

Student Number	
Mark / 35	

Chemistry

Production of Materials

Theory Test • 2003

General Instructions

- Reading time – 5 minutes
- Working time – 55 minutes
- Write using black or blue 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 this page

Total Marks – 35

Part A – 10 marks

- Attempt Questions 1 – 10
- Allow about 15 minutes for this part

Part B – 25 marks

- Attempt Questions 11 – 15
- Allow about 40 minutes for this part

Part A – 10 marks

Attempt Questions 1–10

Allow about 15 minutes for this part

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 the correct answer by writing the word **correct** and drawing an arrow as follows.

A ☒ B ☒ C ☐ D ☐
 correct ↗

Answer Box for Questions 1–10

1	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
2	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
3	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
4	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
5	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
6	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
7	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
8	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
9	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
10	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>

- 1 Which of the following is a transuranic element?
- (A) bohrium
 - (B) thallium
 - (C) thorium
 - (D) thulium
- 2 Which of the following occurs when a polymer is formed by condensation polymerisation?
- (A) The mass of the polymer formed is less than the combined mass of the reactants.
 - (B) It becomes a mixed polymer.
 - (C) Only one product is formed in the reaction.
 - (D) One product must always be water.
- 3 Ethanol is a solvent for many substances. Which of the following statements is an *incorrect* explanation of ethanol's solubility?
- (A) Ethanol has an OH group which helps it dissolve polar molecules.
 - (B) Ethanol can form hydrogen bonds with water.
 - (C) Ethanol has a CH₃CH₂ chain which helps it form covalent bonds with non-polar substances.
 - (D) Ethanol has an OH group which helps it dissolve ionic substances.
- 4 Which of the following is a monomer for cellulose?
- (A) β-glucose
 - (B) β-cellulase
 - (C) starch
 - (D) sucrose
- 5 A student correctly sets up an experiment to convert glucose into ethanol. She monitored the mass of the reaction flask over a few days and found that her reaction flask decreased in mass by 4.4 grams. What mass of ethanol was produced?
- (A) 0 g
 - (B) 4.4 g
 - (C) 4.6 g
 - (D) 9.2 g

6 How can ethylene be obtained from crude oil?

- (A) By separating out the lighter components by fractional distillation.
- (B) By separating out the heavier components by fractional distillation.
- (C) By catalytic cracking of the crude oil followed by distillation.
- (D) By decomposing the crude oil followed by distillation.

7 A student burns ethanol in a spirit burner to heat 150 mL of water. His results are...

Initial temperature of water	24.5 °C
Final temperature of water	74.5 °C
Initial mass of burner + ethanol	236.3 g
Final mass of burner + ethanol	234.3 g

What is the heat of combustion per gram of ethanol from this student's results?

- (A) 31,350 kJ
- (B) 15,675 J
- (C) 418 J
- (D) 31,350 J

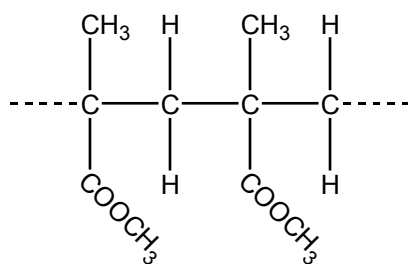
8 Which list shows the metals in order of increasing activity according to the standard potentials data?

- (A) Ag, Fe, Cu, Ni
- (B) Fe, Al, Mn, Ca
- (C) Pb, Fe, Ca, Na
- (D) Cu, Mn, Na, Ba

9 In which species is manganese in the lowest oxidation state?

- (A) MnO_4^{2-}
- (B) MnO_4^-
- (C) MnO
- (D) Mn_2O_3

10 An addition polymer used in the manufacture of artificial eyes has the structure...



Which of the following chemicals is the monomer for this polymer?

- (A)
- (B)
- (C)
- (D)

Part B – 25 marks

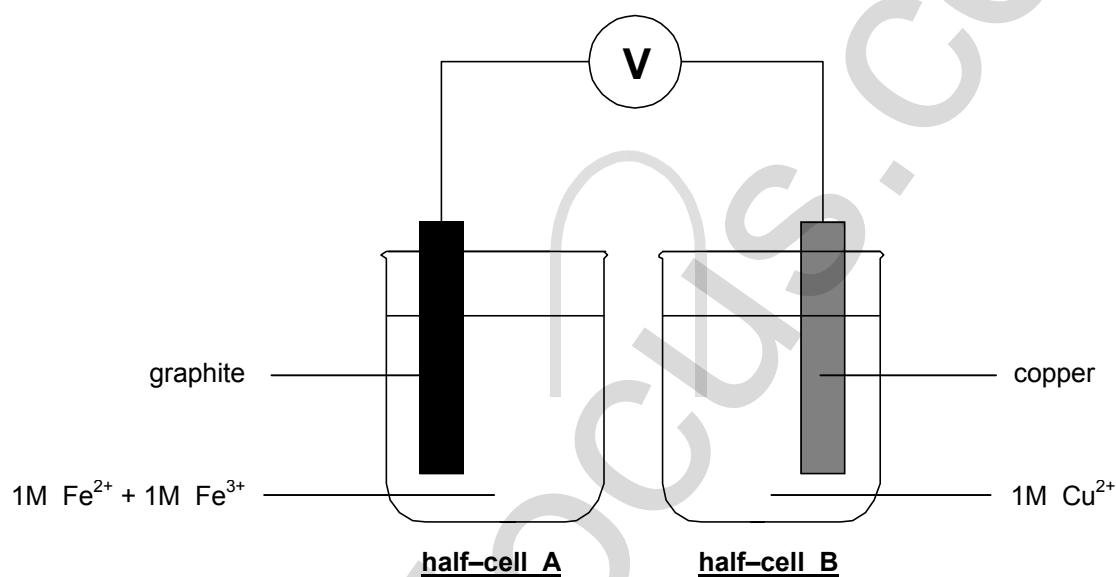
Attempt Questions 11 – 15

Allow about 40 minutes for this part

► **Show all relevant working in questions involving calculations.**

Question 11 (4 marks)

The diagram shows a galvanic cell composed of two half-cells connected by a salt bridge...



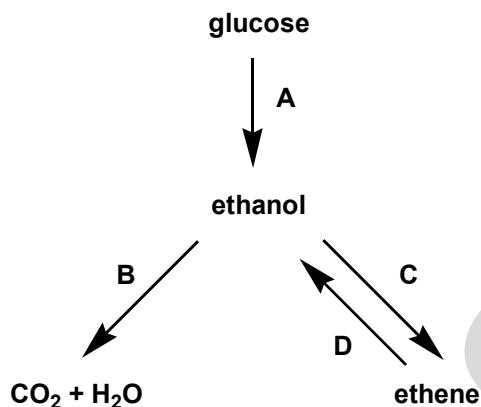
After operating for several hours chemical changes are evident.

The reaction occurring in half-cell A is... $\text{Fe}^{3+}_{(\text{aq})} + \text{e}^{-} \rightarrow \text{Fe}^{2+}_{(\text{aq})}$

- (a) Indicate the direction of electron flow on the diagram. **(1 mark)**
- (b) Describe two changes that would be visible in half-cell B after several hours? **(2 marks)**
-
-
- (c) Calculate the net voltage of the galvanic cell. **(1 mark)**

Question 12 (9 marks)

Identify the type of reaction (A, B, C & D) in the flow chart and write a balanced chemical equation for each reaction. ► *Include states of matter and conditions.*



Reaction	Type of Reaction (4 marks)
A	
B	
C	
D	

Reaction	Chemical Equation (5 marks)
A	
B	
C	
D	

Question 13 (4 marks)

- (a) Describe two conditions under which a nucleus is unstable. **(2 marks)**

- (b) What is the effect of a nucleus being unstable? **(1 mark)**

- (c) Identify an instrument that could be used to detect a substance that has unstable nuclei. **(1 mark)**

Question 14 (5 marks)

- (a) Give an equation (using structural formulae) for the reaction between ethylene and bromine water and name the organic product. **(2 marks)**

- (b) (i) Identify the systematic name for styrene. **(1 mark)**

- (ii) Describe one use for polystyrene and identify a property which makes it useful for this purpose. **(2 marks)**

Question 15 (3 marks)

Complete the table for either a dry cell or lead–acid cell...

	TYPE OF CELL Dry cell <u>or</u> Lead–acid cell (circle your choice above)
Identify the composition of the anode	
Write the reduction half–equation	
<u>One</u> advantage of the cell	

HIGHER SCHOOL CERTIFICATE EXAMINATION
Chemistry

DATA SHEET

Avogadro constant, N_A	$6.022 \times 10^{23} \text{ mol}^{-1}$
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	$4.18 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$

Some useful formulae

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

Some standard potentials

$\text{K}^+ + \text{e}^-$	\rightleftharpoons	K(s)	-2.94 V
$\text{Ba}^{2+} + 2\text{e}^-$	\rightleftharpoons	Ba(s)	-2.91 V
$\text{Ca}^{2+} + 2\text{e}^-$	\rightleftharpoons	Ca(s)	-2.87 V
$\text{Na}^+ + \text{e}^-$	\rightleftharpoons	Na(s)	-2.71 V
$\text{Mg}^{2+} + 2\text{e}^-$	\rightleftharpoons	Mg(s)	-2.36 V
$\text{Al}^{3+} + 3\text{e}^-$	\rightleftharpoons	Al(s)	-1.68 V
$\text{Mn}^{2+} + 2\text{e}^-$	\rightleftharpoons	Mn(s)	-1.18 V
$\text{H}_2\text{O} + \text{e}^-$	\rightleftharpoons	$\frac{1}{2}\text{H}_2(\text{g}) + \text{OH}^-$	-0.83 V
$\text{Zn}^{2+} + 2\text{e}^-$	\rightleftharpoons	Zn(s)	-0.76 V
$\text{Fe}^{2+} + 2\text{e}^-$	\rightleftharpoons	Fe(s)	-0.44 V
$\text{Ni}^{2+} + 2\text{e}^-$	\rightleftharpoons	Ni(s)	-0.24 V
$\text{Sn}^{2+} + 2\text{e}^-$	\rightleftharpoons	Sn(s)	-0.14 V
$\text{Pb}^{2+} + 2\text{e}^-$	\rightleftharpoons	Pb(s)	-0.13 V
$\text{H}^+ + \text{e}^-$	\rightleftharpoons	$\frac{1}{2}\text{H}_2(\text{g})$	0.00 V
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{SO}_2(\text{aq}) + 2\text{H}_2\text{O}$	0.16 V
$\text{Cu}^{2+} + 2\text{e}^-$	\rightleftharpoons	Cu(s)	0.34 V
$\frac{1}{2}\text{O}_2(\text{g}) + \text{H}_2\text{O} + 2\text{e}^-$	\rightleftharpoons	2OH^-	0.40 V
$\text{Cu}^+ + \text{e}^-$	\rightleftharpoons	Cu(s)	0.52 V
$\frac{1}{2}\text{I}_2(\text{s}) + \text{e}^-$	\rightleftharpoons	I^-	0.54 V
$\frac{1}{2}\text{I}_2(\text{aq}) + \text{e}^-$	\rightleftharpoons	I^-	0.62 V
$\text{Fe}^{3+} + \text{e}^-$	\rightleftharpoons	Fe^{2+}	0.77 V
$\text{Ag}^+ + \text{e}^-$	\rightleftharpoons	Ag(s)	0.80 V
$\frac{1}{2}\text{Br}_2(\text{l}) + \text{e}^-$	\rightleftharpoons	Br^-	1.08 V
$\frac{1}{2}\text{Br}_2(\text{aq}) + \text{e}^-$	\rightleftharpoons	Br^-	1.10 V
$\frac{1}{2}\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	H_2O	1.23 V
$\frac{1}{2}\text{Cl}_2(\text{g}) + \text{e}^-$	\rightleftharpoons	Cl^-	1.36 V
$\frac{1}{2}\text{Cr}_2\text{O}_7^{2-} + 7\text{H}^+ + 3\text{e}^-$	\rightleftharpoons	$\text{Cr}^{3+} + \frac{7}{2}\text{H}_2\text{O}$	1.36 V
$\frac{1}{2}\text{Cl}_2(\text{aq}) + \text{e}^-$	\rightleftharpoons	Cl^-	1.40 V
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^-$	\rightleftharpoons	$\text{Mn}^{2+} + 4\text{H}_2\text{O}$	1.51 V
$\frac{1}{2}\text{F}_2(\text{g}) + \text{e}^-$	\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

PERIODIC TABLE OF THE ELEMENTS																		2 He 4.003 Helium	
																		KEY	
1 H 1.008 Hydrogen																		10 Ne 20.18 Neon	
		Atomic Number																	
		Atomic Weight																	
		Symbol of element																	
		Name of element																	
		79 Au 197.0 Gold																	
		5 B 10.81 Boron																6 C 12.01 Carbon	
		13 Al 26.98 Aluminum																14 Si 28.09 Silicon	
		7 N 14.01 Nitrogen																8 O 16.00 Oxygen	
		15 P 30.97 Phosphorus																16 S 32.07 Sulfur	
		9 F 19.00 Fluorine																17 Cl 35.45 Chlorine	
		18 Ar 39.95 Argon																	

Lanthanides

57	La 138.9 Lanthanum	58	Ce 140.1 Cerium	59	Pr 140.9 Praseodymium	60	Nd 144.2 Neodymium	61	Pm [146.9] 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
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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 [239.1] Plutonium	95	Am [241.1] Americium	96	Cm [244.1] Curium	97	Bk [249.1] Berkelium	98	Cf [252.1] 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
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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 ²³⁷Np and ⁹⁹Tc.