CRANBROOK SCHOOL

YEAR 12

TERM 3, 2008

TRIAL HSC EXAMINATION

Chemistry

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- A data sheet and a Periodic Table are provided at the back of this paper
- Write your Student Number at the top of pages to be marked.

Total marks (100)

Section I Pages 3 - 17

100 marks

This section has two parts, Part A and Part B

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

Part B - 85 marks
- Attempt Questions 16 - 30
- Allow about 2 hours and 30 minutes for this part

The content and format of this paper does not necessarily reflect the content and format of the HSC examination paper.

Student Number: ____________________

Section I
Total Marks (100)

Part A – 15 marks
Attempt Questions 1 - 15
Allow about 30 minutes for this part

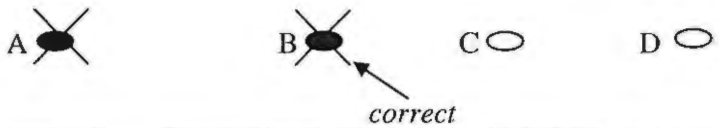
Use the multiple-choice answer sheet.

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.

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



Student Number: ____________________

1. Which equation represents a redox reaction?

(A) $2NaOH(aq) + H_2SO_4(aq) \rightarrow 2H_2O(l) + Na_2SO_4(aq)$
(B) $Fe(NO_3)_2(aq) + Na_2CO_3(aq) \rightarrow 2NaNO_3(aq) + FeCO_3(s)$
(C) $Cu^{2+}(aq) + 2OH^{-}(aq) \rightarrow Cu(OH)_2(s)$
(D) $Mn(NO_3)_3(aq) + FeSO_4(aq) \rightarrow MnSO_4(aq) + Fe(NO_3)_3(aq)$

2. Which molecule contains a co-ordinate covalent bond?

(A) CO
(B) CO_2
(C) Ammonia
(D) BF_3

3. Which of the following statements regarding flame colours is correct?

(A) Copper is brick-red
(B) Lead is blue
(C) Barium is pale green
(D) Chloride is yellow

4. Ammonia is produced using the Haber process. Which statement below is correct?

(A) More ammonia is produced by heating the reaction vessel.
(B) More ammonia is produced by adding a catalyst.
(C) Less ammonia is produced by removing CO_2 and O_2 from the reactants.
(D) More ammonia is produced by increasing pressure.

5. Which of the following reactions needs to be monitored the closest?

(A) Burning wood.
(B) Diesel used in cars as a fuel.
(C) Production of vinyl chloride from ethylene, oxygen, chlorine using a catalyst.
(D) Production of ethanol by fermentation.

6. Which statement about membrane filters is <u>not</u> correct?

(A) Filter particles that paper filters cannot do.
(B) Filter fluoride from the water.
(C) Filter single celled organisms that are microscopic.
(D) Filter particles that sand filters cannot do.

7. Which of the following is correct concerning esterification?

(A) H_2SO_4 is used as a catalyst
(B) The water goes in the top of the condenser and out the bottom.
(C) The top is always closed so no gas escapes
(D) The reaction is fast.

8. What is the concentration of NH_3 if 20.6 mL of the base is neutralised by 23.2 mL of 0.0496 mol/L H_2SO_4 solution?

(A) 0.0279 mol/L
(B) 0.1117 mol/L
(C) 0.0559 mol/L
(D) 1.117 mol/L

9. A 0.100 mol/L acetic acid solution was found to have a pH = 2.9. What is the degree of ionisation of acetic acid?

(A) 0.0126%
(B) 1.26%
(C) 0.79%
(D) 3.4%

10. What is the main cause of sulfur dioxide reaching the atmosphere?

(A) Roasting sulfide ores
(B) Burning coal in power stations.
(C) Combusting petrol in petrol engines
(D) Volcanic activity and geothermal hot springs.

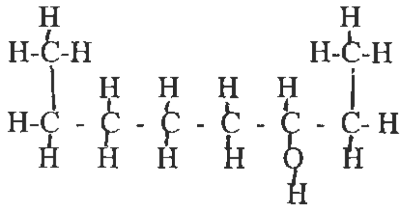
11. Which of the following is correct about indicators and their colours?

(A) Methyl orange will be red in 0.1 mol/L HCl solution.
(B) Phenolphthalein will be red in 0.1 mol/L NaCl solution.
(C) Bromothymol blue will be green in 0.1 mol/L NaOH solution.
(D) Litmus will be purple in 0.1 mol/L acetic acid solution.

12. Which one of the following is a transuranic element?

(A) ^{238}U
(B) ^{208}Pb
(C) ^{247}Cm
(D) ^{99m}Tc

13. What is the correct IUPAC nomenclature for the following molecule?



(A) 1,6-dimethylheptan-5-ol
(B) 1,6-dimethylheptan-2-ol
(C) Octan-3-ol
(D) 1,6-dimethylhexan-2-ol

14. Which of the following is not a recently developed biopolymer?

(A) Biopol
(B) Rayon
(C) Poly(3-hydroxybutanoate) i.e. PHB
(D) Polylactic acid i.e. PLA.

15. HDPE and LDPE are both made from ethylene. Which statement correctly relates to the respective polymer?

	Polymer	**Statement**
(A)	HDPE	Has as lot of chain branching
(B)	LDPE	Is made at about 60° C using very high pressure and uses a catalyst
(C)	LDPE	Is made at high pressure, high temperature and uses a catalyst
(D)	HDPE	Is made at 60° C, few atmospheres pressure and uses a catalyst

Student Number: ______________________

Chemistry

Section I (continued)

Part B – 85 marks
Attempt Questions 16-30
Allow about 2 hour and 30 minutes for this part

Answer the questions in the spaces provided.

Show all relevant working in questions involving calculations.

Marks

Question 16 (6 marks)

(a) Name the ester formed between propanol and methanoic acid. **1**

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(b) Write the equation, using structural formula for all organic species for the reaction in part (a). **3**

(c) Which of the three types of species in part (a) would exhibit a higher melting point if they have a similar molar mass? Explain your answer. **2**

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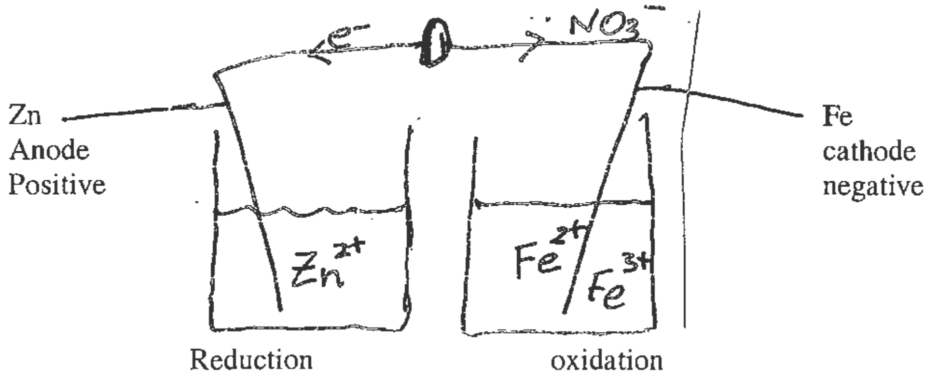
Marks

Question 17 (8 marks)

A galvanic cell was set up by a student based on the cell $Zn|Zn^{2+}||Fe^{2+}, Fe^{3+}|Pt$.
He drew the cell below to represent his working cell.



Cell Voltage is:

$$2Fe^{2+} \rightleftharpoons 2Fe^{3+} + 2e^- \qquad 1.54V$$

$$\underline{Zn^{2+} + 2e^- \longrightarrow Zn} \qquad \underline{-0.76V}$$

$$Zn^{2+} + 2Fe^{2+} \longrightarrow 2Fe^{3+} + Zn \qquad \underline{0.77V}$$

Identify **8** errors and explain what changes would have to be made to overcome these errors. **8**

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(Question 17 continues on the next page)

Marks

Question 17 (continued)

Question 18 (4 marks)

Evaluate the use of cellulose as a raw material for the petrochemical industry. **4**

Student Number: ____________________

Marks

Question 19 (3 marks)

Assess the use of indicators for the testing of soil acidity/basicity. **3**

Question 20 (6 marks)

AAS can be used in many situations. Assess the value of AAS to analyse water samples. **6**

Student Number: ______________________

Question 21 (7 marks) **Marks**

Polyvinyl chloride and cellulose are both polymers.

(a) Compare their production from their raw materials. 3

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(b) Write the equations for <u>both</u> reactions. 2

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(c) Give one use of one of the named polymers and relate the use to the polymer's properties. 2

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Question 22 (2 marks)

Is 100% pure water acidic, basic or neutral? Justify your answer. 2

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Student Number: ______________________

Marks

Question 23 (6 marks)

(a) Describe the natural and industrial origins of the oxides of nitrogen. **3**

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(b) Evaluate reasons for concern about the release of these oxides into the environment. **3**

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Student Number: ____________________

Marks

Question 24 (8 marks)

A student added all at once a large volume of 8 $molL^{-1}$ H_2SO_4 to solid $PbCO_3$ and observed a violent reaction.

(a) Write the equation for the reaction. **1**

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(b) Assess the risks associated with this experiment and justify how to minimise these risks. **4**

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(c) Justify the procedures that would be used to manage the waste. **3**

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Student Number: ____________________

Marks

Question 25 (4 marks)

When hydrochloric acid is added to 5.2g calcium, a reaction occurs.

(a) Write the equation for the reaction. 1

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(b) Calculate the volume of gas produced at 25°C and 100 kPa, assuming all the calcium is consumed. 1

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(c) Assume all the gas escapes into the atmosphere, what would the pH of the salt in pure water be? Justify your answer. 2

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Question 26 (4 marks)

Chemists are employed in many industries. Outline the role of a chemist employed in industry, identify the branch of chemistry undertaken and explain <u>one</u> chemical principle that they use. It cannot be a teacher. 4

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Student Number: ______________________

Marks

Question 27 (8 marks)

Ozone and oxygen are oxygen allotropes.

(a) Define an allotrope. **2**

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(b) Compare the properties of oxygen and ozone and account for them on the basis of their molecular structure and bonding. **6**

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Student Number: ______________________

Marks

Question 28 (8 marks)

Assess the effects of CFC's on the ozone layer. 8

Student Number: ____________________

Marks

Question 29 (5 marks)

(a) Describe and account for the use of ethanol as a solvent in many different situations. **3**

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(b) Give 2 specific uses for ethanol as a solvent (not as a drink) and explain why it is used in preference to water. **2**

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Question 30 (6 marks)

Discuss how the understanding of acids and bases has changed over time. **6**

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Chemistry

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

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

Some standard potentials

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

PERIODIC TABLE OF THE ELEMENTS

KEY

Atomic Number Atomic Weight	79 Au 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 Lanthanoids	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] Francium	88 Ra [226] Radium	89–103 Actinoids	104 Rf [261] Rutherfordium	105 Db [262] Dubnium	106 Sg [266] Seaborgium	107 Bh [264] Bohrium	108 Hs [277] Hassium	109 Mt [268] Meitnerium	110 Ds [271] Darmstadtium	111 Rg [272] Roentgenium							

Lanthanoids

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm [145] 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

Actinoids

89 Ac [227] Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np [237] Neptunium	94 Pu [244] Plutonium	95 Am [243] Americium	96 Cm [247] Curium	97 Bk [247] Berkelium	98 Cf [251] Californium	99 Es [252] Einsteinium	100 Fm [257] Fermium	101 Md [258] Mendelevium	102 No [259] Nobelium	103 Lr [262] Lawrencium

For elements that have no stable or long-lived nuclides, the mass number of the nuclide with the longest confirmed half-life is listed between square brackets.

The International Union of Pure and Applied Chemistry Periodic Table of the Elements (October 2005 version) is the principal source of data. Some data may have been modified.