

ANSWERS and MARKING SCHEME

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

Allow about 5 minutes for this part

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

 A ☐ B ☒ C ☐ D ☐

A B C D

A  B  C  D 

Page 1 of 9

- 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

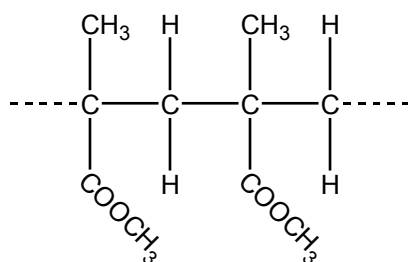
8 Which list shows the metals in order of increasing activity according to the standard potentials data?

- (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 A 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

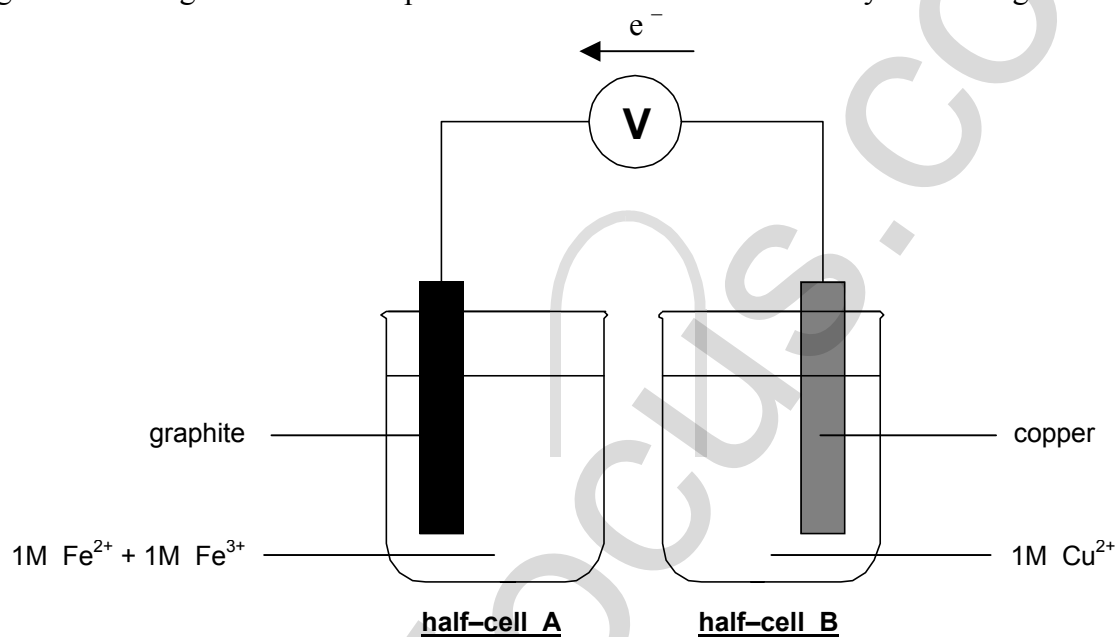
Attempt Questions 11 – 15

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.

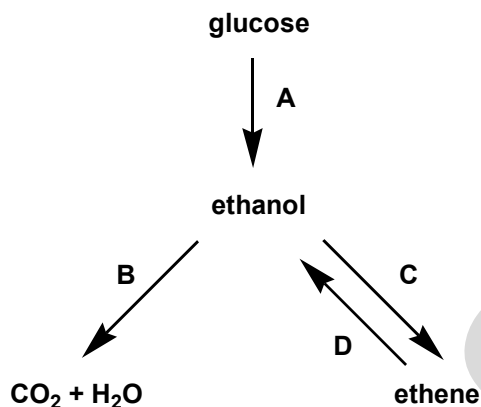
The reaction occurring in half-cell A is... $\text{Fe}^{3+}_{(\text{aq})} + \text{e}^{-} \rightarrow \text{Fe}^{2+}_{(\text{aq})}$

- (a) Indicate the direction of electron flow on the diagram. **(1 mark)**
- (b) What changes would be visible in half-cell B after several hours? **(2 marks)**
- The copper electrode becomes thinner. (1 mark)**
- The blue colour of the Cu²⁺ electrolyte becomes darker. (1 mark)**
- (c) Calculate the net voltage of the galvanic cell. **(1 mark)**

$$E^{\circ}_{\text{net}} = E^{\circ}_{\text{ox}} + E^{\circ}_{\text{red}} = -0.34 \text{ V} + 0.77 \text{ V} = +0.43 \text{ V}$$

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	Fermentation
B	Combustion
C	Dehydration
D	Addition or hydration

Reaction	Chemical Equation (5 marks)
A	$\text{C}_6\text{H}_{12}\text{O}_6 (\text{aq}) \xrightarrow{\text{Yeast (zymase)}} 2\text{CO}_2 (\text{g}) + 2\text{C}_2\text{H}_5\text{OH} (\text{aq})$
B	$\text{C}_2\text{H}_5\text{OH} (\text{l}) + 3\text{O}_2 (\text{g}) \rightarrow 2\text{CO}_2 (\text{g}) + 3\text{H}_2\text{O} (\text{l or g})$
C	$\text{C}_2\text{H}_5\text{OH} (\text{l}) \xrightarrow{\text{conc. H}_2\text{SO}_4 + \text{heat}} \text{C}_2\text{H}_4 (\text{g}) + \text{H}_2\text{O} (\text{l or g})$
D	$\text{C}_2\text{H}_4 (\text{g}) + \text{H}_2\text{O} (\text{g}) \xrightarrow{\text{H}_2\text{SO}_4 \text{ or } \text{H}_3\text{PO}_4 + \text{heat}} \text{C}_2\text{H}_5\text{OH} (\text{l})$

Question 13 (4 marks)

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

(i) **The ratio of neutrons to protons is unstable. (1 mark)**

(ii) **Large atomic number (greater than 83). (1 mark)**

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

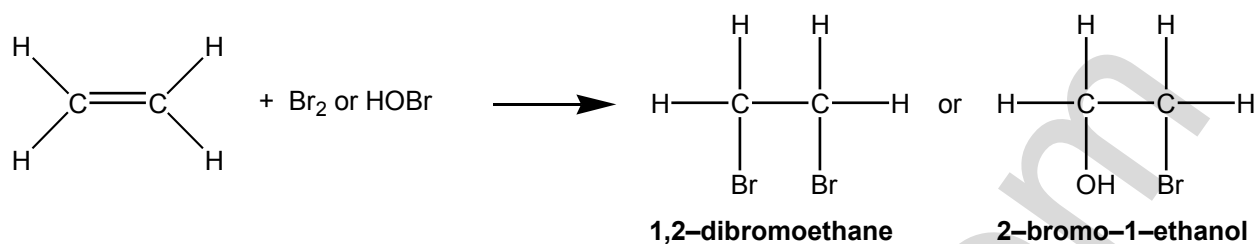
Emission of radioactivity or α or β or γ emission or undergoes radioactive decay.

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

Geiger counter or Cloud chamber or Bubble chamber

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)**

ethenylbenzene

phenylethene

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

Polystyrene can be used for....

- television backings because of its electrical insulating properties.**
- disposable cups for hot/cold drinks because of the excellent thermal insulation of PS foam.**
- lens (magnifying glasses and cheap cameras) because it is transparent and easily moulded.**
- CD cases and model aircraft, etc. because it can be precisely and easily moulded by injection.**

(1 mark for use. 1 marks for property.)

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	Dry cell's anode is zinc. Lead–acid cell's anode is lead.
Write the reduction half–equation	Dry cell – $\text{NH}_4^+ + \text{MnO}_2 + \text{H}_2\text{O} + \text{e}^- \rightarrow \text{Mn(OH)}_3 + \text{NH}_3$ Dry cell – $2\text{NH}_4^+ + 2\text{MnO}_2 + 2\text{e}^- \rightarrow \text{Mn}_2\text{O}_3 + 2\text{NH}_3 + \text{H}_2\text{O}$ Lead–acid – $\text{PbO}_2 + \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightarrow \text{PbSO}_4 + 2\text{H}_2\text{O}$
<u>One</u> advantage of the cell	Dry cell is inexpensive; can be safely disposed when 'dead'. Lead–acid cell provides high current output; reliable; relatively inexpensive; rechargeable.