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

School code | | | | |

School name

Given name/s

Family name

Attach your barcode ID label here

Book of books used

External assessment 2021

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)

- 8 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

- Choose the best answer for Questions 1–20.
- 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.
- 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.	○	○	○	○
11.	○	○	○	○
12.	○	○	○	○
13.	○	○	○	○
14.	○	○	○	○
15.	○	○	○	○
16.	○	○	○	○
17.	○	○	○	○
18.	○	○	○	○
19.	○	○	○	○
20.	○	○	○	○

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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 eight questions and is worth 37 marks.

QUESTION 21 (3 marks)

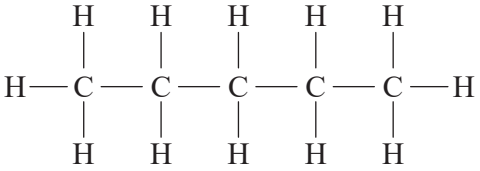
Calculate the pH of a 0.1 M aqueous solution of $Ba(OH)_2$, assuming complete dissociation.
Show your working.

pH = _____ (to one decimal place)

Do not write outside this box.

QUESTION 22 (4 marks)

The structural formula for pentane (C_5H_{12}) is shown.



Draw the structural formulas for two structural isomers of pentane. Name each isomer.

a) Isomer 1 *[2 marks]*

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 on page 16 of this question and response book.

IUPAC name: _____

b) Isomer 2 *[2 marks]*

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 on page 16 of this question and response book.

IUPAC name: _____

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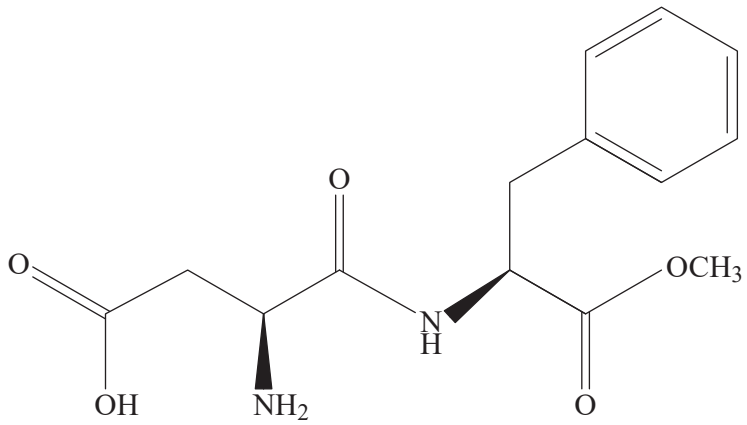
QUESTION 23 (5 marks)

Aspartame is a methyl ester of a dipeptide that hydrolyses to form methanol and two amino acids. The structure of aspartame is shown.



a) Identify the two amino acids that form aspartame. *[1 mark]*

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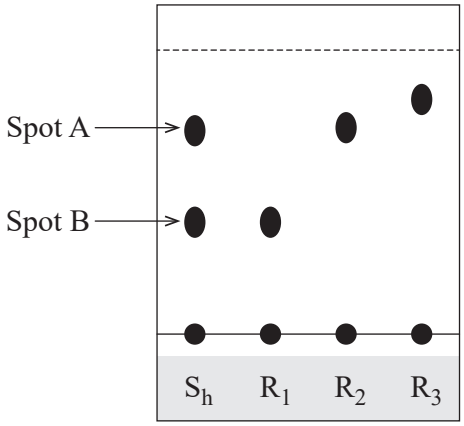
A hydrolysed sample of aspartame was analysed with silica thin layer chromatography (TLC), using a mixture of butanol and ethanoic acid as the solvent. The TLC plate was then reacted with ninhydrin to produce spots.



Key
S_h = hydrolysed aspartame sample
R_1 = reference amino acid 1
R_2 = reference amino acid 2
R_3 = isoleucine

b) Determine which amino acid in aspartame corresponds to Spot A.
Explain your reasoning. *[3 marks]*

c) Explain why the reference amino acids are included on the TLC plate. *[1 mark]*

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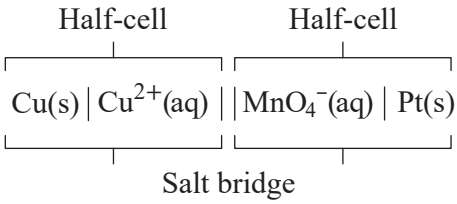
QUESTION 24 (6 marks)

The cell diagram represents a voltaic cell at standard conditions. The copper solution is blue because of the presence of $Cu^{2+}(aq)$ ions. The acidified permanganate solution is purple because of the presence of $MnO_4^-(aq)$ ions.



a) Predict which direction the electrons will flow in the voltaic cell by comparing the relative strength of the oxidising agents. Explain your reasoning. *[3 marks]*

b) Determine the standard reduction potential, E°, for the cell. *[1 mark]*

c) Predict two qualitative observations associated with the flow of electrons and the movement of ions in the voltaic cell. *[2 marks]*

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QUESTION 25 (5 marks)

An equilibrium is formed between two differently coloured cobalt species, $Co(H_2O)_6^{2+}(aq)$, which is pink, and $CoCl_4^{2-}(aq)$, which is blue. The equation for this equilibrium is shown.

$$Co(H_2O)_6^{2+}(aq) + 4Cl^-(aq) \rightleftharpoons CoCl_4^{2-}(aq) + 6H_2O(l)$$

a) Apply Le Châtelier's principle to predict the visible effect of adding $AgNO_3$ to an aqueous blue-coloured solution containing $Co(H_2O)_6^{2+}$ and $CoCl_4^{2-}$ ions. Explain your reasoning. *[3 marks]*

b) When a sample of the equilibrium mixture is put into hot water, the mixture turns more blue. Determine whether the forward reaction of the equation is exothermic or endothermic. Explain your reasoning. *[2 marks]*

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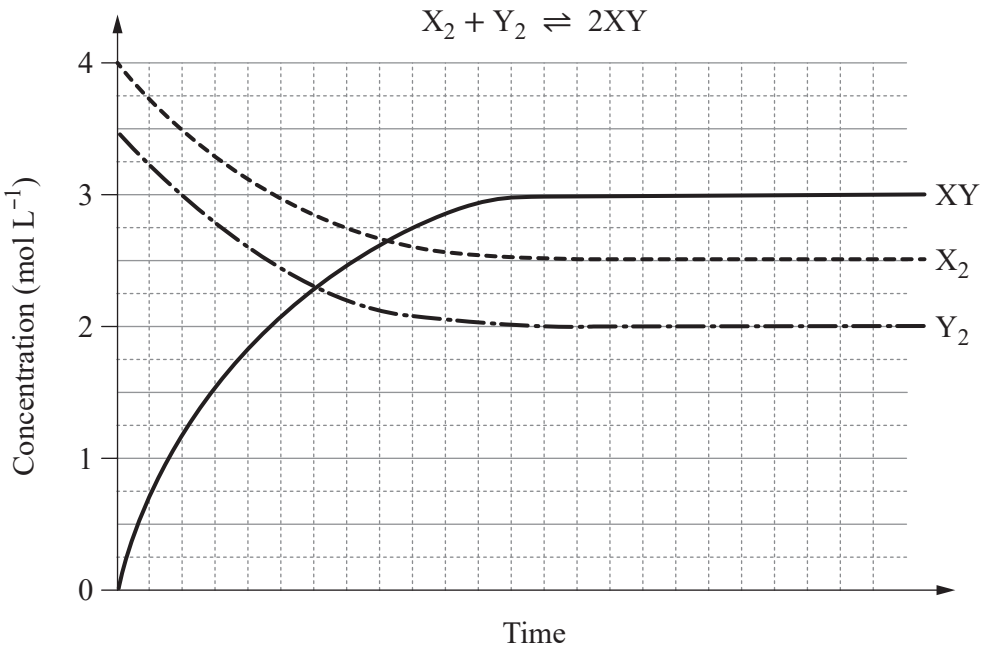
QUESTION 26 (5 marks)

The graph represents changes in concentration over time for three gaseous molecules (X_2, Y_2 and XY) in a closed system at constant temperature and pressure.



a) Identify whether XY is the reactant or the product. *[1 mark]*

b) Calculate the equilibrium constant (K_c) value. *[2 marks]*

$K_c =$ _____ (to two significant figures)

c) Determine whether the position of equilibrium favours the reactants or products. Explain your reasoning. *[2 marks]*

Do not write outside this box.

QUESTION 27 (6 marks)

Arsenous acid, H_3AsO_3, reacts with nitrate ions to form arsenic acid, H_3AsO_4, and nitrogen dioxide.

a) Determine the oxidation number of arsenic in arsenous acid. *[1 mark]*

b) Use half-equations to balance the reaction. *[4 marks]*

c) Determine which species is reduced in this reaction. *[1 mark]*

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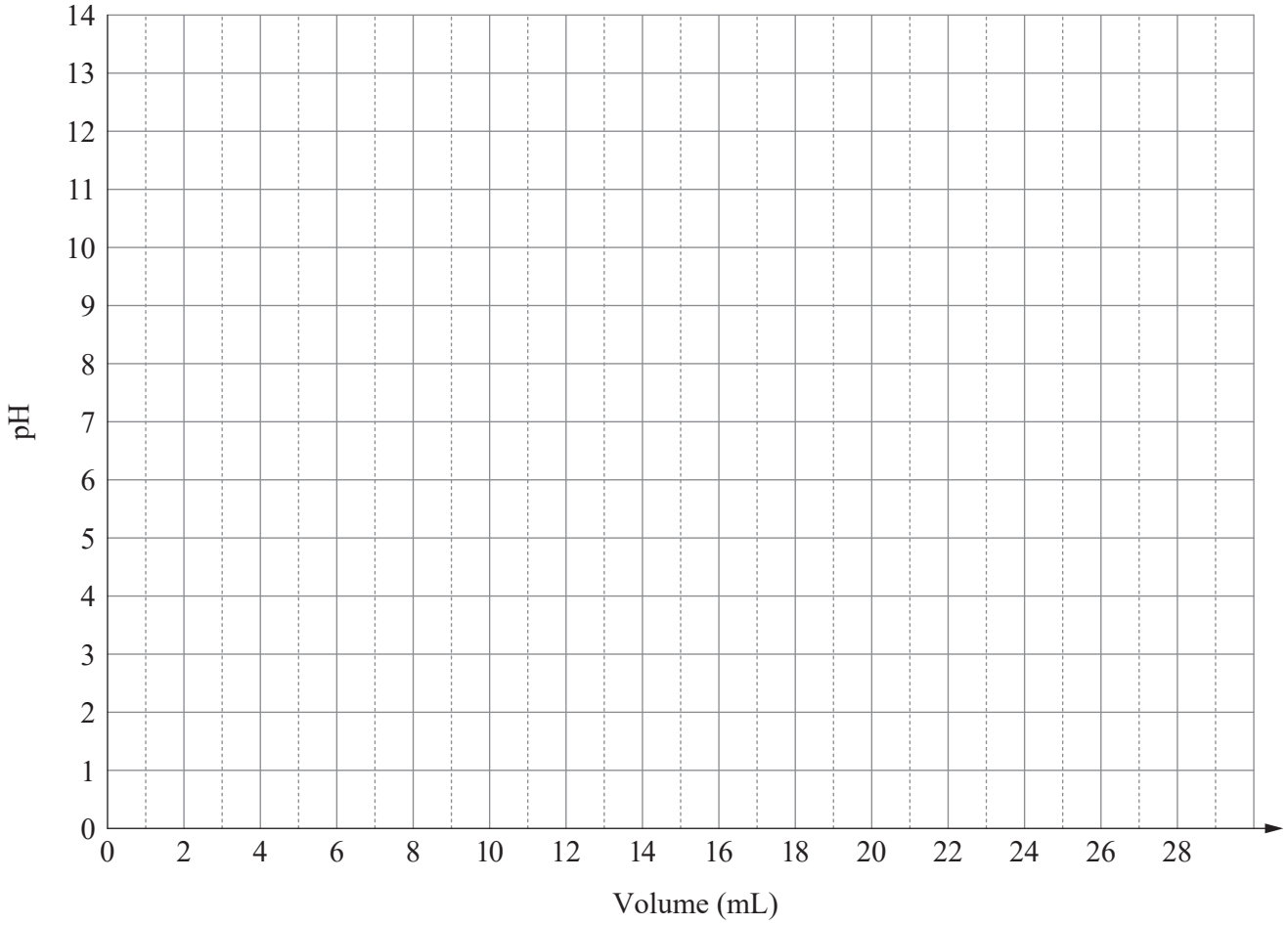
QUESTION 28 (3 marks)

Sketch the titration curve formed when 20 mL of 0.1 M butylamine ($pK_a = 10.0$) is titrated with 0.1 M hydrochloric acid.



Note: If you make a mistake in the sketch, cancel it by ruling a single diagonal line through your work and use the additional response space on page 17 of this question and response book.

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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ADDITIONAL PAGE FOR STUDENT RESPONSES

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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ADDITIONAL RESPONSE SPACE FOR QUESTION 22a)

If you want this drawing to be marked, rule a single diagonal line through the drawing on page 3.

ADDITIONAL RESPONSE SPACE FOR QUESTION 22b)

If you want this drawing to be marked, rule a single diagonal line through the drawing on page 3.

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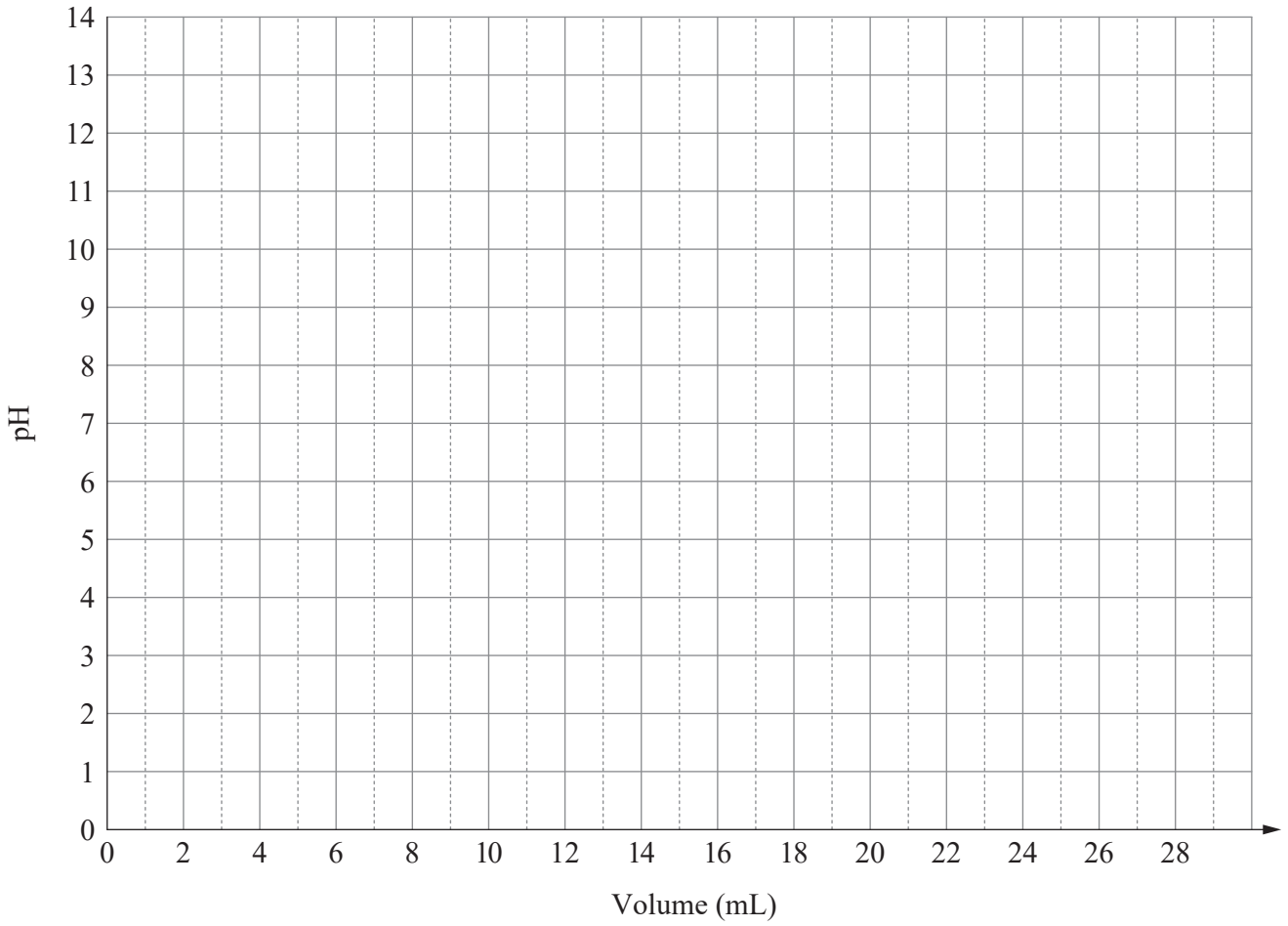
ADDITIONAL RESPONSE SPACE FOR QUESTION 28

If you want this sketch to be marked, rule a single diagonal line through the sketch on page 10.



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