

ERUVIO MENTORING · EXTERNAL-STYLE EXAMINATION

# Chemistry

*Units 3 and 4 · Equilibrium, acids and redox reactions; structure, synthesis and design*

## Paper 1 · Section 2

SHORT RESPONSE · 30 MARKS

### STUDENT DETAILS

GIVEN NAME(S)

FAMILY NAME

SCHOOL

DATE

BOOK OF

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## Structure of this examination

| PAPER          | SECTION   | QUESTION TYPE                 | TIME                             | MARKS      |
|----------------|-----------|-------------------------------|----------------------------------|------------|
| <b>Paper 1</b> | Section 1 | Multiple choice, 20 questions | 10 min perusal<br>90 min working | 20         |
|                | Section 2 | Short response, 5 questions   |                                  | 30         |
| <b>Paper 2</b> | Section 1 | Short response, 9 questions   | 10 min perusal<br>90 min working | 50         |
| <b>Total</b>   |           | <b>34 questions</b>           | <b>200 minutes</b>               | <b>100</b> |

### Instructions

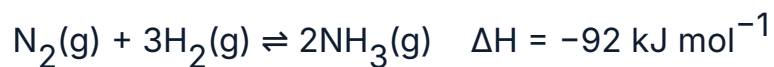
- **Perusal time: 10 minutes. Working time: 90 minutes.**
- You may use a QCAA-approved scientific or graphics calculator. The QCAA Chemistry formula and data book is provided.
- Write using black or blue pen. Planning paper will not be marked.
- All questions are drawn from Unit 3 (equilibrium, acids and redox reactions) and Unit 4 (structure, synthesis and design).
- **Section 2 contains 5 short response questions.** Answer all questions in the spaces provided. Show all working.

*Show all working. Marks are awarded for method as well as for the final answer, so a response with no working cannot receive full marks.*

## Section 2

Short response · 5 questions · 30 marks

- 1 Ammonia is manufactured by the Haber process. The equilibrium is shown below. [6 marks]



- (a) Write the equilibrium constant expression,  $K_c$ , for this reaction. [1]

$K_c =$  \_\_\_\_\_

- (b) State and explain the effect of increasing the temperature on the equilibrium yield of ammonia. [2]

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- (c) State and explain the effect of increasing the total pressure on the equilibrium yield of ammonia. [2]

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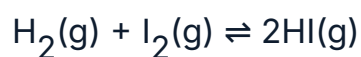
- (d) State the effect of adding a catalyst on the position of this equilibrium. [1]

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- 2 0.500 mol of hydrogen and 0.500 mol of iodine vapour are sealed in a 1.00 L vessel and allowed to reach equilibrium at 700 K. At equilibrium, 0.786 mol of hydrogen iodide is present. [6 marks]



- (a) Complete the ICE table below. [2]

|                           | $\text{H}_2$ | $\text{I}_2$ | $\text{HI}$ |
|---------------------------|--------------|--------------|-------------|
| Initial concentration     |              |              |             |
| Change in concentration   |              |              |             |
| Equilibrium concentration |              |              |             |

(b) Calculate the value of  $K_c$  at 700 K.

[3]

WORKING

$K_c =$  \_\_\_\_\_

(c) State what this value of  $K_c$  indicates about the position of equilibrium.

[1]

3 Ethanoic acid is a weak monoprotic acid with  $K_a = 1.74 \times 10^{-5}$  at 25 °C.

[6 marks]

(a) Write the equation for the reaction of ethanoic acid with water, and identify the two conjugate acid and base pairs.

[2]

(b) Calculate the pH of a  $0.150 \text{ mol L}^{-1}$  solution of ethanoic acid.

[3]

WORKING

pH = \_\_\_\_\_

- (c) Explain why this solution has a higher pH than a  $0.150 \text{ mol L}^{-1}$  solution of hydrochloric acid. [1]

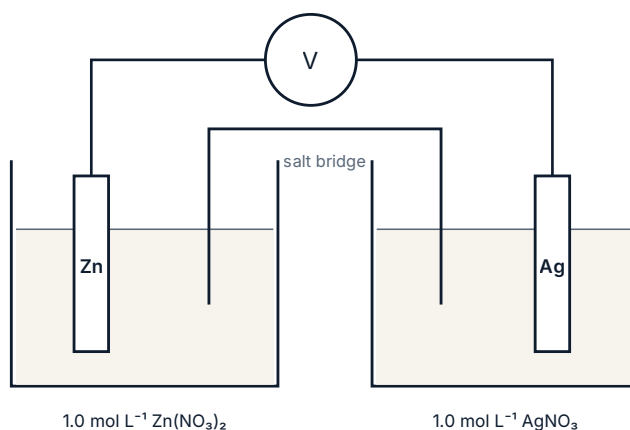
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- 4 The galvanic cell below operates under standard conditions.  $E^\circ(\text{Zn}^{2+}/\text{Zn}) = -0.76 \text{ V}$  and  $E^\circ(\text{Ag}^+/\text{Ag}) = +0.80 \text{ V}$ . [6 marks]



- (a) Write the half-equation occurring at the anode and the half-equation occurring at the cathode. [2]

Anode \_\_\_\_\_

Cathode \_\_\_\_\_

- (b) Calculate the standard cell potential. [1]

WORKING

$E^\circ_{\text{cell}} = \text{----- V}$  \_\_\_\_\_

- (c) State the direction of electron flow in the external circuit and the direction in which anions move through the salt bridge. [2]

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(d) State the function of the salt bridge.

[1]

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5 This question is about organic compounds and their reactions.

[6 marks]

(a) Give the IUPAC name of each of the following compounds.

[2]



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(b) Name the type of reaction occurring in each conversion below.

[2]



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(c) Write the equation for the reaction between ethanoic acid and ethanol in the presence of concentrated sulfuric acid, and name the organic product.

[2]

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END OF PAPER