LUI | | | | | | | | | | |

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Book [ ] of [ ] books used

External assessment 2023

Question and response book

Chemistry

Paper 1

Time allowed

- Perusal time — 10 minutes
- Working time — 90 minutes

General instructions

- Answer all questions in this question and response book.
- QCAA-approved calculator permitted.
- QCAA formula and data book provided.
- Planning paper will not be marked.

Section 1 (20 marks)

- 20 multiple choice questions

Section 2 (37 marks)

- 7 short response questions

Clear zone — margin trimmed off after completion of assessment

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

Do not write on this page

This page will not be marked

Section 1

Instructions

- This section has 20 questions and is worth 20 marks.
- Use a 2B pencil to fill in the A, B, C or D answer bubble completely.
- Choose the best answer for Questions 1–20.
- If you change your mind or make a mistake, use an eraser to remove your response and fill in the new answer bubble completely.

	A	B	C	D
Example:	●	○	○	○

	A	B	C	D
1.	○	○	○	○
2.	○	○	○	○
3.	○	○	○	○
4.	○	○	○	○
5.	○	○	○	○
6.	○	○	○	○
7.	○	○	○	○
8.	○	○	○	○
9.	○	○	○	○
10.	○	○	○	○

	A	B	C	D
11.	○	○	○	○
12.	○	○	○	○
13.	○	○	○	○
14.	○	○	○	○
15.	○	○	○	○
16.	○	○	○	○
17.	○	○	○	○
18.	○	○	○	○
19.	○	○	○	○
20.	○	○	○	○

Ensure you have filled an answer bubble for each question.

Do not write outside this box.

Section 2

Instructions

- Write using black or blue pen.
- If you need more space for a response, use the additional pages at the back of this book.
  - On the additional pages, write the question number you are responding to.
  - Cancel any incorrect response by ruling a single diagonal line through your work.
  - Write the page number of your alternative/additional response, i.e. See page ...
  - If you do not do this, your original response will be marked.
- This section has seven questions and is worth 37 marks.

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Question 21 (4 marks)

CO(g) reacts with $O_2(g)$ in a sealed container producing $CO_2(g)$ to reach equilibrium.

$$2CO(g) + O_2(g) \rightleftharpoons 2CO_2(g)$$

Apply collision theory to explain how increasing the concentration of O_2 at equilibrium will affect the concentration of CO_2 if the temperature and volume are held constant.

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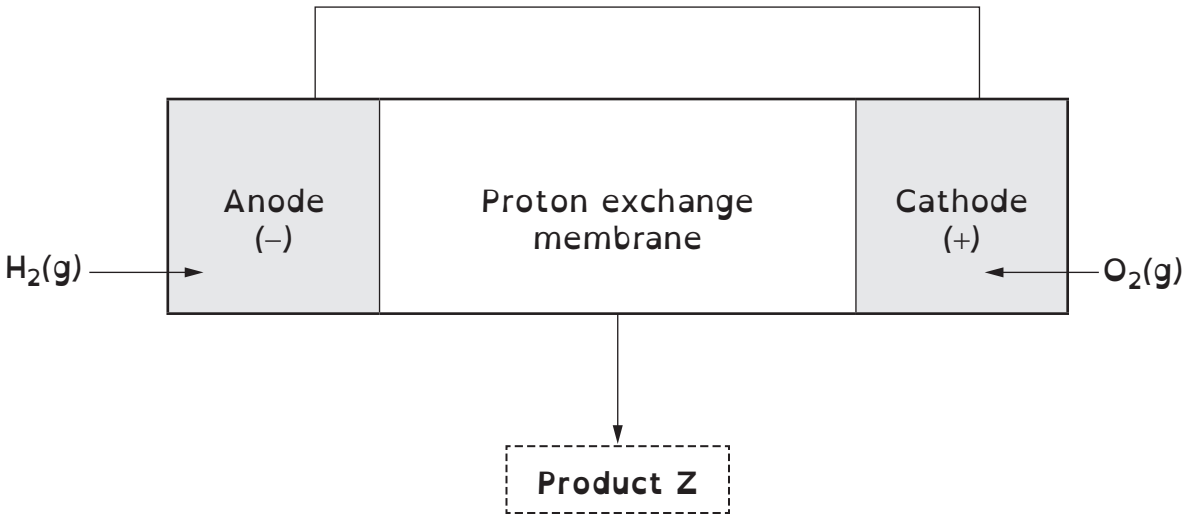
Question 22 (4 marks)

(a) Write a balanced chemical equation to describe how polytetrafluorethene (PTFE) is produced from its monomer. [2 marks]

(b) Determine whether polytetrafluorethene is an addition or condensation polymer. Explain your reasoning. [2 marks]

Question 23 (6 marks)

The diagram represents a hydrogen fuel cell with an acid electrolyte.



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

Anode half-equation: _____

Cathode half-equation: _____

(b) Identify product Z. [1 mark]

_____

(c) Compare the movement of electrons and hydrogen ions in the fuel cell. [3 marks]

Similarity: _____

_____

_____

Difference: _____

_____

_____

Significance: _____

_____

_____

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Question 24 (5 marks)

R and Q are unknown transition metals from period 4 of the periodic table. Pieces of R and Q were placed separately into four 0.1 M aqueous solutions. The results are shown.

Unknown metal	0.1 M aqueous solution			
	$Zn(NO_3)_2$	$Mg(NO_3)_2$	$Cu(NO_3)_2$	$AgNO_3$
R	Coating	No coating	Coating	Coating
Q	No coating	No coating	Coating	Coating

A second experiment was conducted to determine the potential difference produced by electrochemical cells constructed using metals R and Q as the electrodes.

Electrochemical cell	Cathode	Anode	Voltage (V)
1	Q	R	+0.94
2	R	Q	−0.94

Do not write outside this box.

Determine the identity of metals R and Q. Explain your reasoning.

Do not write outside this box.

Question 25 (7 marks)

During the contact process for manufacturing sulfuric acid, sulfur dioxide (SO_2) and oxygen (O_2) are passed over a vanadium oxide catalyst to produce sulfur trioxide (SO_3). In the process, the vanadium oxide undergoes the following reactions.

Reaction 1: $SO_2(g) + V_2O_5(s) \rightarrow SO_3(g) + V_2O_4(s)$

Reaction 2: $2V_2O_4(s) + O_2(g) \rightarrow 2V_2O_5(s)$

Overall reaction: $2SO_2(g) + O_2(g) \xrightarrow{V_2O_5(s)} 2SO_3(g)$

(a) Determine the oxidation state of vanadium in $V_2O_4(s)$. [1 mark]

(b) Determine if vanadium in $V_2O_5(s)$ in reaction 1 is acting as an oxidising or reducing agent. Explain your reasoning. [2 marks]

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(c) Use the reactions provided to explain why $V_2O_5(s)$ is a catalyst for the overall reaction. [4 marks]

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Question 26 (5 marks)

The table shows a series of reactions that were performed to produce organic compounds A, B and C.

Reaction	Reactant	Reagents/conditions	Products
1	propanol	conc. $H_2SO_4(aq)$ / heat	compound A and water
2	compound A	$H_2O(g)$ / heat	compound B and propanol
3	compound B	$H^+(aq)$ / $KMnO_4(aq)$ / heat	compound C

(a) Determine the IUPAC name for compound A. [1 mark]

IUPAC name: _____

(b) Explain one structural difference between compound B and propanol. [2 marks]

_____

_____

_____

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(c) Deduce the structural formula of compound C. [1 mark]

Note: If you make a mistake in the drawing, cancel it by ruling a single diagonal line through your work and use the additional response space at the back of this question and response book.

(d) Describe one qualitative observation that would be expected for reaction 3. [1 mark]

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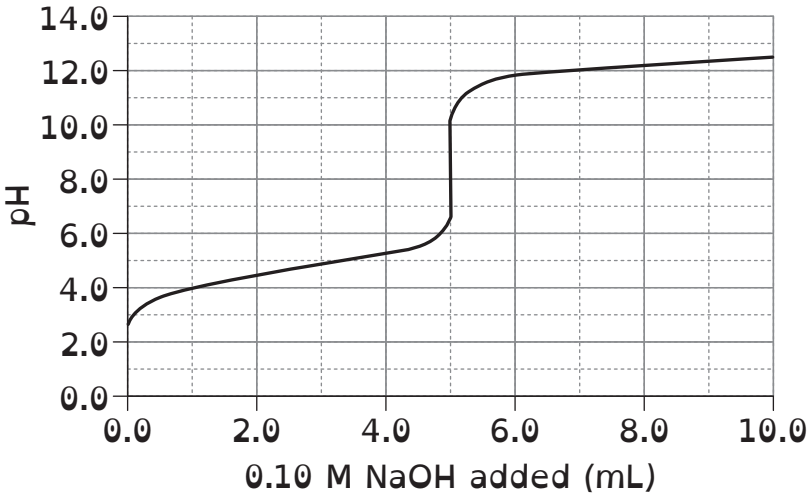
Question 27 (6 marks)

An unknown monoprotic acid solution was titrated with 0.1 M NaOH(aq).



(a) Use Le Châtelier's principle to explain why phenolphthalein is a suitable indicator for this titration. [4 marks]

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(b) Predict whether the pH of the equivalence point and the volume of NaOH required to neutralise the acid would change if the concentration of NaOH was doubled to 0.2 M. [2 marks]

End of paper

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Additional page for student responses

Write the question number you are responding to.

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References

Question 26

Modified from Brown, C & Ford, M 2009, *Chemistry*, 1st edition, Pearson Education, Marlow, Essex.