Section I
Total Marks (75)

Part A
Total marks (15)
Attempt Questions 1-15
Allow about 30 minutes for this part

INSTRUCTIONS
Use the multiple choice answer sheet on page 6.
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

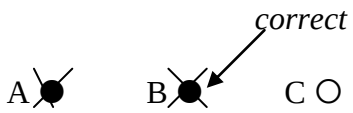
Sample 2+4= (A) 2 (B) 6 (C) 8 (D)9

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ● C ○ D ○

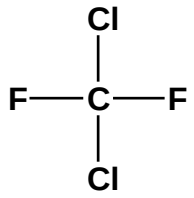
If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:



1. Which of these substances is detectable using AAS*?*

(A) Scandium
(B) Sulfate
(C) Sulfur
(D) Sulfur dioxide

2.



Which is the correct systematic name for the above structure*?*

(A) dichlorofluoromethane
(B) dichlorodifluoromethane
(C) 1,1–difluoro–1,1–dichloromethane
(D) 2,4–dichloro–1,3–difluoromethane

3. Fritz Haber and many other chemists worldwide were actively working to solve the problem of making ammonia by direct synthesis. What was the reason for this great interest ammonia*?*

(A) Ammonia was unsurpassed as a coolant in refrigerators.
(B) Ammonia was essential for making high explosives for World War II.
(C) Ammonia was a very effective cleaning agent, but too expensive for household use.
(D) Ammonia was a possible solution to a projected global problem of soil infertility.

4. Which metal ion cannot be identified by a flame test*?*

(A) $Ba^{2+}_{(aq)}$
(B) $Ca^{2+}_{(aq)}$
(C) $Cu^{2+}_{(aq)}$
(D) $Pb^{2+}_{(aq)}$

5. A fruit cannery factory discharges untreated wastes, consisting largely of rinse water and fruit pulp, into a nearby stream. What effect will this have on the water*?*

(A) The level of dissolved oxygen will increase.
(B) Turbidity would decrease.
(C) The biochemical oxygen demand will increase.
(D) The hardness of the water will increase.

6. Which oxide does not produce an acid in water?

(A) N_2O
(B) NO_2
(C) SO_2
(D) SO_3

7. A certain solution has ten times the hydrogen ion concentration of a solution of pH = 8. What is the pH of the more acidic solution?

(A) 0.8
(B) 4
(C) 7
(D) 9

8. 10 mL of a 0.1 mol L^{-1} hydrochloric acid solution is added to 20 mL of a 0.1 mol L^{-1} nitric acid solution. What is the pH of the mixture?

(A) 1
(B) 0.5
(C) -0.5
(D) 2

9. What volume of carbon dioxide (measured at 25 ^{0}C & 100kPa) is formed from the reaction of 25.0 g calcium carbonate with excess hydrochloric acid?

(A) 24.79 L
(B) 3.1 L
(C) 12.4L
(D) 6.2 L

10. When carbon dioxide is dissolved in water the following equilibrium occurs:

$CO_2(g) + H_2O(l) \rightleftharpoons H_2CO_3(aq)$

The process is exothermic. What happens to the solubility of carbon dioxide if the solution is heated?

(A) increases
(B) decreases
(C) remains constant, solubility is only affected by pH
(D) increases then decreases slightly.

11. How is ethylene produced industrially?

(A) extracted from crude oil
(B) fractional distillation of crude oil
(C) cracking of the low molecular weight fraction of crude oil
(D) fermentation of glucose

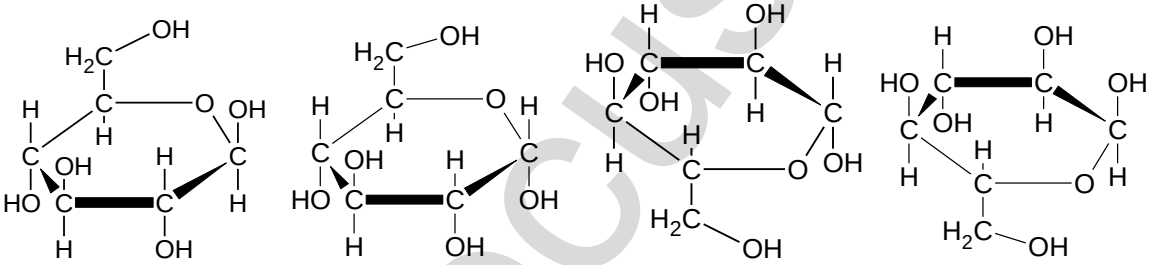
12. Low density polyethylene is produced using an organic peroxide initiator.
Given below is a randomly numbered list of the steps involved in its production:

1. Monomer radicals react with doubly bonded carbon atom of another molecule
2. Free radical organic peroxide initiator react with the doubly bonded carbon atom in a monomer
3. Organic peroxide splits to form free radical
4. Activated monomer radicals form
5. Chain growth stops if free radicals combine together
6. Chain builds and lengthen

Choose the correct sequence from among the choices given below

(A) 2 → 3 → 4 → 1 → 5 → 6
(B) 3 → 2 → 4 → 1 → 6 → 5
(C) 4 → 3 → 1 → 2 → 6 → 5
(D) 3 → 1→ 2 → 4 → 5 → 6

13. Cellulose is a natural biopolymer composed of glucose monomers. Which glucose structures in the diagram are required to form a strand of cellulose with six glucose units:



Structure 1 **Structure 2** **Structure 3** **Structure 4**

(A) 1, 4, 1, 4, 1, 4
(B) 2, 3, 2, 3, 2, 3
(C) 1, 3, 1, 3, 1, 3
(D) 2, 4, 2, 4, 2, 4

14. The molar heat of combustion of ethanol is 1364 kJ mol^{-1}. How much water at 20 ^{0}C can be heated to 90 ^{0}C if 20.0 g of ethanol is completely combusted to carbon dioxide and water?

(A) 2.02 g
(B) 2.02 kg
(C) 20.2 g
(D) 20.2 kg

15. A student undertook a first hand investigation to determine the reactivity of cyclohexene
Which test reagents and results are appropriate for this experiment?

Conditions	**A**	**B**	**C**	**D**
Reagent used	bromine water	chlorine gas	bromine water	ethanol
To increase validity	protect from light	control the temperature	repeat the experiment	repeat the experiment
Result observed	decolourised	odourless gas released	purple solution formed	sweet smelling gas released

Student No. …….

Section A **Mark -----/15**

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 ○

Section I (continued)

Part B - 60 marks
Attempt Questions 16 -27
Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided
Show all relevant working in questions involving calculations

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Question 16 (6 marks) **MARKS**

The aim of a Prac Test was the identification of four unknown solutions using four test solutions. A student records these test results (R = reaction; NR = no reaction) …

		Unknown Solutions			
		W	**X**	**Y**	**Z**
Test Solutions	**HNO_3**	NR	NR	NR	R
	H_2SO_4	R	R	NR	R*
	$Ba(NO_3)_2$	NR	NR	R*	NR
	$AgNO_3$	R	R*	NR	NR

The student was told that the unknowns were potassium sulfate, barium chloride, sodium carbonate and calcium chloride.

(a) Identify the compounds which match–up with unknowns W, X, Y and Z. **3**

W =

X =

Y=

Z=

(b) Write balanced chemical equations for the three asterisked reactions (R*) in the table above. **3**

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Question 17 (5 marks)

The *National Australian Standard* for sulfur in petrol is 500 ppm maximum.

(a) Calculate the mass of sulfur in one litre of petrol weighing 714 grams. (Assume 500 ppm sulfur) **1**

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(b) Calculate the volume of sulfur dioxide produced by the complete combustion of one litre of petrol at 100 kPa and 25°C. **2**

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(c) Write a balanced chemical equation showing sulfur dioxide producing acid rain and name the acid formed. **2**

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Question 18 **(**8 marks) **MARKS**

A Year 9 student does a research project testing the BOD of a polluted stream near his home. He writes this entry in his science journal…

I got a bucketful of stream water and carried it home. It looked a bit murky so I decided to filter it through a plastic funnel using paper towel for filter paper. It worked well and cleared up the water.

I measured out exactly one litre of stream water and poured it into a 2 litre beaker. I then measured the dissolved oxygen using a borrowed oxygen–sensitive electrode and recorded the reading. I then placed the beaker on a shelf underneath the awning on the back veranda.

A week later I measured the dissolved oxygen again and recorded the reading.

(a) The procedural errors made by the student will greatly affect the validity of the BOD result. Identify two errors made and provide the correct procedures he should have followed. **2**

Student's Error	**Correct Procedure**

(b) The student suspects that the polluted stream is subject to eutrophication. Identify two (2) chemical species which he could test for as proof of eutrophication. **2**

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Question 18 continues next page

MARKS

(c) The student decides to test the stream water for total dissolved solids without using a TDS meter. Describe a simple test procedure he should follow and the data he should collect and record **2**

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(d) High tech microscopic membrane filters are a means of cleaning up some polluted water.

(i) Identify the composition of the membranes, i.e. what are they made of? **1**

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(ii) Membrane filters can capture germs but not heavy metal ions. Describe the physical basis of how these filters work. **1**

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Question 19 (3 marks)

In a titration to find the concentration of sulfuric acid solution, 28.6 mL of 0.176 mol L^{-1} sodium hydroxide solution was required to neutralise 25.0 mL of sulfuric acid solution. Calculate the concentration of the sulfuric acid solution in mol L^{-1}. **3**

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MARKS

Student Number ……

Question 20 (3 marks)

(a) Describe using a balanced chemical equation the formation of an ester from the reaction of C_3H_7COOH (*l*) with C_2H_5OH *(l)* **2**

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(b) Name the ester. **1**

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Question 21 (4 marks)

Identify examples of naturally occurring acid and base.. In the table below record their names and their chemical formulae. **4**

ACID	**Chemical Formula**
.	
BASE	**Chemical Formula**

Question 22 (3 marks)

Some commercial baking powders use sodium pyrophosphate ($Na_2H_2P_2O_7$) and sodium hydrogen carbonate ($NaHCO_3$) to make cakes rise when baked.

The reaction that occurs can be described by the following equation (states excluded)

$$NaHCO_3 + Na_2H_2P_2O_7 \longrightarrow Na_3HP_2O_7 + H_2O + CO_2$$

(a) Write the net ionic equation for this reaction, including states. **1**

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(b) From this net ionic equation, write the formula for a species behaving as a Bronsted-Lowry acid. **1**

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(c)What is the conjugate base of the acid species identified in (b)? **1**

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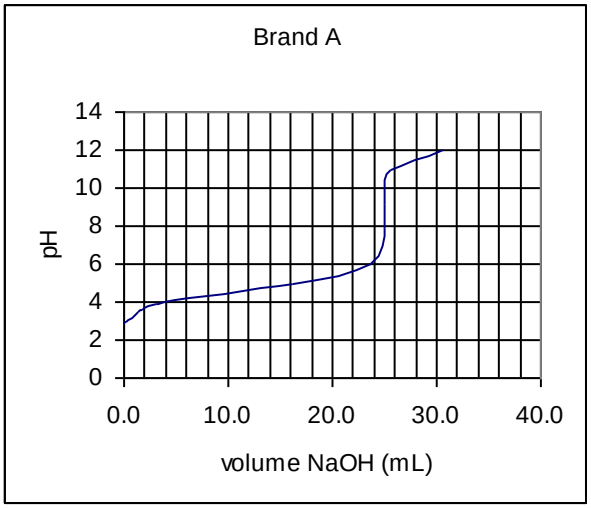
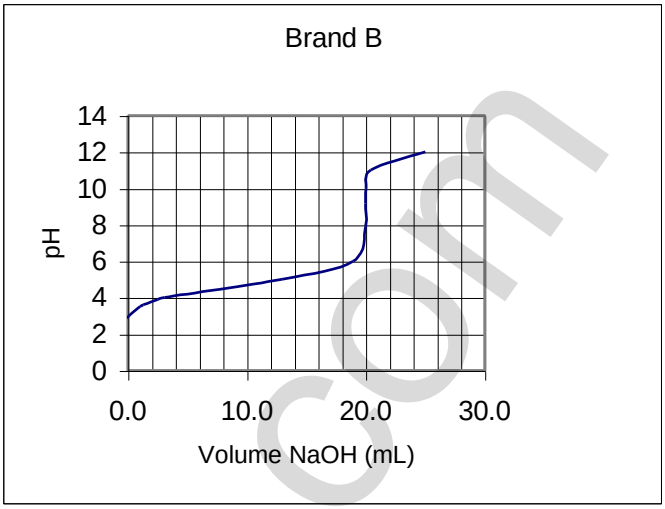
Question 23 (7 marks)

An investigation to determine the concentration of acetic acid in two brands of domestic vinegar was carried out. Standard sodium hydroxide solution was used to titrate equal volumes of Brand A and Brand B. The results of these titrations are shown below.





(a) Explain the procedure that can generate these titration curves. **3**

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(b) Identify the solution used to rinse the pipette before its final use. **1**

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(c) Which brand (A or B) had the higher concentration of acetic acid? Give a reason. **1**

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(d) Is the salt produced by this neutralisation reaction acidic, basic or neutral? Write a net ionic equation to support your answer. **2**

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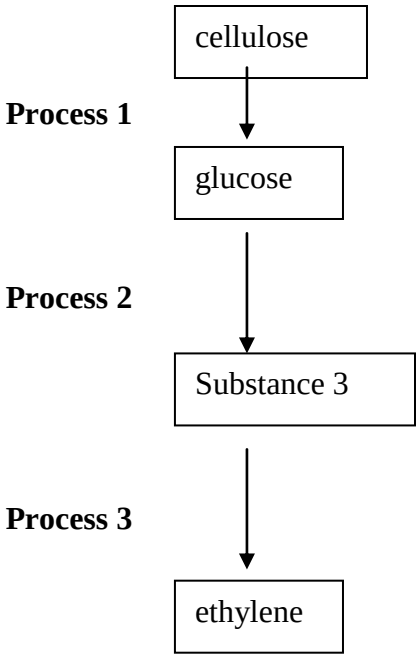
Question 24 (5 marks)

(a) Examine the following flowchart showing the conversion of cellulose to ethylene.



(i) Name substance 3……. **1**

(ii) Write a balanced equation for **Process 2**

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(iii) Write a balanced equation , including the catalyst for **Process 3**

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(b) Discuss the potential of cellulose as a raw material for building petrochemicals in terms of its structure and in terms of the energy requirement of a possible process given in (a) above **2**

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MARKS

Question 25 (2 marks)

Write the details on the property and use of the polymer poly(vinyl chloride) **3**

Common monomer name	**vinyl chloride**
Polymer name (systematic)	
Polymer property	
Polymer use related to property	

Question 26 (4 marks)

Compare a named transuranic element and a named commercial radioisotope in terms of their production **4**

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Student Number ……

MARKS

Question 27 (9 marks)

(a) Draw a simple, neat well-labelled diagram of a dry cell OR a lead-acid cell. In your diagram, you should indicate : **4**

(i) the direction of flow of electrons

(ii) the cathode, the anode and the electrolyte

(b) Evaluate the dry cell or the lead acid cell in comparison to ONE of the following:

- button cell
- fuel cell
- vanadium redox cell
- lithium cell
- liquid junction photovoltaic device

in terms of chemistry and environmental impact. **5**

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Section II

25 marks

Attempt Question 28
Allow about 45 minutes for this section.

Answer the question in a writing booklet provided
Show all relevant working in questions involving calculations

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Question 28 **MARKS**

(a) (i) Outline two uses of sulfuric acid in industry **2**

(ii) Describe, using examples and equations the reactions of sulfuric acid acting as: **4**

(1) an oxidising agent
(2) a dehydrating agent

(b) The dissociation of nitrosyl chloride into nitric oxide and chlorine takes place according to the equation:

$$2\ NOCl\ (g) \leftrightarrows 2\ NO\ (g) + Cl_2\ (g)$$

Varying amounts of the three gases were placed in a container and allowed to come to equilibrium at two different temperatures. The equilibrium concentrations of the three gases obtained are tabulated below.

Temperature, ^0C	Concentrations (mol L^{-1})		
	NOCl	NO	Cl_2
230	2.33×10^{-3}	1.46×10^{-3}	1.15×10^{-2}
465	3.68×10^{-4}	7.63×10^{-3}	2.14×10^{-4}

(i) Calculate the equilibrium constant K, for the reaction at 230^0 C . Show relevant working. **3**

(ii) The equilibrium constant at 465 ^{0}C is 9.20×10^{-2}. Does the different value for the equilibrium constant indicate that the reaction is endothermic or exothermic? Explain your answer. **2**

(iii) The energy change involved in the above reaction is + 38kJ per mole of nitrosyl chloride decomposed. Rewrite the equation for the dissociation of one mole of nitrosyl chloride and complete the description of the reaction by specifying ΔH (sign and magnitude) for the reaction you have written. **1**

Question 29 continues next page, Turn the page over.

MARK

(c) Describe two potential environmental issues associated with the extraction of sulfur from mineral deposits. **2**

(d) Describe the reactant conditions necessary for the production of SO_3 from SO_2. **3**

(e) Explain the difference between galvanic cells and electrolytic cells in terms of energy requirement. **2**

(f) (i) Write the full formulae equation for the production of sodium hydroxide from sodium chloride. **1**

(ii) The membrane process is one electrolytic method used to extract sodium hydroxide from sodium chloride. Describe the membrane process and explain, in terms of environmental considerations, why it is the industrially preferred method of extraction. **5**

END