Student No. .....

Barker College

2006

YEAR 12

EXAMINATION TERM 1

Chemistry

ANSWER SHEET

Staff Involved:

- **TER***
- **ASH**
- **KHW**
- **RZS**
- **RJP**

PM THURSDAY 6 APRIL

110 copies

Section I – Multiple Choice

Choose the best response and fill in the response oval completely

---

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)

Barker College

2006
YEAR 12 EXAMINATION TERM 1

Chemistry

Staff Involved:

- **TER***
- **ASH**
- **KHW**
- **RZS**
- **RJP**

110 copies

PM THURSDAY 6 APRIL

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 at the top of ALL answer pages in Section II**
- **ALL working or relevant equation writing must be shown in Questions 16 – 28**

Total marks – 80

Section I Pages 2 – 7

15 marks
- Attempt Questions 1 – 15
- Indicate all answers on the Answer Sheet provided
- Allow about 25 minutes for this part

Section II Pages 8 – 22

65 marks
- Attempt Questions 16 – 27
- Indicate all answers in the spaces provided on paper
- Allow about 1 hour 30 minutes for this section

Section I

15 marks

Attempt Questions 1–15
Allow about 25 minutes for this section

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 ←

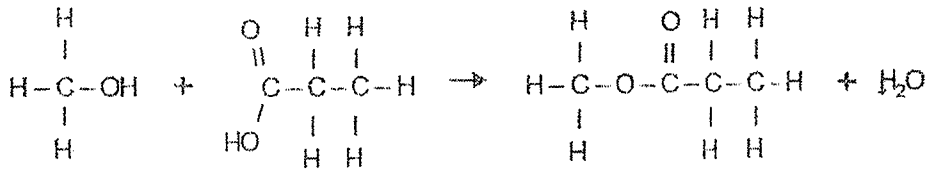
(A) ⊗ (B) ⊗ (C) ○ (D) ○

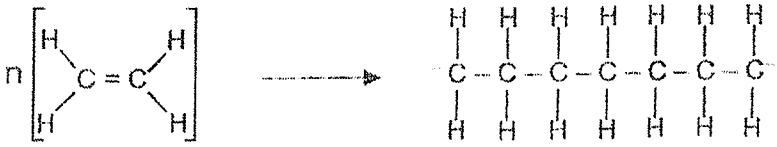
---

1. Which of the following is a systematic name for styrene?

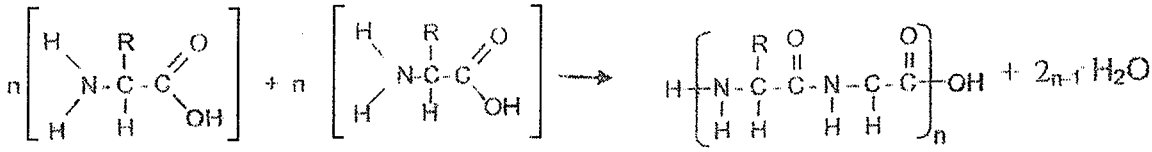
(A) Ethenylbenzene
(B) Choroethene
(C) Benzylethene
(D) Chlorobenzene

2. Which of the following is a condensation **polymerisation** reaction?

(A) 

(B) 

(C) $2C_6H_{12}O_6 \longrightarrow C_{12}H_{22}O_{11} + H_2O$

(D) 

3. What is the best reason that ethene can be transformed easily into many useful products?

(A) Ethene is a gas composed of non-polar molecules.
(B) Ethene has a highly reactive double bond.
(C) Ethene is 86% carbon by mass.
(D) Ethene can be produced by catalytic cracking.

4. The table gives the heat of combustion in $kJ.g^{-1}$ for a number of different fuels.

Fuel	Heat of combustion ($kJ.g^{-1}$)
Methanol	22.7
Ethanol	29.6
Propanol	33.6
Petrol (octane)	47.8

The heat of combustion in kJ mol^{-1} for one of the fuels was calculated as 2016 kJ mol^{-1}.

What was the fuel?

(A) Methanol

(B) Ethanol

(C) Propanol

(D) Petrol

5. What substance may ethanol be dehydrated to?

(A) Ethylene

(B) Ethanolic acid

(C) Ethyne

(D) Ethyl ethanoate

6. The boiling points of three compounds are:

Compound A: 78.3°C
Compound B: –88.6°C
Compound C: 117.9°C

The compounds are known to be, in no particular order, ethane, ethanoic acid and ethanol.

Which of the following correctly identifies compounds A, B and C in that order?

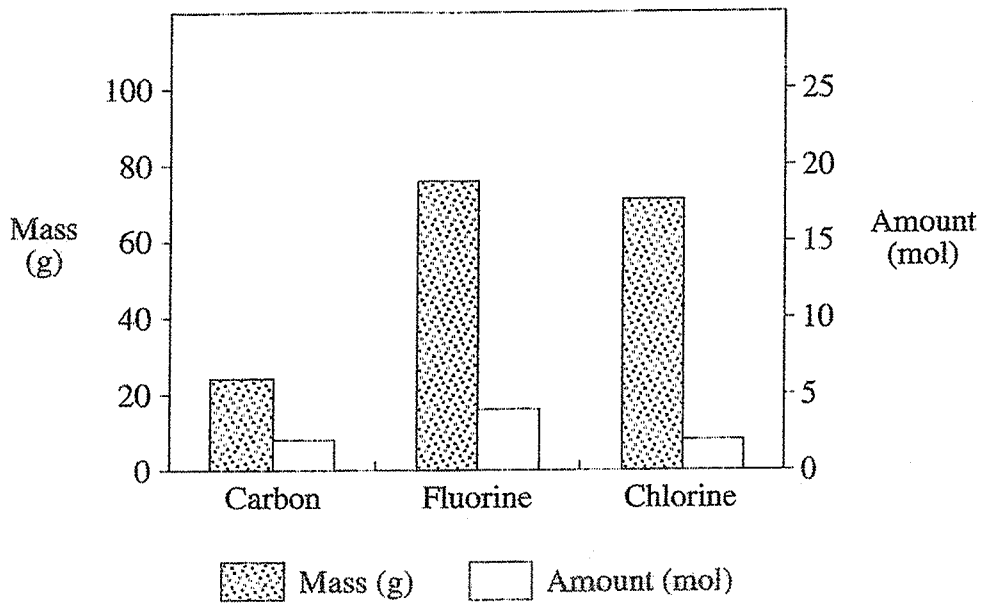
(A) Ethane, ethanol, ethanoic acid.

(B) Ethanoic acid, ethane, ethanol.

(C) Ethanoic acid, ethanol, ethane.

(D) Ethanol, ethane, ethanoic acid.

7. The graph shows the mass and amount of carbon, fluorine and chlorine atoms in one mole of a compound.



What is the molecular formula for this compound?

(A) CF_2Cl

(B) CF_2Cl_2

(C) $C_2F_3Cl_3$

(D) $C_2F_4Cl_2$

8. The table below shows some properties of four commonly used radioisotopes.

Name of isotope	**Half-life**	**Ionising power**
Technetium-99	hours	low
Cobalt-60	years	high
Carbon-14	thousands of years	low
Uranium-238	millions of years	moderate

Which of these isotopes would be most suitable for **killing** cancerous cells in radiotherapy?

(A) Technetium-99

(B) Cobalt-60

(C) Carbon-14

(D) Uranium-238

9. Phenol red is an acid-base indicator, yellow 6.8 – red 8.4.
Methyl orange indicator, red 3.1 – yellow 4.4.

A small quantity of soil was added to 5 mL of pure water, stirred for 5 minutes, allowed to settle and filtered. When one sample of the filtrate was tested with phenol red, the colour turned yellow. When another sample was tested with methyl orange, the colour turned yellow.

What is the best conclusion about the soil?

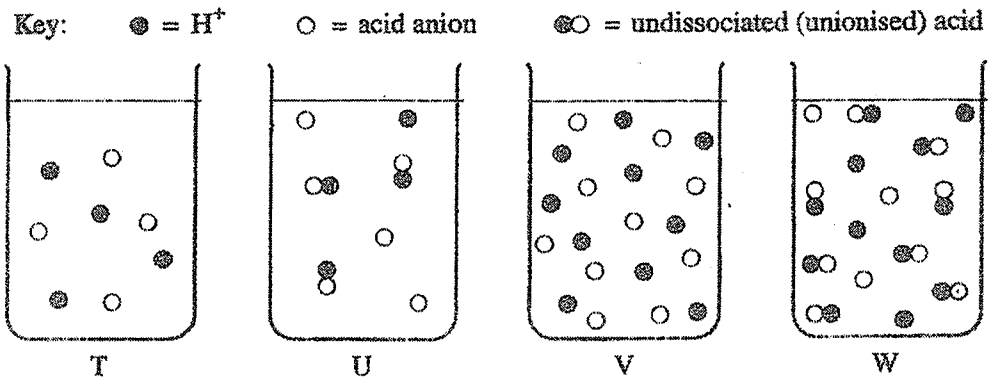
(A) That it is slightly acidic and has a pH less than 8.4.

(B) That it is slightly acidic and has a pH less than 6.8.

(C) That it is slightly alkaline and has a pH less than 6.8.

(D) That it is very acidic and has a pH less than 4.4.

10. The following diagrams represent samples of four acids.



Which beaker can best be described as containing a sample of dilute, strong acid?

(A) T

(B) U

(C) V

(D) W

11. The Haber Process is used to synthesise ammonia in the following exothermic reaction.

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} + \text{heat}$$

Which of the following procedures would increase the equilibrium yield of ammonia?

(A) Decrease both the temperature and pressure.

(B) Decrease the temperature and increase the pressure.

(C) Decrease the pressure and increase the temperature.

(D) Increase both the temperature and the pressure.

12. Which of the following best describes a solution with a pH of 5?

(A) Contains $[H^+]$ of concentration 10^{-5}M.
(B) More acidic than a substance with a pH of 4.
(C) Basic
(D) Contains an equal concentration of hydroxide and hydronium ions.

13. The pH of unpolluted rainwater is about 6.0. Which of these gases contributes most to this?

(A) CO_2
(B) N_2
(C) NO_2
(D) O_3

14. 0.40 g of sodium hydroxide was weighed and dissolved in 15.0 mL of water in a conical flask. The solution was then titrated with 0.50 M hydrochloric acid. The endpoint was detected when 19.0 mL of acid has been added. The value of 19.0 mL was less than the expected 20.0 mL. This difference could be explained if:

(A) the burette had been rinsed with water prior to adding the hydrochloric acid solution
(B) the equivalence point was reached before the endpoint
(C) the sodium hydroxide solution had been left exposed to the air for a long period of time before the titration was performed
(D) the conical flask contained 25.0 mL of water instead of 15.0 mL

15. A student prepares four solutions of acids, such that they are all of the same pH (pH = 6.0). Which of the following solutions is the most dilute?

(A) Hydrochloric acid
(B) Ethanoic acid
(C) Citric acid
(D) Carbonic acid

Student No. .....

Section II – 65 marks
Attempt ALL questions
Allow about 1 hour 30 minutes for this section

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

Marks

Question 16 (5 marks)

Polyethylene (polyethene) is a very important chemical in today's society.

(a) Outline the **THREE** main steps in the commercial production of polyethylene. **3**

.....

.....

.....

.....

.....

.....

(b) By altering the conditions under which polyethylene is produced, two different polymers can be produced, LDPE and HDPE.

Compare the uses of LDPE and HDPE, relating to their physical properties. **2**

.....

.....

.....

.....

Student No. .....

Marks

Question 17 (7 marks)

(a) Using the standard electrode potentials on your data sheet and equipment from the list below, construct a fully labelled scientific diagram of a galvanic cell. **3**

Equipment:

- Zinc metal, nickel metal
- Zinc nitrate solution, nickel nitrate solution, potassium nitrate solution
- Filter paper
- 2 x 100 mL beakers
- Alligator leads
- Voltmeter

Question 17 continues on page 10

Student No. .....

Marks

Question 17 (continued)

(b) Write the reduction half-equation. **0.5**

.....

(c) Write the oxidation half-equation. **0.5**

.....

(d) Write the overall redox equation. **0.5**

.....

(e) Calculate the standard e.m.f. of the cell. Show working. **1.5**

.....

.....

.....

(f) In the laboratory, you would not obtain a voltage close to the standard e.m.f. as calculated in part (e). State **ONE** possible reason for this. **1**

.....

.....

End of Question 17

Student No. .....

Marks

Question 18 (5 marks)

Over the past 100 years, there has been an enormous increase in the amount of fossil fuel used. As supplies of these are finite, a suitable alternative must be found.

(a) Explain why ethanol can be regarded as both a fuel and as a renewable resource. **2**

.....

.....

.....

.....

(b) Evaluate the conversion of starch (or glucose or sucrose) to ethanol as a source of ethanol. **3**

.....

.....

.....

.....

.....

.....

Student No. .....

Marks

Question 19 (7 marks)

(a) During your HSC course you have performed an experiment to compare the reactivities of an alkene and an alkane.

Outline how you conducted this experiment in your school laboratory using a named alkene and a named alkane. **2**

.....

.....

.....

.....

(b) In this experiment, you were required to select an appropriate alkene and alkane based on safety information. Justify your choice. **1**

.....

.....

.....

.....

(c) Summarise your results from this experiment and include relevant chemical equations to explain your observations. **4**

.....

.....

.....

.....

.....

.....

.....

.....

Student No. .....

Marks

Question 20 (5 marks)

Since Luigi Galvani undertook his famous experiments into "animal electricity" there have been great advances in our ability to harness electrochemical energy in the form of batteries.

Using your knowledge of the dry cell or lead-acid cell, evaluate it in comparison to one of the following:

- button cell
- fuel cell
- vanadium redox cell
- lithium cell
- Gratzel cell

in terms of: chemistry, cost/practicality, impact on society, environmental impact. **5**

Properties	**Dry cell / lead acid**	
Chemistry		
Cost/Practicality		
Impact on society		
Environmental impact		

Evaluation: .....

.....

Student No. .....

Marks

Question 21 (7 marks)

(a) Describe why some isotopes are stable and others are unstable. **1**

.....

.....

(b) Write an equation to represent the alpha decay of Thorium-230. **1**

.....

(c) The Lucas Heights nuclear reactor in Sydney currently produces radioisotopes for use in a range of medical treatments and diagnoses.

Using your knowledge of a named medical radioisotope, analyse the benefits and problems associated with its use. **5**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Student No. .....

Marks

Question 22 (4 marks)

(a) Recent evidence suggests that there has been an increase in atmospheric concentrations of oxides of sulfur and nitrogen due to industrial plants and vehicle emissions through the burning of fossil fuels.

Explain, including relevant equations, how this may be contributing to the formation of acid rain. **2**

.....

.....

.....

.....

(b) Outline reasons for concern about the release of these oxides with respect to the environment. **2**

.....

.....

.....

.....

Student No. .....

Marks

Question 23 (4 marks)

When carbon dioxide dissolves in water the following equilibrium process occurs.

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

Explain, in terms of Le Chatelier's Principle, what happens:

(i) to the solubility of carbon dioxide in a soft drink bottle if the pressure decreases (i.e. when the lid is opened). **2**

.....

.....

.....

.....

(ii) when a bottle of soft drink is heated. **2**

.....

.....

.....

.....

Student No. .....

Marks

Question 24 (4 marks)

A student places 2.4 g of magnesium into a beaker containing 4M nitric acid. They observed that the acid fizzed vigorously until the magnesium had disappeared and a colourless liquid remained.

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

.....

(b) Calculate the number of moles of Magnesium that reacted, showing ALL working. **1**

.....

.....

(c) Assuming that this reaction was carried out at 25°C and 100 kPa, calculate the volume of gas produced. **2**

.....

.....

.....

.....

Student No. .....

Marks

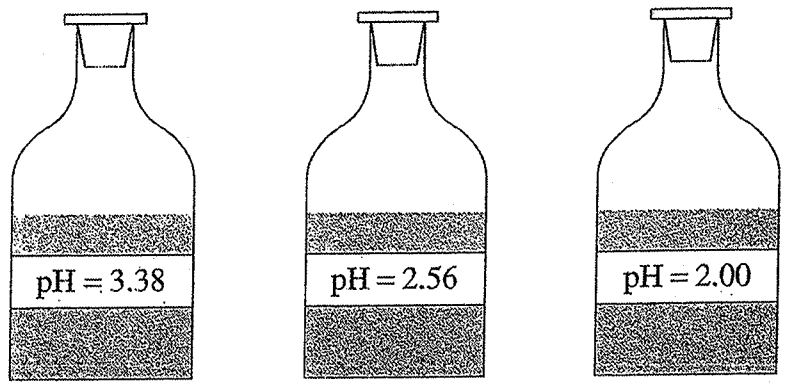
Question 25 (8 marks)

(a) Calculate the pH of 0.0060 M hydrochloric acid. **1**

.....

.....

(b) The diagram shows three reagent bottles containing acids.



0.01 mol L^{-1} Acetic acid

0.01 mol L^{-1} Citric acid

0.01 mol L^{-1} Hydrochloric acid

Explain why the pH of these acids are different, even though they have the same concentrations. Include suitable equations for acetic acid and hydrochloric acid to assist your explanation. **3**

.....

.....

.....

.....

.....

.....

Question 25 continues on page 19

Marks

Question 25 (continued)

(c) Define the term *amphiprotic*. **1**

.....

.....

(d) Write **TWO** chemical equations to show that the dihydrogen phosphate ion $\left(H_2PO_4^-\right)$ is amphiprotic. Identify a conjugate acid/base pair in one of your equations. **3**

.....

.....

.....

.....

.....

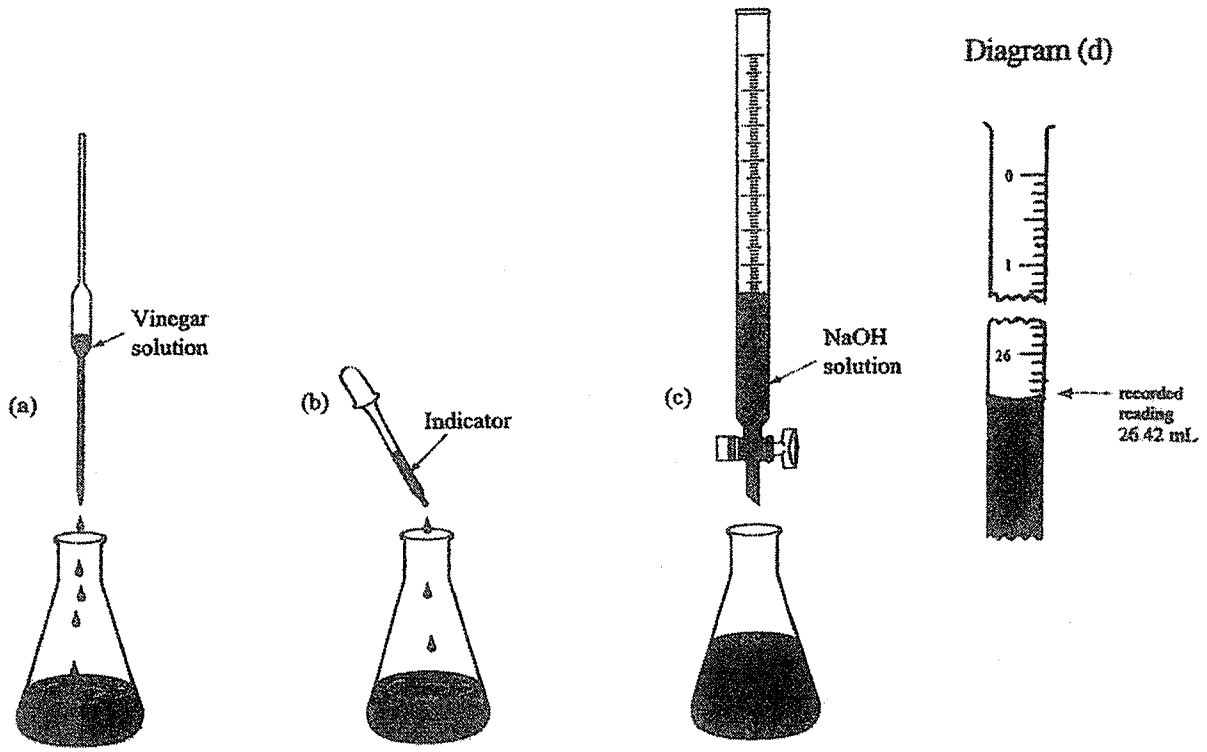
.....

End of Question 25

Question 26 (7 marks)

A student determines the ethanoic acid content in white vinegar by titration with a standard NaOH solution. The equation for the reaction is:

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$



The following procedure was used:

Step 1: Wash burette with distilled water then fill the burette with 0.100 M NaOH and record the volume

Step 2: Wash a 20 mL pipette with distilled water and then fill with the vinegar solution and allow to run into the conical flask.

Step 3: Add five drops of the indicator phenolphthalein to the conical flask.

Step 4: Titrate the vinegar solution till the endpoint is reached. Record the volume as shown in diagram (d).

Question 26 continues on page 21

Student No. .....

Marks

Question 26 (continued)

(a) Unfortunately, the student made a number of mistakes.

State **ONE** mistake made in:

(i) Step 1: .....

(ii) Step 2: **2**

(b) The student then correctly repeats the titration three times. The experimental results for the three titrations are:

Titration Number	**1**	**2**	**3**
Final Reading (mL)	22.48	22.55	22.43
Initial Reading (mL)	0.05	0.05	0.06
Titre (mL)			

(i) Calculate the appropriate values of NaOH required for the titration by filling in the table above, and then calculate the average titre of the titration. **1**

.....

.....

(ii) From the titration, determine the number of moles of ethanoic acid in a 20 mL sample of vinegar. **2**

(iii) Calculate the concentration of CH_3COOH in the 20 mL sample of vinegar in moles per litre. **2**

Student No. .....

Marks

Question 27 (2 marks)

(a) Identify the products formed when propanoic acid and butanol are refluxed with acid catalyst. **1**

.....

.....

(b) State **ONE** advantage of using reflux to prepare the ester. **1**

.....

.....

End of Paper

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

$K^+ + e^-$	$\rightleftharpoons$	$K(s)$	−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	Symbol of element	Name of element
79	Au	Gold
Atomic Weight	197.0	

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.