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Candidate Name ____



Meridian Junior College 2009 JC 2 Preliminary Examination H2 Chemistry 9746

24 September 2009

1 hr

Paper 1 MULTIPLE CHOICE QUESTIONS

Additional Materials Data Booklet

INSTRUCTION TO CANDIDATES

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

There are **fourty** questions in this section. Answer **all** questions. For each question, there are four possible answers labeled **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 <u>**21**</u> in the index number column.

This question paper consists of 21 printed pages

1 The reaction between silicon tetrabromide, SiBr₄, with moist ethoxyethane produces four oxobromides with the formulae SiO₂Br₈, Si₂OBr₆, Si₃O₂Br₈ and Si₄O₃Br₁₀. When 0.192 g of one of the oxobromides was completely reacted with water, all its bromine was converted into bromide ions and produced 0.392 g of a cream precipitate when an excess of silver nitrate was added.

Which of the following shows the correct identity of the oxobromide which reacted with water?

- A SiO₂Br₈
- B Si₂OBr₆
- C Si₃O₂Br₈
- **D** $Si_4O_3Br_{10}$
- 2 Nitrogen oxides are 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:

$$N_{x}O_{y}(g) + \frac{3x + 2y}{2}H_{2}(g) \rightarrow x NH_{3}(g) + y H_{2}O(I)$$

What is the molecular formula of the oxide?

3 In an experiment, H_2S was reacted with 24.00 cm³ of 0.15 mol dm⁻³ of an unknown bromate ion, BrO_x^- in acidic medium to form sulphur of mass 0.289 g as well as bromine solution, Br_2 .

What is the value of \mathbf{x} in BrO_x⁻?

A 2
B 3
C 4
D 5

- Which of the following ions has more electrons than protons and more 4 protons than neutrons? [$H = {}^{1}_{1}H$; $D = {}^{2}_{1}H$; $T = {}^{3}_{1}H$; $C = {}^{12}_{6}C$; $O = {}^{16}_{8}O$]
 - CO32-Α H_2DO^+
 - В С OH-
 - TCO₃⁻ D
- 5 Which transition metal ion in the following species has only one unpaired electron in its d orbitals?
 - $[CoCl_4]^{2-}$ Α
 - $[Fe(H_2O)_5(SCN)]^{2+}$ $[Mn(CN)_6]^{3-}$ В
 - С
 - [VO(H₂O)₅]²⁺ D
- 6 Which of the following is the most accurate representation of a graph of P/ρ vs T for an ideal gas?

(P = pressure; ρ = density; T = temperature in °C)



- 7 Which of the following statements describes a phenomenon which **cannot** be explained by the relative size of the atoms involved?
 - **A** Sulphur can form SF_6 but oxygen cannot form OF_6 .
 - **B** The bond angle in H_2S is smaller than the bond angle in H_2O .
 - **C** The boiling point of the group IV hydrides increases from C to Ge.
 - **D** Though nitrogen and phosphorus are both in Group V, nitrogen can exist as N=N molecules but phosphorus does not.
- 8 A small amount of solid lead iodide was added to a beaker of water, which was stirred. Most of the solid settled on the bottom of the beaker, but a little dissolved, establishing the equilibrium shown below:

$$PbI_2(s) \longrightarrow Pb^{2+}(aq) + 2I^{-}(aq)$$

The rates of the forward and reverse reactions were monitored over time, producing the graph shown below:



What happened at time *t*?

- **A** The beaker was cooled in an ice-bath.
- **B** A small amount of solid $Pb(NO_3)_2$ was added to the beaker.
- **C** A small amount of solid PbI₂ was removed from the beaker.
- **D** A small amount of water was added to the beaker.

9 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

What are the approximate values of the pH of pure water at 0°C, 25°C and 100°C?

pH of pure water at different temperature

	0 °C	25 °C	100 °C
Α	6.1	7.0	7.5
в	7.0	7.0	7.0
С	7.5	7.0	6.1
D	15.0	14.0	12.3

- 10 Which of the following statements about acids, bases and salts is correct?
 - A 10 cm³ of 0.02 mol dm⁻³ of ethanoic acid neutralised by 5 cm³ of 0.02 mol dm⁻³ of sodium hydroxide produces a basic buffer.
 - **B** 10 cm³ of 0.02 mol dm⁻³ of hydrochloric acid neutralised by 5 cm³ of 0.02 mol dm⁻³ of ammonia produces an acidic buffer.
 - **C** 0.02 mol dm⁻³ of sodium ethanoate has a higher pH than 0.02 mol dm⁻³ of ammonium chloride.
 - **D** 0.02 mol dm⁻³ of ethanoic acid has a higher pH than 0.02 mol dm⁻³ of sodium ethanoate.
- 11 Instant 'heat packs' are composed of a supersaturated solution of sodium acetate and a small flat disc of iron metal embedded in the liquid. Pressing the disc releases very tiny crystals of sodium acetate into the solution which then act as nucleation sites for the recrystallisation of the remainder of the salt solution.

Which of the following reflects the correct signs of ΔH , ΔS and ΔG for the overall process of the reaction?

	$\Delta \mathbf{H}$	ΔS	$\Delta \mathbf{G}$
Α	+	-	+
В	+	+	-
С	-	+	-
D	-	-	-

12 Use of the Data Booklet is relevant to this question.

A blue solution containing only vanadium ions was mixed with 10 cm³ of dilute sulphuric acid and titrated against 0.0200 mol dm⁻³ KMnO₄. The E_{cell} was measured against a standard hydrogen electrode and the following graph obtained.



Which of the following lists the approximate electrode potential values, in volts, for the points X and Y?

	Point X	Point Y
Α	0.34	1.52
В	1.00	1.52
С	0.34	1.67
D	1.00	1.67

13 Ron wanted to surprise his desired sweetheart, Hermione, with a gold heart-shaped pendant of total surface area 7 cm^2 .

In the Potions laboratory, Ron set up an electrolytic cell to conduct the electroplating process whereby one of the electrodes used was platinum and the electrolyte was concentrated 2.0 mol dm⁻³ gold(III) chloride, AuC l_3 solution. In the process, 0.025 mol of gas was liberated at the platinum electrode at room temperature and pressure.

What is the thickness of the gold coating, given that the density of gold is 19.3 g cm^{-3} ?

- **A** 0.0243
- **B** 0.0486
- **C** 0.0729
- **D** 0.1458

14 The following aqueous solutions were connected in series as shown below:



Which of the following gives the correct representation for reactions occurring at electrodes A, D and F?

	Electrode A	Electrode D	Electrode F
Α	Cu (s) → Cu ²⁺ (aq) + 2e	$Ag^{+}(aq) + e \rightarrow Ag(s)$	Cu^{2+} (aq) + 2e \rightarrow Cu (s)
В	Cu (s) → Cu ²⁺ (aq) + 2e	$2H^{+}(aq) + 2e \rightarrow H_{2}(g)$	$2H_2O(I) + 2e \rightarrow H_2(g) + 2OH(aq)$
С	$2H_2O(I) \rightarrow O_2(g) + 4H^+(aq) + 4e$	$Ag^{+}(aq) + e \rightarrow Ag(s)$	$2H_2O(I) + 2e \rightarrow H_2(g) + 2OH(aq)$
D	$2H_2O(I) \rightarrow O_2 (g) + 4H^+(aq) + 4e$	$2H^{+}(aq) + 2e \rightarrow H_{2}(g)$	Cu^{2+} (aq) + 2e \rightarrow Cu (s)

15 Elements **W**, **X**, **Y** and **Z** are four consecutive elements in Period 3 of the Periodic Table. The table below shows the first 4 ionisation energies of these elements.

Element	First	Second	Third	Fourth
W	733	1451	7740	10502
Х	580	1819	2729	11599
Y	786	1582	3230	4360
Z	1062	1904	2920	4958

Which one of the following statements is incorrect?

- A The atomic radius of **W** is larger than the atomic radius of **Z**.
- **B** The chlorides of **X**, **Y** and **Z** are simple molecular compounds.
- C The melting point of the elements increases from W to Y and decreases from Y to Z.
- **D** The oxides of both **Y** and **Z** react with water to form acidic solutions.

16 The graph below shows the variation in mass when **x** g of strontium nitrate is heated. At time *t*, decomposition is complete and the mass of the residue is **m** g.



Which of the following graphs below show the variation in mass when x g of magnesium nitrate is heated to a time t_d when the decomposition is complete with a final mass of m_f ?



17 In the laboratory, there are three bottles labeled **X**, **Y** and **Z**. Each bottle contains one of the following reagents: Cl_2 (aq), KI (aq) and NaBr (aq).

The tests were carried out using the reagents in the bottles. The results were summarized in the table below:

Tests	Observations
Mixing reagent in bottle X with reagent in bottle Z	Mixture turns brown
Mixing reagent in bottle Y with reagent in bottle Z	No observable change
Mixing reagent in bottle \mathbf{Z} with Br ₂ in CCl ₄	Mixture turns violet in CCl ₄

What are the identities of the reagents in bottle X, Y and Z?

	X	Y	Z
Α	Cl_2	KI	NaBr
В	Cl_2	NaBr	KI
С	NaBr	Cl_2	KI
D	KI	NaBr	Cl_2

18 Chromium (III) bromide combines with ammonia to form compound **R** in which the co-ordination number of chromium is six. When solution **R** is treated with excess aqueous silver nitrate, only two third of the total bromide present is precipitated as AgBr.

What is the formula of compound R?

- **A** $Cr(NH_3)_3Br_3$
- **B** $Cr(NH_3)_4Br_3$
- **C** $Cr(NH_3)_5Br_3$
- **D** $Cr(NH_3)_6Br_3$
- **19** Which of the following statement regarding the reaction of chloroethane with bromine in sunlight is true?
 - **A** A possible product of the reaction is $CH_2BrCBrC/CBrC/CH_3$.
 - **B** During the reaction, there is no product formed that can rotate plane-polarised light.
 - **C** HBr will be formed during the termination step.
 - **D** The intermediates are more energetically stable than the reactants.

20 Beta-isoamylene, $(CH_3)_2C=CHCH_3$, can be used in various applications such as flavourings and fragrances.

Which of the following statement regarding beta-isoamylene is true?

- **A** It can be formed from the reduction of an alkyne (hydrocarbons that have a carbon-carbon triple bond) with H₂.
- **B** It reacts with Cl-Br in an inert solvent to give mainly $(CH_3)_2CClCHBrCH_3$.
- **C** It reacts with Cl-I in aqueous sodium bromide to form $(CH_3)_2CBrCHC/CH_3$ as one of its products.
- **D** The C atoms in beta-isoamylene do not lie on the same plane.
- **21** The Friedel-Crafts alkylation is a reaction discovered in 1877. An example of the reaction is given below.



Which of the following statements is **false**?

- **A** The arrangement of bonds at the carbon atom in benzene at which the reaction takes place changes during the reaction.
- **B** The intermediate contains 4 delocalised electrons.
- **C E** and **F** would react slower with $CH_3CH_2CH_2Br$ than benzene.
- **D E** could also be formed using $CH_3CHBrCH_3$ instead.
- **22** 0.5 mol of the compound $HOCH_2CH_2COOH$ was reacted with 0.25 mol of KBr and 0.4 mol of H_2SO_4 . What is the maximum mass of the product that can be formed from the reaction?
 - **A** 28.8 g
 - **B** 38.2 g
 - **C** 76.5 g
 - **D** 115.9 g

23 Phenol can be used as the starting reagent in a 3-step synthesis to form compound **G**.



Starting from phenol, which sequence of reagents would give the best yield for compound **G**?

	Step 1	Step 2	Step 3
A	aq. Br ₂	dilute HNO ₃	Sn in conc. HC <i>l</i> followed by aq. NaOH
В	conc. HNO ₃	excess NH ₃ (g)	aq. Br ₂
С	dilute HNO ₃	aq. Br ₂	Sn in conc. HC <i>l</i> followed by aq. NaOH
D	dilute HNO ₃	Sn in conc. HC <i>l</i> followed by aq. NaOH	aq. Br ₂

24 The flowchart below shows an inappropriate method of synthesis to obtain the compound $CH_3CH(Br)CH_2NHCOCH_3$.



Which is the only step in the flowchart that can be satisfactorily achieved?

A Step I	
----------	--

- B Step II
- C Step III
- D Step IV

25 The *Claisen* condensation reaction occurs between esters. An example of the reaction is given below:

 $2 \text{ CH}_3\text{COOCH}_2\text{CH}_3 \rightarrow \text{CH}_3\text{COCH}_2\text{COOCH}_2\text{CH}_3$

What could be a possible product if CH₃CH₂COOCH₃ was used instead?

- A CH₃CH₂COOCH₂CH₂COOCH₃
- **B** CH₃CH₂COCH₂CH₂CH₂COOCH₃

C CH₃CHCOOCH₃ | COCH₂CH₃

- D CH₃COCH₂CH₂CH₂COOCH₂CH₃
- **26** The following is part of a reaction scheme for the formation of *Tamiflu*, a drug that is used to combat the avian flu.



What are the types of reactions for I and III?



27 A solid compound **H** dissolved readily in water to give a strongly alkaline solution.

Which one of the following could **H** be?

- **A** $CH_3O^-Na^+$
- **B** $CH_3NH_3^+Cl^-$
- $C = C_6H_5NH_2$
- \mathbf{D} $C_6H_5O^-Na^+$
- 28 Compound L reacts with the following reagents in a sequential manner.



Compound L

- Step 1: Concentrated H₂SO₄
- Step **2**: Tollens' reagent, followed by dilute H_2SO_4
- Step **3**: Hydrogen gas

Which of the following statement is false?

- A The major product from step **1** as well as the product from step **3** can exhibit stereoisomerism.
- **B** The products from step **1** contain three sp² hybridised carbon atoms.
- **C** The product from step **2** can undergo nucleophilic substitution with compound **L**.
- **D** One mole of the product from step **3** reacts completely with one mole of Na_2CO_3 .

29 Separate samples of propanone, propanal, and 2-fluoropropanal are reacted with alkaline sodium cyanide under the same conditions.

Which of the following statements is expected to be true?

- **A** All three compounds would lead to the formation of optically active products.
- **B** Propanal would react fastest due to the lack of bulky groups surrounding the carbonyl carbon atom.
- **C** Propanone would react fastest due to the two methyl groups that donate electrons.
- **D** The K_c of the overall reaction would be the largest for 2-fluoropropanal.
- **30** Collagen is a protein responsible for keeping skin taut and youthful. Partial hydrolysis of collagen produces polypeptide **P**.

Enzyme **A** digests protein or polypeptides at the carboxylic acid end of the amino-acid valine, val. The following peptides were identified after digestion of the polypeptide P with enzyme **A**, and subsequent separation.

asp-ser-gly-val ser-phe-cys phe-val

Another enzyme **B** digests at the carboxylic acid end of serine, ser. The following peptides were identified after digestion of the same polypeptide **P** with enzyme **B**, and subsequent separation.

gly-val-ser phe-cys phe-val-asp-ser

Which of the following is the correct primary structure of polypeptide **P**?

- A asp-ser-gly-val-ser-phe-cys-phe-val
- **B** ser-phe-cys-phe-val-asp-ser-gly-val
- **C** phe-val-asp-ser-gly-val-ser-phe-cys
- **D** gly-val-ser-phe-cys-phe-val-asp-ser

For questions 31 to 40, 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	1 and 2 only are	2 and 3 only are	1 only is correct
correct	correct	correct	

31 In an experiment, two moles of methylamine was added to one mole of gaseous beryllium fluoride in a container of fixed volume at a constant temperature.

Which of the following statements are correct?

- 1 The bond angle around each central atom in the product is 109°.
- 2 The sign for the standard enthalpy change of reaction is negative.
- **3** There is an increase in the final pressure of the system after the methylamine had reacted completely with the beryllium fluoride.
- **32** The diagram below shows the diagram of a typical hydrogen-oxygen fuel cell.

Which of the following statements are correct about the hydrogen-oxygen fuel cell shown below?



- 1 The cell emf value is +1.23 V.
- 2 The negative electrode is the anode.

- **3** Changing the electrolyte to aqueous ethanoic acid has no effect on the value of the cell emf.
- **33** The diagram shows the ionisation of an acid, $HX(aq) \rightarrow H^+(aq) + X^-(aq)$, where **X** is a halogen.



Which of the following properties would change when comparing different acids?

- 1 enthalpy change of dissociation
- 2 enthalpy change of dehydration
- 3 ionisation energy

34 The equilibrium reaction involving SO_2 , Cl_2 and SO_2Cl_2 can be represented by the following exothermic reaction:

 $SO_2(g) + Cl_2(g) \implies SO_2Cl_2(g)$

Below is the graphical representation of the chemical system.

Which of the following statements are correct about the system at time = 9 minutes?

Partial Pressure / atm



- 1 The K_p value is 8.33.
- **2** Adding a catalyst to the mixture will result in an increase in the partial pressure of SO_2Cl_2 .

- **3** Placing the mixture on an ice-bath would result in a decrease in the magnitude of K_p .
- **35** The enzyme 'potato phosphorylase' catalyses the reaction

glucose-1-phosphate + amylose_n \rightarrow phosphate + amylose_{n+1}

The rate of reaction can be followed by determining the phosphate ion concentration by the use of a coloured reagent and a colorimeter. The initial rate of the reaction was measured at different concentrations of glucose-1-phosphate, symbolised as [substrate].



The steps involved in the catalysis reactions are:

enzyme + substrate	enzyme-substrate complex	(fast)
enzyme-substrate complex		(slow)

Which of the following statements are correct?

- 1 When [substrate] is low, the reaction is first order with respect to the substrate.
- 2 The rate equation is given as : Rate = k [enzyme-substrate complex].
- **3** When [substrate] is at its maximum, the reaction is mixed order with respect to the substrate.

36 A Chemistry student was involved in a laboratory project involving the investigation of the colour chemistry of various nickel complexes. In an experiment, the student first added potassium cyanide to a sample of nickel(II) sulphate solution. She then added dilute aqueous ammonia to the solution formed.

Formula of complex	colour	K _c value
[Ni(H ₂ O) ₆] ²⁺	green	7 x 10 ²
[Ni(NH ₃) ₆] ²⁺	blue	4 x 10 ⁸
[Ni(CN) ₄] ²⁻	yellow	2 x 10 ¹⁸

Which of the following statements are correct?

- 1 The strongest field ligand amongst the three is the cyanide ion.
- 2 The final colour of the solution is blue.
- **3** The small difference in energies between the 3d and 4s electrons allow Ni to exist in different oxidation states as shown in the complexes in the above table.
- **37** The following reaction profile is for the reaction between $(CH_3)_3CBr$ and hot aqueous NaOH.



Reaction pathway

Which of the following statements are correct?

- 1 Between **X** and **Y** the C-Br bond will be lengthening.
- **2 Y** is an electrophile.

3 The rate equation for the reaction is: rate = $k[(CH_3)_3CBr][OH^-]$

38 Compounds **J** and **K** are both reacted with hot aqueous NaOH followed by dilute HC*l* at room temperature.



Which reagents could be used to distinguish the final products of J and K?

- **1** Fehling's solution
- 2 Iodine in aqueous NaOH
- **3** 2,4-dinitrophenylhydrazine
- **39** *Tamiflu* is the anti-influenza drug currently being used to treat avian flu. Its structure is shown below.



Which of the following statements about Tamiflu are correct?

- 1 It reacts with steam under suitable conditions to give a product with 4 chiral centres.
- 2 It reacts with hot aqueous alkaline iodine to give a yellow precipitate.
- **3** One mole of *Tamiflu* reacts completely with one mole of aqueous sulphuric acid at room temperature and pressure.

40 Zanamivir is a drug used in the treatment of flu virus.



Which of the following statements about *Zanamivir* are **incorrect**?

- 1 One mole of *Zanamivir* reacts with excess potassium metal to give 4 moles of H₂.
- 2 It reacts with 2,4-DNPH to give an orange precipitate.
- 3 Its solubility will be increased in both dilute H_2SO_4 and dilute KOH.

END OF PAPER