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School
code

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School name

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Given name/s

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Family name

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Attach your
barcode ID label here

Book of books used

External assessment 2023

Question and response book

Chemistry

Paper 2

Time allowed

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

General instructions

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

Section 1 (54 marks)

- 9 short response questions



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This page will not be marked



Section 1

Instructions

- 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.
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Do not write on this page

This page will not be marked

Do not write outside this box.

Question 1 (2 marks)

Polylactic acid (PLA) and low-density polyethylene (LDPE) are both used to produce plastic wrapping film.

Plastic	Composition	Density (g/cm ³)	Tensile stress (MPa)	Elongation (%)	Degradation rate
PLA	plant-based	1.24	60	6	slow
LDPE	petrochemical-based	0.92	12	148	none

Analyse the data to discuss one advantage and one disadvantage of using PLA rather than LDPE to produce plastic wrapping film.

Advantage: _____

Disadvantage: _____

Do not write outside this box.

Question 2 (3 marks)

Compare the structure of α -helix and β -pleated sheets in the secondary structure of proteins.

Similarity: _____

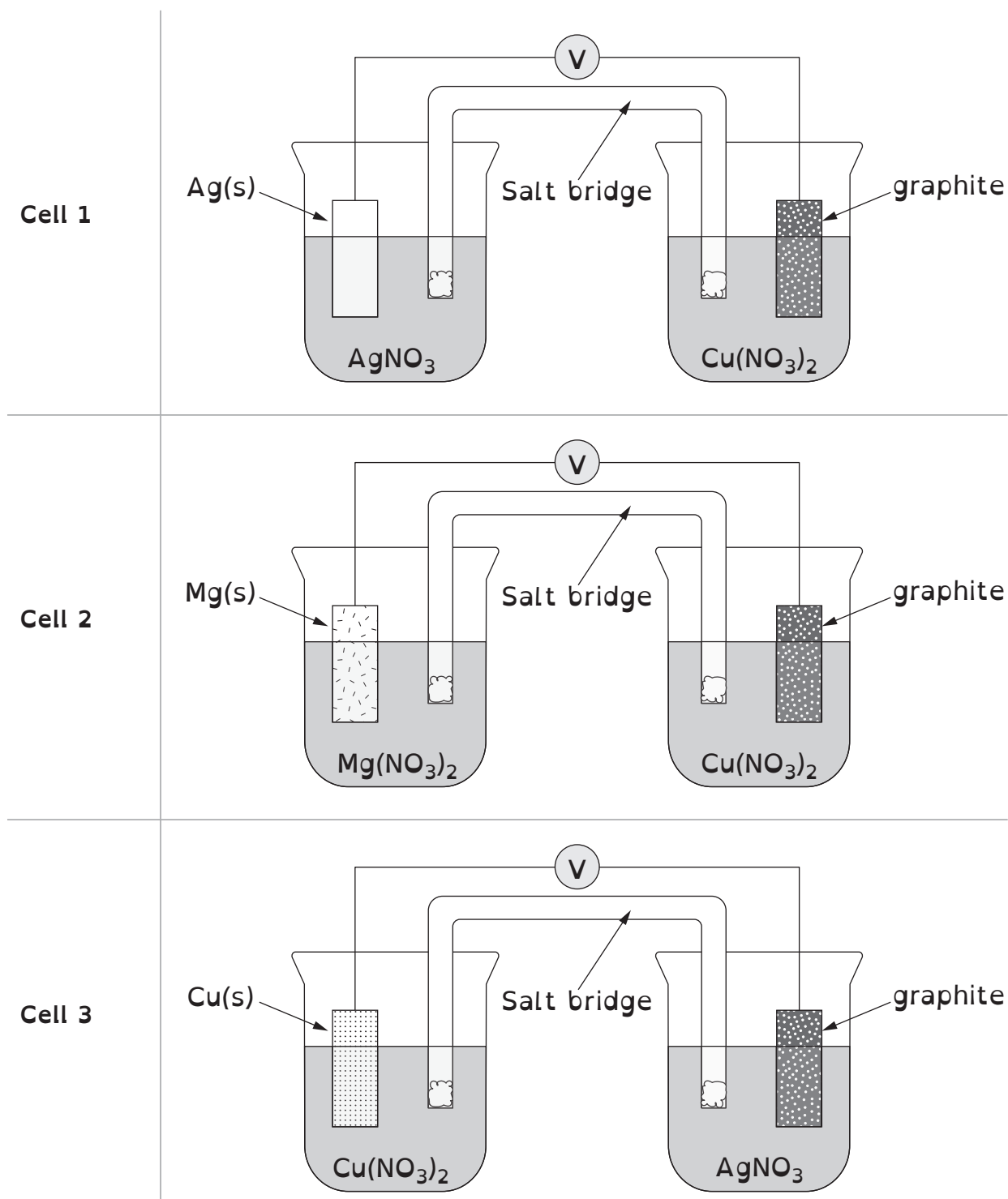
Difference: _____

Significance: _____

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Question 3 (7 marks)

An experiment was conducted at standard state conditions to investigate the potential difference (V) produced by different galvanic cells. The three cells used in the experiment are shown.



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(a) Predict which cell produced the highest voltage. Explain your reasoning. [3 marks]

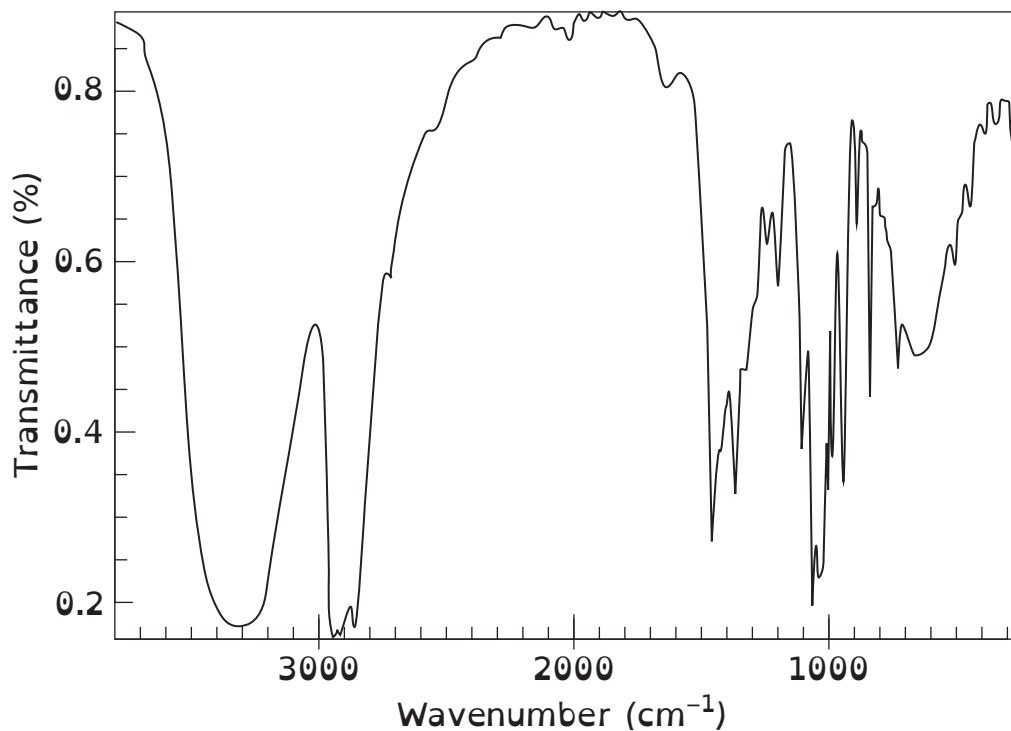
(b) Determine the maximum voltage that could be produced by a fourth galvanic cell constructed from any of the components used in the first three cells. Use oxidation and reduction half-equations to justify your answer. [4 marks]

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Question 4 (8 marks)

Compound C has the molecular formula $C_4H_{10}O$ and is either an alcohol, an aldehyde or a carboxylic acid.

Compound C infrared spectrum



(a) Deduce the class of compound C. Explain your reasoning. [4 marks]

Do not write outside this box.

(b) Deduce the structural formula and IUPAC name of two isomers of compound C. [2 marks]

Isomer 1:

IUPAC name: _____

Isomer 2:

IUPAC name: _____

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.

Do not write outside this box.

(c) Distinguish between structural and geometric isomers. [2 marks]

Question 5 (13 marks)

The table gives the properties of four monoprotic acids.

Acid	Concentration (mol L ⁻¹)	[H ⁺] (mol L ⁻¹)	pH	K _a
1	0.200	7.90×10^{-5}		
2	0.100	4.20×10^{-3}	2.34	1.80×10^{-4}
CH ₃ COOH(aq)	0.100			1.78×10^{-5}
HCl(aq)	0.010	1.00×10^{-2}	2.00	>1

(a) Determine the relative strength of acids 1 and 2 by contrasting their K_a values. [3 marks]

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(b) Write a balanced chemical equation for the dissociation of ethanoic acid (CH_3COOH) in water. [2 marks]

(c) Identify whether the conjugate base of ethanoic acid ($\text{CH}_3\text{COOH}(\text{aq})$) is amphiprotic. Explain your reasoning. [2 marks]

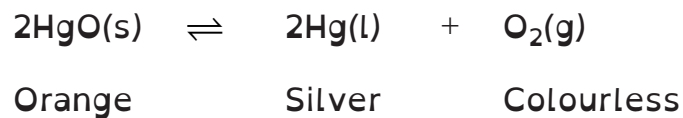
(d) Calculate the pH of the aqueous solution of ethanoic acid (CH_3COOH). Show your working. [3 marks]

(e) Determine the volume of water that would need to be added to 100.0 mL of $\text{HCl}(\text{aq})$ to change the pH from 2.00 to 3.00. Explain your reasoning. [3 marks]

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Question 7 (4 marks)

When heated in a sealed container, solid mercury(II) oxide (HgO) decomposed to form metallic mercury (Hg) and oxygen gas (O₂).



(a) Identify whether the reaction occurs in an open or closed system.
[1 mark]

(b) Explain why the colour of the system does not change once equilibrium is established. [3 marks]

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Question 8 (7 marks)

Two experiments were conducted to investigate the effect of temperature on the equilibrium formed during the decomposition of hydrogen iodide (HI).



Experiment	Initial concentration (mol L ⁻¹)			Equilibrium concentration (mol L ⁻¹)			K _c
	[HI]	[H ₂]	[I ₂]	[HI]	[H ₂]	[I ₂]	
1	0.08	0.00	0.00		0.01		2.78 × 10 ⁻²
2	0.00	0.06	0.06	0.06	0.03	0.03	

(a) Determine the concentration of HI(g) and I₂(g) at equilibrium for experiment 1. [2 marks]

[HI]: _____

[I₂]: _____

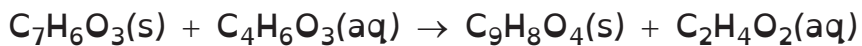
(b) Calculate the equilibrium constant (K_c) for experiment 2. Show your working. [2 marks]

(c) Determine which experiment was conducted at a higher temperature. Explain your reasoning. [3 marks]

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Question 9 (4 marks)

Aspirin ($C_9H_8O_4$) can be produced from a reaction between salicylic acid ($C_7H_6O_3$) and acetic anhydride ($C_4H_6O_3$) with ethanoic acid being a minor product.



Calculate the mass of salicylic acid required to produce 8.25 g of aspirin if the percentage yield of the reaction is 60%. Show your working.

End of paper

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Additional page for student responses

Write the question number you are responding to.

Do not write outside this box.

References

Question 4

Minor adaptation from Coblenz Society, Inc., 2-Butanol 2018, in NIST Chemistry WebBook, NIST Standard Reference Database Number 69, Nist.gov, National Institute of Standards and Technology, U.S. Secretary of Commerce <https://webbook.nist.gov/cgi/cbook.cgi?ID=C78922&Type=IR-SPEC&Index=1>



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