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.

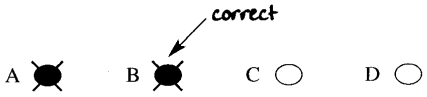
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

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.



Answer Box for Questions 1–10				
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** ○

► **Mark your answers for Questions 1 – 10 in the Answer Box on page 1.**

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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 CH_3CH_2 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

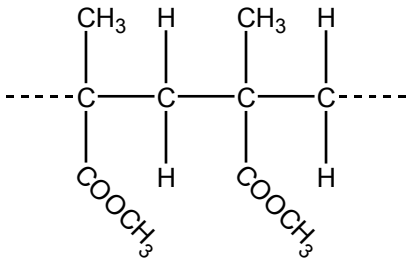
8 Which list shows the metals in order of increasing activity according to the standard potentials data?

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

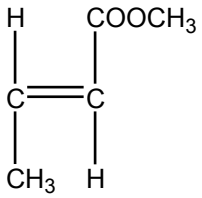
9 In which species is manganese in the lowest oxidation state?

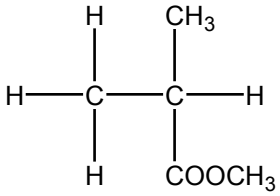
(A) MnO_4^{2-}
(B) MnO_4^{-}
(C) MnO
(D) Mn_2O_3

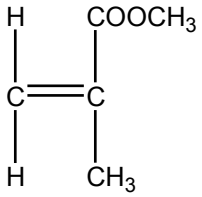
10 An addition polymer used in the manufacture of artificial eyes has the structure…

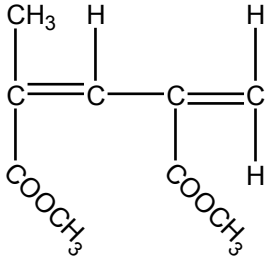


Which of the following chemicals is the monomer for this polymer?

(A) 

(B) 

(C) 

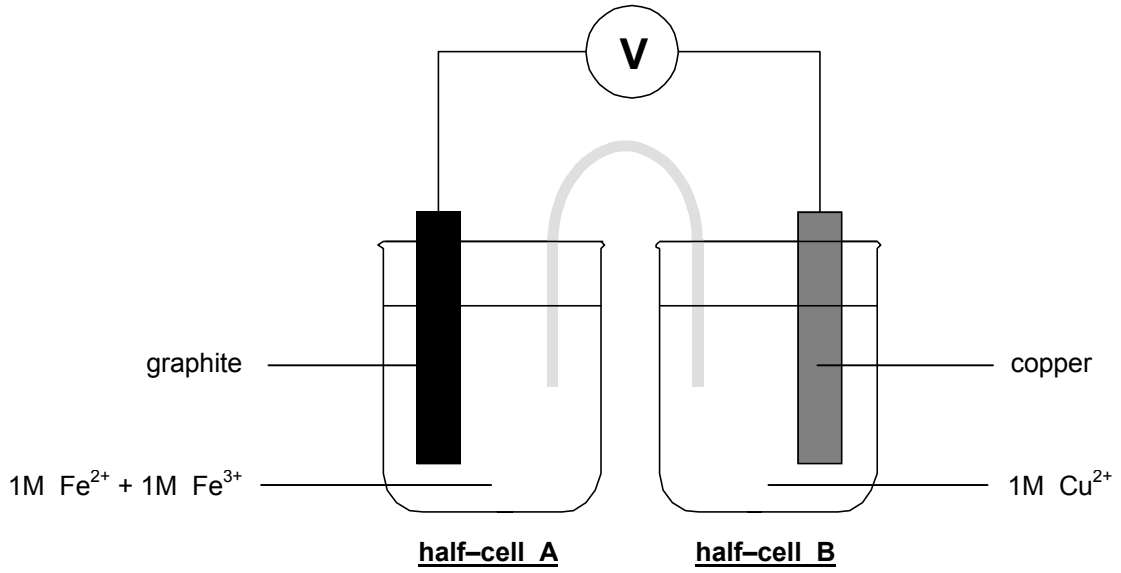
(D) 

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… $Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$

(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)**

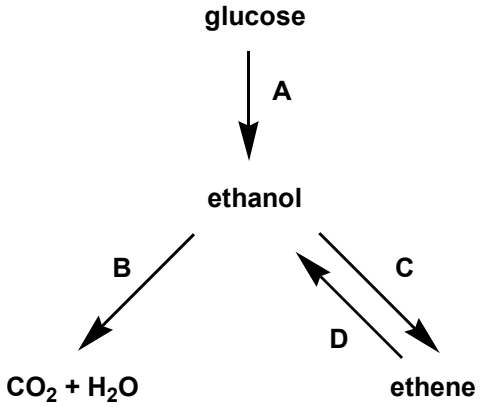
_____

_____

(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 or Lead–acid cell** **(circle your choice above)**
Identify the composition of the anode	
Write the reduction half–equation	
One advantage of the cell	

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

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 65.39 Zinc	31 Ga 69.72 Gallium	32 Ge 72.61 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 [98.91] 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 [210.0] 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 [263.1] Seaborgium	107 Bh [264.1] Bohrium	108 Hs [265.1] Hassium	109 Mt [268] Meitnerium	110 Uun — Ununnilium	111 Uuu — Unununium	112 Uub — Ununbium	113	114 Uuq — Ununquadium	115	116 Uuh — Ununhexium	117	118 Uuo — Ununoctium

KEY

Atomic Number: 79
Symbol of element: Au
Atomic Weight: 197.0
Name of element: Gold

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

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

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.