A – 10; B – 13; C – 8; D – 9.