Student No. .....

Barker College

2007
YEAR 12
EXAMINATION
TERM 1

Chemistry

ANSWER SHEET

Staff Involved:

- **RJP***
- **RZS**
- **JFH**

AM MONDAY 26 MARCH

95 copies

Section I – Multiple Choice

Choose the best response and fill in the response oval completely

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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

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General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using blue or black pen
- Board-approved calculators may be used
- Draw diagrams using pencil
- A Data Sheet and Periodic Table are provided at the back of this paper
- Write your Barker Student Number at the top of the Answer Sheet and Cover Sheet and ALL pages in Section II

Total marks (80)

Section I Pages – 2 5

15 marks
- Indicate all answers on the Answer Sheet provided
- Allow about 25 minutes for this section

Section II Pages 6 – 18

65 marks
- Attempt ALL questions
- Indicate all answers in the spaces provided on the Answer Sheets
- Show all working for this section
- Allow about $1\frac{1}{2}$ hours this section

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Section I

15 marks

Allow about 25 minutes for this section

Attempt ALL questions

Use the multiple-choice answer sheet

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.

correct

(A) ~~●~~ (B) ~~●~~ (C) ○ (D) ○

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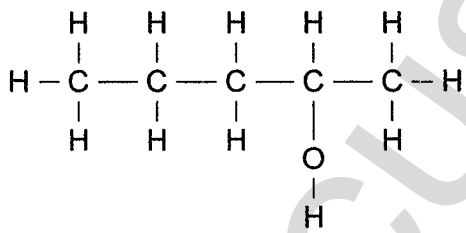
1. Which of the following processes is used to convert some fractions from the refining of petroleum into ethylene?

(A) polymerisation
(B) fermentation
(C) dehydration
(D) catalytic cracking

2. What is the term used to describe the conversion of ethanol into ethylene?

(A) condensation
(B) hydrogenation
(C) addition
(D) dehydration

3. What is the name of the compound represented below?



(A) 2-butanol
(B) 4-pentanol
(C) pentan-4-ol
(D) 2-pentanol

4. Polystyrene is an example of an addition polymer. What is the common name and the systematic name for the monomer from which this polymer is formed?

(A) common name: styrene, systematic name: phenylethene
(B) common name: phenylethene, systematic name: styrene
(C) common name: ethenyl benzene, systematic name: styrene
(D) common name: vinyl chloride, systematic name 2-dichloroethene

5. Which of the following is a monomer of cellulose?

(A) ethylene
(B) glucose
(C) starch
(D) galactose

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6. What is the oxidation state (number) of Mn in MnO_4^- ?

(A) +1

(B) +2

(C) -7

(D) +7

7. The reaction that goes in the direction shown is:

(A) $Mg^{2+}_{(aq)} + Fe_{(s)} \rightarrow Mg_{(s)} + Fe^{2+}_{(aq)}$

(B) $Zn_{(s)} + Pb^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Pb_{(s)}$

(C) $Pb_{(s)} + Fe^{2+}_{(aq)} \rightarrow Pb^{2+}_{(aq)} + Fe_{(s)}$

(D) $2Ag_{(s)} + Sn^{2+}_{(aq)} \rightarrow 2Ag^{+}_{(aq)} + Sn_{(s)}$

8. Iron-58 is bombarded with neutrons in a nuclear fission reactor. A single neutron is captured by the Fe-58 nucleus to form a new isotope of iron? This isotope then undergoes beta decay, producing a daughter nucleus. What is the identity of the daughter nucleus?

(A) ${}^{59}_{27}Co$

(B) ${}^{59}_{26}Fe$

(C) ${}^{57}_{26}Fe$

(D) ${}^{59}_{25}Fe$

9. Consider the following reaction (the forward reaction is exothermic):

$$CO_{2(g)} + H_2O_{(l)} \rightleftharpoons H_2CO_{3(aq)}$$

Which of the following changes to equilibrium conditions would favour the formation of bubbles of carbon dioxide?

(A) increasing the pressure

(B) increasing the temperature

(C) decreasing the temperature

(D) addition of water

10. What is the pH of orange juice closest to?

(A) 6.5

(B) 1.5

(C) 7.5

(D) 3.5

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11. A nitric acid solution had a pH of 2. 10mL of the solution was diluted to 100mL. What is the pH of the final solution closest to?

(A) 0.2

(B) 2.5

(C) 1.0

(D) 3.0

12. Which one of the following statements concerning equimolar (equal concentrations) solutions of a strong monoprotic acid (HA) and a weak monoprotic acid (HB) is **incorrect**?

(A) HA has a higher pH than HB.

(B) The concentration of A^- is greater than the concentration of B^-.

(C) The degree of ionization is greatest in HA.

(D) HA has a lower pH than HB.

13. Which of the following is the conjugate base of HSO_4^-?

(A) SO_4^{2-}

(B) H_2SO_4

(C) HSO_3^-

(D) H_2SO_3

14. Which of the substances below could be classified as an Arrhenius base?

(A) water

(B) potassium hydroxide

(C) sodium carbonate

(D) calcium oxide

15. Which of the following groups of carbon compounds is listed in order of increasing solubility in water?

(A) acetic acid, octanoic acid, ethanol, ethane

(B) ethane, octanoic acid, ethanol, acetic acid

(C) acetic acid, ethanol, octanoic acid, ethane

(D) ethane, ethanol, octanoic acid, acetic acid

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Section II
65 marks
Attempt ALL questions
Allow about $1\frac{1}{2}$ hours for this section

Use the spaces provided on the paper.

Marks

Question 16 (5 marks)

A student is given two test tubes during a practical lesson. He is told that one test tube contains cyclohexane while the other contains cyclohexene.

(a) What chemical should the student use to identify which test tube contains the cyclohexane and which test tube the cyclohexene? **1**

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(b) The student adds one mL of the reagent mentioned in (a) to each of the test tubes and shakes the tubes. Write down the immediate observations made by the student. **2**

Cyclohexane: .....

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Cyclohexene: .....

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(c) Draw structural formulae to show the reaction of cyclohexane with the reagent mentioned in (a) (assuming the reaction was allowed to take place exposed to light (uv) and left for some time). **2**

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Marks

Question 17 (5 marks)

Vinyl chloride has the condensed formula CH_2CHCl.

(a) What is the systematic name for this compound? **1**

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(b) Draw a diagram using structural formulae to show the formation of a section of poly (vinyl chloride). Show at least three monomer units. **2**

(c) Give ONE use for PVC, explaining the properties which make it suitable for this purpose. **2**

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Marks

Question 18 (5 marks)

An experiment was performed to determine the Heats of Combustion of two alkanols. The amount of fuel required to heat 200 mL of water by approximately 10 degrees was measured. The following results were obtained.

	1-butanol	**1-pentanol**
initial mass of burner (g)	25.25	28.42
final mass of burner (g)	24.96	28.24
initial temperature of water (°C)	22.5	22.0
final temperature of water (°C)	33.0	35.0

(a) Calculate the Molar Heat of Combustion for 1-butanol using the data given and your data sheet. (Density of water is 1.0 g mL^{-1}) **3**

(b) The theoretical value for the Molar Heat of Combustion for 1-butanol is 2677 kJ mol^{-1}. Discuss the reasons for any discrepancy from your result calculated in part (a). **2**

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Marks

Question 19 (5 marks)

Discuss the advantages and disadvantages of using ethanol as a fuel or fuel additive for motor cars and assess its potential as an alternative fuel. **5**

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Marks

Question 20 (6 marks)

(a) Write an equation for the fermentation of glucose $C_6H_{12}O_6$. **1**

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(b) Name TWO conditions under which fermentation is promoted. **1**

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(c) Identify a factor which causes the fermentation process to cease after a few days. **1**

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(d) Outline an investigation you carried out in the laboratory to monitor the process of fermentation of glucose. **3**

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Marks

Question 21 (6 marks)

In the laboratory you have conducted an experiment to measure the voltage of an electrochemical cell that you set up. One of the combinations you used was a lead electrode in a lead (II) nitrate solution connected to a zinc electrode in a zinc nitrate solution.

(a) Draw a neat, **labelled** diagram of the experimental setup showing the direction of electron flow in the external circuit as well as the movement of ions in the salt bridge. **3**

(b) oxidation half equation: .....

reduction half equation: **1**

(c) Calculate the EMF of the cell and comment on why the voltage you obtained in the lab when doing this experiment was lower than the theoretical EMF for the cell. **2**

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Marks

Question 22 (4 marks)

Describe, with examples, how commercial radioisotopes are produced. **4**

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Marks

Question 23 (11 marks)

Sulfur was burnt in a gas jar of oxygen. There was enough oxygen for all the sulfur to react. The product of this reaction was dissolved in water and tested with phenolpthalein. The indicator remained colourless.

(a) Is the solution acidic or basic? **1**

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(b) Write a balanced chemical equation for the reaction involving the burning of sulfur, including states. **1**

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(c) Identify ONE natural and ONE industrial source of sulfur dioxide.

Natural source: .....

Industrial source: **2**

Question 23 continues on page 14

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Question 23 (continued)

(d) Discuss reasons for concern about the release into the environment of oxides of sulfur and nitrogen. Include relevant equations. **5**

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Question 23 continues on page 15

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Student No. .....

Marks

Question 23 (continued)

(e) If 22.00 g of sulfur were burned, calculate the volume of gas produced at $0^{o}C$ and 100 kPa. **2**

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Question 24 (3 marks)

(a) Define Le Chatelier's Principle. **1**

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(b) Use Le Chatelier's Principle to explain what will happen to the following reaction at equilibrium when sodium hydroxide solution was added to the system.
State any colour changes. **2**

$$2CrO_4^{2-}(aq) + 2H^+(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + H_2O(l)$$

yellow **orange**

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Marks

Question 25 (5 marks)

Describe an experiment you have performed to measure the pH of a range of salt solutions. Mention the precautions you took to ensure the accuracy of your results.
For TWO of the salts used explain, using equations, why their pHs were not 7. **5**

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Marks

Question 26 (5 marks)

Show ALL working.

The equation for the reaction between potassium hydroxide and sulfuric acid is

$$2KOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow K_2SO_{4(aq)} + 2H_2O_{(l)}$$

A chemist carries out a titration to find the concentration of a sulfuric acid solution. In the titration, the acid is in the burette. These are the details of the titration:

- concentration of potassium hydroxide solution: 0.0671 mol L^{-1}
- volume of potassium hydroxide solution used in each titration: 20.0 mL
- average volume of sulfuric acid used to just react with the base: 27.5 mL

(a) Calculate the number of moles of KOH used in each titration. **1**

(b) Calculate the concentration of the sulfuric acid solution in mol L^{-1} **2**

(c) Outline TWO possible sources of error when carrying out a titration **2**

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Marks

Question 27 (5 marks)

Esters are fruity organic compounds made by reacting an alcohol (alkanol) with a carboxylic acid (alkanoic acid).

(a) Describe the purpose of using concentrated acid in esterification and name the acid used. **2**

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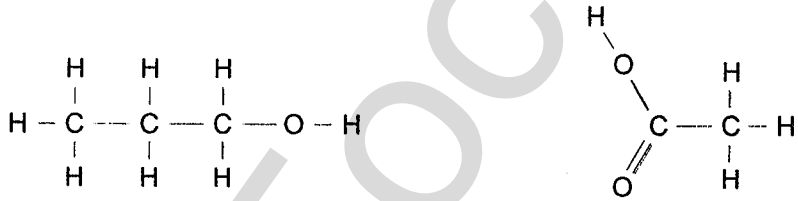
(b) Identify the IUPAC nomenclature for describing the ester produced from the following reactants i.e. name the ester produced when the reactants below are refluxed. **1**



Name of ester produced: .....

(c) Explain the need for refluxing during esterification. **2**

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End of Paper

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DATA SHEET

Avogadro constant, N_A ..... 6.022×10^{23} mol^{-1}

Volume of 1 mole ideal gas: at 100 kPa and

at 0°C (273.15 K) ..... 22.71 L

at 25°C (298.15 K) ..... 24.79 L

Ionisation constant for water at 25°C (298.15 K), K_w ..... 1.0×10^{-14}

Specific heat capacity of water ..... 4.18×10^3 J kg^{-1} K^{-1}

Some useful formulae

$$pH = -\log_{10}[H^+] \qquad \Delta H = -mC\Delta T$$

Some standard potentials

$K^+ + e^-$	⇌	$K(s)$	−2.94 V
$Ba^{2+} + 2e^-$	⇌	$Ba(s)$	−2.91 V
$Ca^{2+} + 2e^-$	⇌	$Ca(s)$	−2.87 V
$Na^+ + e^-$	⇌	$Na(s)$	−2.71 V
$Mg^{2+} + 2e^-$	⇌	$Mg(s)$	−2.36 V
$Al^{3+} + 3e^-$	⇌	$Al(s)$	−1.68 V
$Mn^{2+} + 2e^-$	⇌	$Mn(s)$	−1.18 V
$H_2O + e^-$	⇌	$\frac{1}{2}H_2(g) + OH^-$	−0.83 V
$Zn^{2+} + 2e^-$	⇌	$Zn(s)$	−0.76 V
$Fe^{2+} + 2e^-$	⇌	$Fe(s)$	−0.44 V
$Ni^{2+} + 2e^-$	⇌	$Ni(s)$	−0.24 V
$Sn^{2+} + 2e^-$	⇌	$Sn(s)$	−0.14 V
$Pb^{2+} + 2e^-$	⇌	$Pb(s)$	−0.13 V
$H^+ + e^-$	⇌	$\frac{1}{2}H_2(g)$	0.00 V
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(aq) + 2H_2O$	0.16 V
$Cu^{2+} + 2e^-$	⇌	$Cu(s)$	0.34 V
$\frac{1}{2}O_2(g) + H_2O + 2e^-$	⇌	$2OH^-$	0.40 V
$Cu^+ + e^-$	⇌	$Cu(s)$	0.52 V
$\frac{1}{2}I_2(s) + e^-$	⇌	I^-	0.54 V
$\frac{1}{2}I_2(aq) + e^-$	⇌	I^-	0.62 V
$Fe^{3+} + e^-$	⇌	Fe^{2+}	0.77 V
$Ag^+ + e^-$	⇌	$Ag(s)$	0.80 V
$\frac{1}{2}Br_2(l) + e^-$	⇌	Br^-	1.08 V
$\frac{1}{2}Br_2(aq) + e^-$	⇌	Br^-	1.10 V
$\frac{1}{2}O_2(g) + 2H^+ + 2e^-$	⇌	H_2O	1.23 V
$\frac{1}{2}Cl_2(g) + e^-$	⇌	Cl^-	1.36 V
$\frac{1}{2}Cr_2O_7^{2-} + 7H^+ + 3e^-$	⇌	$Cr^{3+} + \frac{7}{2}H_2O$	1.36 V
$\frac{1}{2}Cl_2(aq) + e^-$	⇌	Cl^-	1.40 V
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	1.51 V
$\frac{1}{2}F_2(g) + e^-$	⇌	F^-	2.89 V

Aylward and Findlay, *SI Chemical Data* (5th Edition) is the principal source of data for this examination paper. Some data may have been modified for examination purposes.

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PERIODIC TABLE OF THE ELEMENTS

KEY

Atomic Number	79
	Au
Atomic Weight	197.0
	Gold

Symbol of element

Name of element

1 H 1.008 Hydrogen																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.41 Zinc	31 Ga 69.72 Gallium	32 Ge 72.64 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.62 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.94 Molybdenum	43 Tc [97.91] Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Caesium	56 Ba 137.3 Barium	57–71 Lanthanides	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.8 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po [209.0] Polonium	85 At [210.0] Astatine	86 Rn [222.0] Radon
87 Fr [223.0] Francium	88 Ra [226.0] Radium	89–103 Actinides	104 Rf [261.1] Rutherfordium	105 Db [262.1] Dubnium	106 Sg [266.1] Seaborgium	107 Bh [264.1] Bohrium	108 Hs [277] Hassium	109 Mt [268] Meitnerium	110 Ds [271] Darmstadtium	111 Rg [272] Roentgenium							

Lanthanides

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm [144.9] Promethium	62 Sm 150.4 Samarium	63 Eu 152.0 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.0 Ytterbium	71 Lu 175.0 Lutetium

Actinides

89 Ac [227.0] Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np [237.0] Neptunium	94 Pu [244.1] Plutonium	95 Am [243.1] Americium	96 Cm [247.1] Curium	97 Bk [247.1] Berkelium	98 Cf [251.1] Californium	99 Es [252.1] Einsteinium	100 Fm [257.1] Fermium	101 Md [258.1] Mendelevium	102 No [259.1] Nobelium	103 Lr [262.1] Lawrencium

Where the atomic weight is not known, the relative atomic mass of the most common radioactive isotope is shown in brackets.
The atomic weights of Np and Tc are given for the isotopes ^{237}Np and ^{99}Tc.

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