
Student Number

Cranbrook School
2009
YEAR 12
TERM 1 EXAMINATION

Chemistry

General Instructions

- Reading time – 5 minutes
- Working time – 45 minutes per section
- Write using black or blue pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Use the Data Sheet and Periodic Table provided
- Use the Multiple-Choice Answer Sheets provided
- Write your Centre Number and Student Number at the beginning of each part

Total marks - 55

Your teacher will instruct you as to which sections of this paper to attempt

Section 1
- **Core 1** – Parts A and B – 26 marks
- Allow 45 minutes for this section

Section 2
- **Core 2** – Parts A and B – 29 marks
- Allow 45 minutes for this section

Cranbrook School
2009 YEAR 12 TERM 1 EXAMINATION

Student Number

Chemistry
Section 1 – Core 1
Production of Materials

Part A – 5 marks
Attempt Questions 1-5
Allow about 10 minutes for this part

Use the multiple-choice answer sheet provided.

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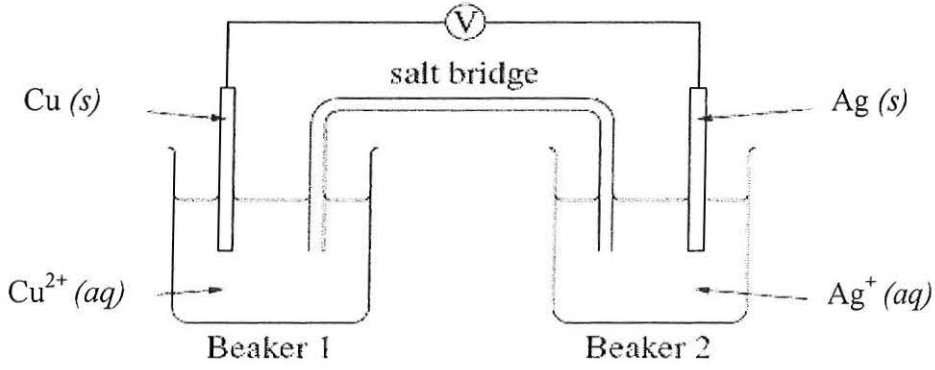
1 An electrochemical cell was set up as shown in the diagram.



TWO correct OBSERVATIONS for this electrochemical cell are:

	Observation 1	*Observation 2*
(A)	Electrons moved through the voltmeter	In Beaker 1 the solution became a darker blue
(B)	In Beaker 2 the colour of the solution faded	A reddish solid formed on the copper electrode
(C)	A solid formed on the silver electrode	In Beaker 1 the solution became a darker blue
(D)	Ions moved through the salt bridge	A solid formed on the silver electrode

2 Which of the following lists properties of an isotope which would make it suitable for medical diagnosis?

	Half-life	*Emission*
(A)	6 hours	Gamma rays only
(B)	6 years	Beta and gamma rays
(C)	1 hour	Alpha and gamma rays
(D)	Thousands of years	Beta rays only

3 Which of the following is a correct statement about biopolymers?

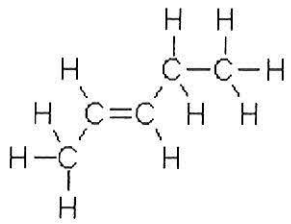
(A) Biopolymers are made by living things but are not biodegradable.

(B) All biopolymers can be manufactured synthetically in the laboratory by condensation reactions.

(C) Synthetic biopolymers are being produced from living organisms and are replacing polymers made from petrochemicals.

(D) All natural biopolymers are made by condensation reactions involving glucose monomers.

4 What is the correct systematic name for the following molecule?



(A) 2-ethyl-1-methylethylene

(B) 1-ethyl-2-methylethylene

(C) 2-pentene

(D) 3-pentene

5 The reversible reaction to form ethanol from ethylene is represented:

$$C_2H_4\,(g) + H_2O\,(g) \overset{\text{conc. } H_2SO_4}{\rightleftharpoons} C_2H_6O\,(g) \quad \Delta H = -45 \text{ kJ/mol}$$

Identify the INCORRECT statement.

(A) Sulfuric acid acts as a catalyst for both the backward and forward reactions.

(B) The dehydration of ethanol is an endothermic reaction.

(C) The highest yield of ethanol from ethylene is achieved when excess $H_2O(g)$ is present in the reaction vessel.

(D) The highest yield of ethanol is achieved at high temperature and high pressure.

End of Section 1 – Part A

Cranbrook School
2009 YEAR TERM 1 EXAMINATION

Student Number

Chemistry
Section 1 – Core 1
Production of Materials (continued)

Part B – 21 marks
Attempt Questions 6-10
Allow about 35 minutes for this part

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

Question 6 (8 marks) **Marks**

The alkanols form a homologous series.

(a) Explain why the alkanols show a regular change in their boiling points as the number of carbon atoms increases. **2**

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Question 6 continues on the next page

Question 6 (continued) **Marks**

(b) Students were asked to carry out a first-hand investigation to monitor the progress of fermentation of glucose by making measurements of mass.

Write a balanced equation for this fermentation reaction. **1**

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(c) "Glucose (derived from sugarcane) is becoming a significant renewable source of energy and of materials, despite the inefficiency of the fermentation process." **5**

Assess this statement.

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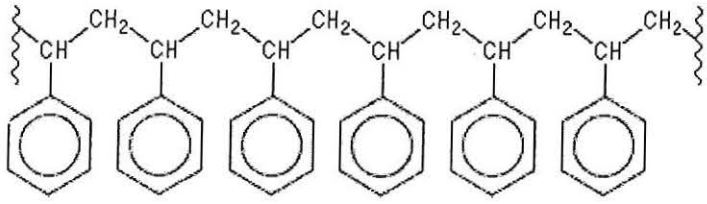
Question 7 (3 marks) **Marks**

The diagram shows a section of a polymer chain.



(a) Draw the structure of the monomer from which this polymer is made. **1**

(b) State the preferred name for this polymer. **1**

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(c) Identify ONE common use of this polymer and explain how this use is related to a property of the polymer. **1**

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Question 8 (4 marks) **Marks**

"Galvanic cells are recognised as a suitable source of energy for transport for future decades." **4**

By referring EITHER to a dry cell battery OR a lead-acid battery, explain why galvanic cells can be regarded as a source of energy. Include half-equations for any reactions you describe.

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Question 9 (3 marks) **Marks**

An unstable isotope of uranium is formed by bombarding the nucleus of uranium-238 with a neutron in a nuclear reactor. The unstable isotope then emits beta particles to form a transuranic element.

(a) Define the term "transuranic element". **1**

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(b) Write TWO balanced nuclear equations for the reactions described above. **2**

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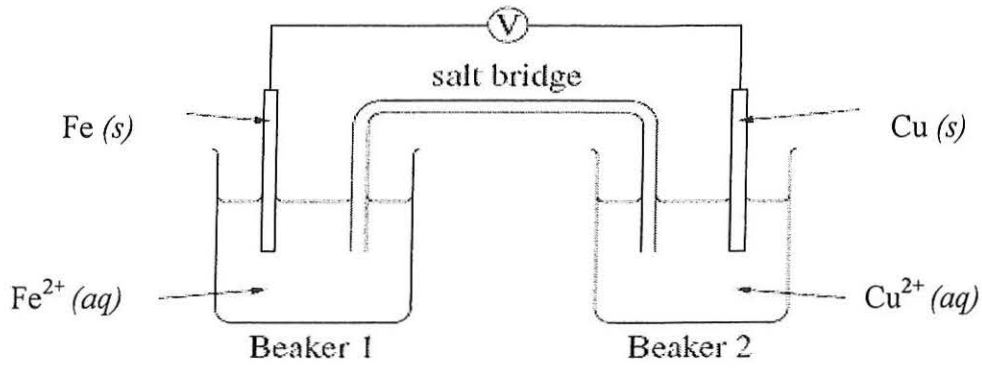
Marks

Question 10 (3 marks)

An electrochemical cell was set up as shown in the diagram.



(a) Outline TWO observations a student would make as the cell was operating. **1**

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(b) Write a balanced ionic equation for the overall cell reaction and predict the cell voltage under standard conditions. **2**

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End of Section 1 – Part B

Cranbrook School
2009 YEAR 12 TERM 1 EXAMINATION

Student Number

Chemistry
Section 2 – Core 2
The Acidic Environment

Part A – 5 marks
Attempt Questions 1-5
Allow about 10 minutes for this part

Use the multiple-choice answer sheet provided.

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1 Which of the following best describes the equivalence point in a titration between a strong acid and a strong base?

(A) The point at which the indicator first changes colour.

(B) The point at which equal moles of hydrogen ions and hydroxide ions have been added together.

(C) The point at which equal moles of the acid and the base have been added together.

(D) The point at which the molecules of the strong acid have completely ionised.

2 Which of the aqueous solutions has a pH below 7?

(A) Sodium ethanoate

(B) Sodium nitrate

(C) Ammonium nitrate

(D) Ammonia

3 A 0.01 mol/L HCl solution has a pH of 2.0.

What volume of water must be added to 60 mL of this solution to change the pH to 4.0?

(A) 180 mL

(B) 240 mL

(C) 5940 mL

(D) 6000 mL

4 Acid X and acid Y are both monoprotic, weak acids of equal concentration. Acid X is a stronger acid than acid Y.

Which statement about acid X and acid Y is CORRECT?

(A) Acid X is completely ionised in solution, whereas acid Y is only partially ionised.

(B) The solution of acid Y is more ionised than the solution of acid X.

(C) The solution of acid Y has a higher pH than the solution of acid X.

(D) 1 mole of acid Y requires a greater number of moles of sodium hydroxide for neutralisation than 1 mole of acid X.

5 The compound methyl propanoate is made from the reaction of

(A) methanol, propanoic acid and concentrated sulfuric acid.

(B) propanol, ethanoic acid and concentrated hydrochloric acid.

(C) propene, methanoic acid and concentrated sulfuric acid.

(D) propanol, methanoic acid and concentrated sulfuric acid.

End of Section 2 – Part A

Cranbrook School
2009 YEAR 12 TERM 1 EXAMINATION

Student Number

Chemistry
Section 2 – Core 2
The Acidic Environment (continued)

Part B – 24 marks
Attempt Questions 6-9
Allow about 35 minutes for this part

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

Question 6 (8 marks) **Marks**

Gaseous sulfur dioxide *(g)* can be removed from the exhaust gases of power stations by reacting it with calcium oxide to form calcium sulfite.

(a) Write a balanced equation for this reaction. **1**

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(b) Determine the mass of calcium oxide needed to absorb 5.500×10^4 L of sulfur dioxide (measured at 25°C and 100.0 kPa). **2**

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Question 6 continues on the next page

Question 6 (continued) **Marks**

(c) Is sulfur dioxide classified as an acidic or basic oxide? Explain your answer and include a balanced equation for the reaction of sulfur dioxide with water. **2**

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(d) Evaluate the effect of oxides of sulfur on the environment. **3**

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Question 7 (9 marks) **Marks**

Consider the bonding and structure of the following molecules:

- HCl *(g)*
- CH_3COOH *(l)*
- CH_4 *(g)*

(a) Explain how EACH of these THREE molecules would have been classified according to the theories of acids proposed by Lavoisier AND by Lowry-Brönsted. **6**

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(b) Explain why CH_3COOH is classified as a monoprotic, rather than polyprotic, acid. **2**

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(c) Write a balanced equation for the reaction between HCl *(g)* and NH_3 *(g)*. **1**

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Question 8 (4 marks) **Marks**

100.0 mL of a solution of 0.250 mol/L hydrochloric acid was added to a solution containing 100.0 mL of 0.200 mol/L potassium hydroxide.

(a) Would the resulting solution be acidic, alkaline or neutral? Explain your answer. **2**

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(b) Calculate the pH of the resulting solution. **2**

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Question 9 (3 marks) **Marks**

Esterification involves refluxing to produce the optimal yield of ester. The compounds remaining after the refluxing step need to be separated to obtain a pure sample of the ester. **3**

Discuss the TWO steps needed to separate a pure sample of the ester from the other product(s) and the unreacted species.

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End of Section 2 – Part B

Student Number

2009 YEAR 12 TERM 1 EXAMINATION

CHEMISTRY – MULTIPLE-CHOICE ANSWER SHEET

CORE 1 – PRODUCTION OF MATERIALS – PART A

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 have changed 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○

ATTEMPT ALL QUESTIONS

Question	**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 ○

Student Number

2009 YEAR 12 TERM 1 EXAMINATION

CHEMISTRY – MULTIPLE-CHOICE ANSWER SHEET

CORE 2 – THE ACIDIC ENVIRONMENT – PART A

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 have changed 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○

ATTEMPT ALL QUESTIONS

Question	**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 ○

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

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

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 — 79 — Symbol of element
Atomic Weight — Au 197.0 — Name of element
Gold

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.