

SEMESTER ONE EXAMINATION 2005

QUESTION/ANSWER BOOKLET

CHEMISTRY

NAME: _____

CLASS: _____

TIME ALLOWED FOR THIS PAPER

Reading time before commencing work: Ten minutes
Working time for paper: Two hours

MATERIAL REQUIRED/RECOMMENDED FOR THIS PAPER

TO BE PROVIDED BY THE SUPERVISOR

This Question/Answer Booklet
Separate Multiple Choice Answer Sheet
Chemistry Data Sheet

TO BE PROVIDED BY THE CANDIDATE

Standard Items: Pens, pencils, eraser or correction fluid, ruler

Special Items: Calculators satisfying the conditions set by the Curriculum Council
and a 2B,B or HB pencil for the Separate Multiple Choice Answer Sheet.

IMPORTANT NOTE TO CANDIDATES

No other items may be taken into the examination room.

It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you hand it to the supervisor **BEFORE** reading any further.

STRUCTURE OF PAPER

Part	Format	No of Questions Set	No of Questions to be attempted	Recommended Time (Minutes)	Marks Allocated
1	Multiple Choice	20	ALL	35	30 (30%)
2	Short Answers	6	ALL	40	30 (30%)
3	Calculations	3	ALL	30	30 (30%)
4	Extended Answers	1	1	15	10 (100%)
Total marks					100 (100%)

INSTRUCTIONS TO CANDIDATES

- The rules for the conduct of the Tuart College Semester Examinations are the same as those for the conduct of the Tertiary Entrance Examinations and are detailed in the booklet *TEE Handbook*. Sitting this examination implies that you agree to abide by these rules.
- Answer the questions according to the following instructions:

Part 1

Answer all questions, using a 2B, B or HB pencil, on the separate Multiple Choice Answer Sheet. Do **not** use a ballpoint or ink pen.

If you consider that two or more of the alternative responses are correct, choose the one you think is best. If you think you know an answer, mark it even if you are not certain you are correct. Marks will **not** be deducted for incorrect answers.

Feel free to write or do working on the question paper; many students who score high marks in the Multiple Choice Section do this.

Part 2, 3 and 4

Write your answers in the spaces provided in this Question/Answer Booklet. A blue or black ball point or ink pen should be used. Questions containing specific instructions to show working should be answered with a complete, logical, clear sequence of reasoning showing how the final answer was arrived at. Correct answers which do not show working will not be awarded full marks.

- The examiners recommend that you spend your reading time mainly reading the instructions to candidates and Parts 2, 3 and 4.
- CHEMICAL EQUATIONS**

For full marks, chemical equations should refer only to those species consumed in the reaction and new species produced. These species may be **ions** [for example $\text{Ag}^+(\text{aq})$],

molecules [for example $\text{NH}_3(\text{g})$, $\text{NH}_3(\text{aq})$, $\text{CH}_3\text{COOH}(\ell)$, $\text{CH}_3\text{COOH}(\text{aq})$] or **solids** [for example $\text{BaSO}_4(\text{s})$, $\text{Cu}(\text{s})$, $\text{Na}_2\text{CO}_3(\text{s})$].

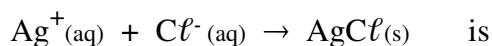
PART 1 (30 marks = 30% of paper)

Answer ALL questions in Part 1 on the Separate Multiple Choice Answer Sheet provided, using a 2B, B, or HB pencil. Each question in this part is worth 1½ marks.

1. In which one of the following solids would you expect hydrogen bonding to play a significant role in determining the melting temperature?
 - (a) $\text{H}_2(\text{s})$
 - (b) $\text{C}_2\text{H}_6(\text{s})$
 - (c) $(\text{NH}_2)_2\text{CO}(\text{s})$
 - (d) $\text{CH}_3\text{Br}(\text{s})$
2. Which one of the following is a linear molecule?
 - (a) H_2O
 - (b) H_2S
 - (c) C_2H_2
 - (d) SO_2
3. A 0.100 mol L⁻¹ solution of $\text{Na}_2\text{CO}_3(\text{aq})$ is prepared. Which one of the following aqueous solutions (each 0.100 mol L⁻¹) would cause the formation of precipitate if it was added to the $\text{Na}_2\text{CO}_3(\text{aq})$?
 - (a) hydrochloric acid
 - (b) calcium chloride
 - (c) sodium hydroxide
 - (d) sodium hydrogencarbonate
4. A catalyst is used in the industrial production of SO_3 from SO_2 . The **best** description of the effect of the catalyst is that it
 - (a) increases the proportion of SO_3 in the mixture at equilibrium.
 - (b) increases the rate of production of SO_2 .
 - (c) increases both rate of production of SO_2 and the rate of production of SO_3 .
 - (d) decreases the rate of production of SO_3 .
5. The smelting of chalcopyrite CuFeS_2 is represented by the following equation
$$2\text{CuFeS}_2(\text{s}) + 5\text{O}_2(\text{g}) \rightarrow 2\text{Cu}(\text{s}) + 2\text{FeO}(\text{s}) + 4\text{SO}_2(\text{g})$$
If 25.0 kg of chalcopyrite reacts, what mass of copper is formed?
 - (a) 4.33 kg
 - (b) 8.66 kg
 - (c) 119 kg

(d) 17.3 kg

6. A mixture is prepared by mixing 100.0 mL portions of solutions of $0.010 \text{ mol L}^{-1} \text{NaCl}$, $0.010 \text{ mol L}^{-1} \text{CaCl}_2$, and $0.010 \text{ mol L}^{-1} \text{AlCl}_3$. The volume of $0.020 \text{ mol L}^{-1} \text{AgNO}_3$ required to precipitate all of the chloride ions in the mixture, according to the equation



- (a) $1.5 \times 10^2 \text{ mL}$
(b) $2.0 \times 10^2 \text{ mL}$
(c) $3.0 \times 10^2 \text{ mL}$
(d) $6.0 \times 10^2 \text{ mL}$
7. Which one of the following properties is characteristic of elements whose atoms have incompletely filled d-subshells?
- (a) They have only one valency.
(b) Their salts are usually coloured.
(c) They have low electrical conductivity.
(d) They are covalent network solids.
8. The numbers of neutrons (n), protons (p^+) and electrons (\bar{e}) in $^{33}_{16}\text{S}^{2-}$ are:
- (a) $n = 33, p^+ = 16, \bar{e} = 18$
(b) $n = 17, p^+ = 16, \bar{e} = 16$
(c) $n = 17, p^+ = 16, \bar{e} = 18$
(d) $n = 16, p^+ = 17, \bar{e} = 14$

QUESTIONS 9 AND 10 REFER TO THE FOLLOWING

An important reaction in the production of nickel is as follows

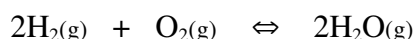


9. Which of the following sets of conditions will bring about the **highest yield** of nickel at equilibrium?
- (a) High concentration of hydrogen and low concentration of ammonia.
(b) High concentration of hydrogen and high concentration of ammonia.
(c) Low concentration of hydrogen and low concentration of ammonia
(d) Low concentration of hydrogen and high concentration of ammonia

10. Which of the following conditions will bring about the **fastest rate** of formation of nickel?
- (a) High concentration of hydrogen
 - (b) Low concentration of hydrogen
 - (c) High concentration of ammonia
 - (d) Low concentration of ammonia

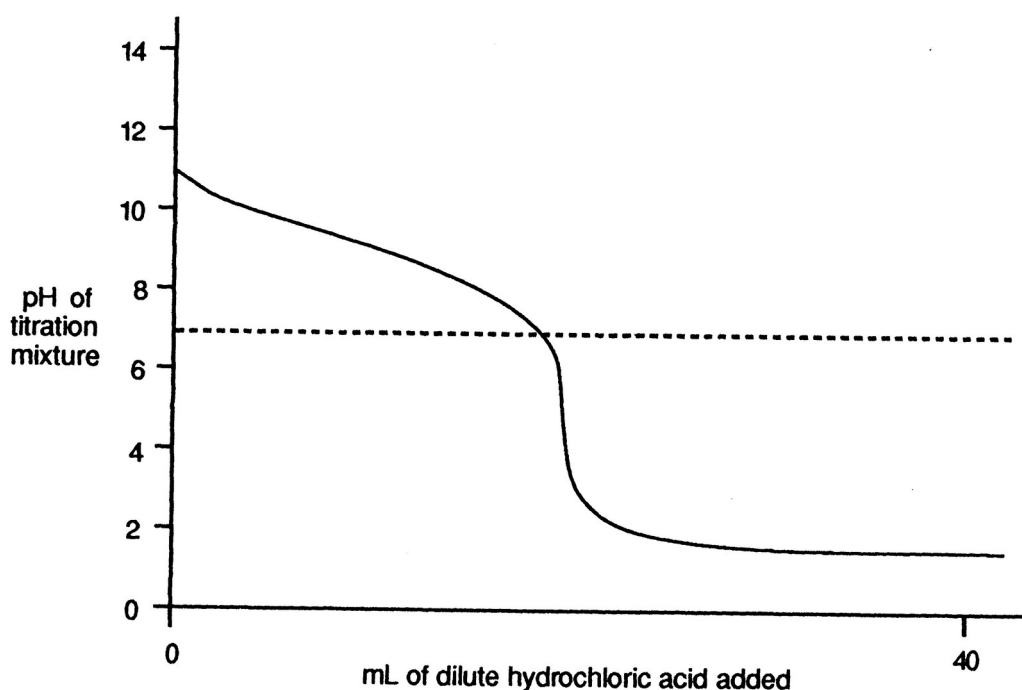
11. As ammonium chloride dissolves in water the temperature of the solution decreases. Which one of the following statements about the reaction is correct?
- (a) ΔH for $\text{NH}_4\text{Cl}_{(\text{s})} \rightarrow \text{NH}_4^{+}(\text{aq}) + \text{Cl}^{-}(\text{aq})$ is positive.
 - (b) When the NH_4Cl dissolves, the NH_4^{+} reacts to a small extent with water to give a basic solution.
 - (c) When the NH_4Cl dissolves, the conductivity of the solution decreases.
 - (d) Less energy is needed to separate the ions from each other than is released when water molecules surround the ions.

12. Which expression gives the equilibrium constant, K , for the following reaction.?



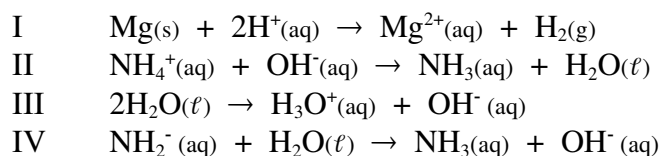
- (a) $K = \frac{[\text{H}_2\text{O}]^2}{[\text{H}_2]^2[\text{O}_2]}$
 - (b) $K = \frac{1}{[\text{H}_2]^2[\text{O}_2]}$
 - (c) $K = [\text{H}_2]^2[\text{O}_2]$
 - (d) $K = \frac{[2\text{H}_2\text{O}]}{[2\text{H}_2][\text{O}_2]}$
13. Solid sodium hydroxide would not be a suitable primary standard for the standardisation of an acid because it
- (a) has too low a formula mass.
 - (b) catches fire readily in air.
 - (c) is insoluble in water.
 - (d) absorbs water readily from the air.
14. Which of the following oxides forms the strongest acid when dissolved in water?
- (a) CO_2
 - (b) NO
 - (c) P_2O_5
 - (d) Na_2O

15. Which one of the following aqueous solutions has a pH greater than 7?
- (a) 0.1 mol L⁻¹ ammonium iodide
 - (b) 0.1 mol L⁻¹ magnesium nitrate
 - (c) 0.1 mol L⁻¹ potassium ethanoate
 - (d) 0.1 mol L⁻¹ sodium bromide
16. A dilute solution of ammonia (in the conical flask) is titrated with dilute hydrochloric acid (from the burette), and the following graph is obtained.



If bromothymol blue, which changes colour around pH7, is used as indicator, which one of the following statements is **true**?

- (a) The end-point occurs before the equivalence-point.
 - (b) The end-point occurs at the equivalence-point.
 - (c) The end-point occurs after the equivalence-point.
 - (d) There is no equivalence-point because it is the wrong indicator.
17. Which of the following are Bronsted-Lowry acid-base reactions?



- (a) I only
- (b) I and III only
- (c) II, III and IV only
- (d) II and IV only

18. What volume of pure water must be **added** to 10.0 mL of 0.100 mol L⁻¹ HCl solution to change the pH to 3.0?
- (a) 3.00×10^1 mL
 - (b) 9.90×10^2 mL
 - (c) 1.00×10^3 mL
 - (d) 9.99×10^2 mL
19. A certain neutral atom has the electronic configuration $1s^2 2s^2 2p^6 3s^2$. The electronic configuration of the next atom in the same group in the periodic table would be
- (a) $1s^2 2s^2 2p^6 3s^2 3p^1$
 - (b) $1s^2 2s^2 2p^6 3s^2 3p^2$
 - (c) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
 - (d) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
20. 0.200 g of gas X occupies a volume of 70.0 mL at S.T.P. Which of the following substances could gas X be?
- (a) O₂
 - (b) SO₂
 - (c) NO
 - (d) C₄H₁₀

END OF PART 1

PART 2 (30 marks = 30% of paper)

Answer ALL questions in Part 2 in the spaces provided below.

1. Write equations for any reactions that occur in the following procedures.

In each case describe **in full** what you would observe, including any

- colour change
- odour
- precipitates (give the colour)
- gases evolved (give the colour or describe as colourless).

If reaction occurs but the change is not observable, you should state this.

- (a) Dilute sulphuric acid is added to barium chloride solution.

Equation: _____

Observation: _____

- (b) Solid aluminium hydroxide is mixed with sodium hydroxide solution.

Equation: _____

Observation: _____

- (c) A small piece of caesium is added to a beaker of water.

Equation: _____

Observation: _____

- (d) A freshly cleaned piece of copper is added to dilute hydrochloric acid

Equation: _____

Observation: _____

[8 marks]

2. For each molecule or ion listed in the table below

(i) Draw the structural formula, representing all valence shell electron pairs as " $\cdot\cdot$ "

for example, water $\text{H}:\ddot{\text{O}}:\text{H}$

(ii) Sketch and name the shape of each molecule or ion.

Molecule or ion	Structure formula (showing all valence electrons)	Sketch of shape	Name of shape
carbonate ion			
arsenic trihydride			
selenium dihydride			

[6 marks]

3. Calculate the concentration of hydroxide ions in a calcium hydroxide, $\text{Ca}(\text{OH})_2$, solution of $\text{pH} = 10.5$.

[2 marks]

4. Explain the following

	Explanation
Calcium carbonate chips react slower than calcium carbonate powder, when added to dilute acid.	
Nitrogen reacts faster with oxygen when a high temperature is used.	
Hydrogen peroxide decomposes faster when a suitable catalyst is used.	

[6 marks]

5. Identify by name or formula an example of each of the following.

- (a) a positively charged complex ion _____
- (b) a triprotic acid _____
- (c) a network compound _____
- (d) a halogen which is solid at room temperature _____

[4 marks]

6. For each of the following pairs of compounds, describe a **chemical** test to distinguish between them. Give all steps, but equations are not required.

	Your chemical test. Describe fully	What you would observe in each case
solid zinc sulfate and solid zinc nitrate		with ZnSO_4
		with $\text{Zn(NO}_3)_2$
solid copper (II) carbonate and solid copper (II) chloride		with CuCO_3
		with CuCl_2

[4 marks]

END OF PART 2

Answer ALL questions in Part 3. The calculations are to be set out in detail in this Question/Answer Booklet. Marks will be allocated for correct equations and clear setting out, even if you cannot complete the problem. When questions are divided into sections, clearly distinguish each section using (a), (b) and so on. Correct final numerical answers to three (3) significant figures where appropriate, and provide units where applicable. Information which may be necessary for solving the problems is located on the separate Chemistry Data Sheet. Show clear reasoning: if you don't, you will lose marks.

- [2 marks]

[illegible]

[illegible]

- [1 mark]

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[illegible]

- 1.0308 g of the acid is dissolved in water in a 250 mL volumetric flask and the volume made up to the mark. 20.00 mL portions of this solution are titrated with 0.1031 mol L⁻¹ sodium hydroxide in the burette using phenolphthalein as indicator. The following titration figures were recorded.

	Trial				
	Rough	1 st	2 nd	3 rd	4 th
Final reading (mL)	9.96	17.00	23.32	29.50	35.70
Initial reading (mL)	0.07	9.96	17.10	23.32	29.50

- (a) Calculate the appropriate value for the volume of the average titre of sodium hydroxide solution used. [2 marks]
- (b) From the titration results determine the number of moles of the acid in the original 1.0308 g sample and calculate its molecular weight (relative molecular mass). [7 marks]
- (c) Suggest one way in which the experiment could be modified to involve less experimental error, so that a more accurate value for the molecular weight might be obtained. [2 marks]

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[illegible]

END OF PART 3

Answer the following extended answer question in blue or black ball point or ink pen. Where applicable use equations, diagrams and illustrative examples of the chemistry you are describing.

Begin your answer on the lined page following the end of the question.

- Using specific examples from the periodic table (up to element 36) show how the rows and columns are related to the principal energy levels, sub levels and orbitals of the current atomic model.

(b) Explain how these relationships help us to understand the similarities in chemical reactions for elements in the same group.

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This image shows a full page of blank, lined paper. It features approximately 20 evenly spaced horizontal grey lines across its entire width, providing a template for handwriting practice or general note-taking. The margins are consistent on all sides.

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END OF PAPER



CHEMISTRY

SEMESTER ONE EXAMINATION 2005

NAME: _____

CLASS: _____

PART 1: MULTIPLE CHOICE ANSWER SHEET

- | | | | | |
|-----|-----|-----|-----|-----|
| 1. | (a) | (b) | (c) | (d) |
| 2. | (a) | (b) | (c) | (d) |
| 3. | (a) | (b) | (c) | (d) |
| 4. | (a) | (b) | (c) | (d) |
| 5. | (a) | (b) | (c) | (d) |
| 6. | (a) | (b) | (c) | (d) |
| 7. | (a) | (b) | (c) | (d) |
| 8. | (a) | (b) | (c) | (d) |
| 9. | (a) | (b) | (c) | (d) |
| 10. | (a) | (b) | (c) | (d) |
| 11. | (a) | (b) | (c) | (d) |
| 12. | (a) | (b) | (c) | (d) |
| 13. | (a) | (b) | (c) | (d) |
| 14. | (a) | (b) | (c) | (d) |
| 15. | (a) | (b) | (c) | (d) |
| 16. | (a) | (b) | (c) | (d) |
| 17. | (a) | (b) | (c) | (d) |
| 18. | (a) | (b) | (c) | (d) |
| 19. | (a) | (b) | (c) | (d) |
| 20. | (a) | (b) | (c) | (d) |