LUI | | | | | | | | | | | School code | | | | |

School name

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Attach your barcode ID label here

Book of books used

External assessment 2024

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 (38 marks)

- 9 short response questions

Clear zone — margin trimmed off after completion of assessment

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

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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.	○	○	○	○
11.	○	○	○	○
12.	○	○	○	○
13.	○	○	○	○
14.	○	○	○	○
15.	○	○	○	○
16.	○	○	○	○
17.	○	○	○	○
18.	○	○	○	○
19.	○	○	○	○
20.	○	○	○	○

Ensure you have filled an answer bubble for each question.

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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 nine questions and is worth 38 marks.

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QUESTION 21 (3 marks)

Reactants A and B are placed in a 1.00 L container and react to form product C. The reaction then reaches equilibrium.

$$A(g) + B(g) \rightleftharpoons C(g) \quad (K_c = 9.9 \times 10^2)$$

a) Explain why a reversible arrow ($\rightleftharpoons$) is used to symbolise this reaction. *[1 mark]*

b) Deduce whether the equilibrium for the reaction lies towards the reactants or products. Explain your reasoning. *[2 marks]*

QUESTION 22 (3 marks)

a) Describe the type of reaction that occurs when amino acid monomers are joined to form polypeptides. *[2 marks]*

b) Identify the bond formed when amino acid monomers join to form a dipeptide. *[1 mark]*

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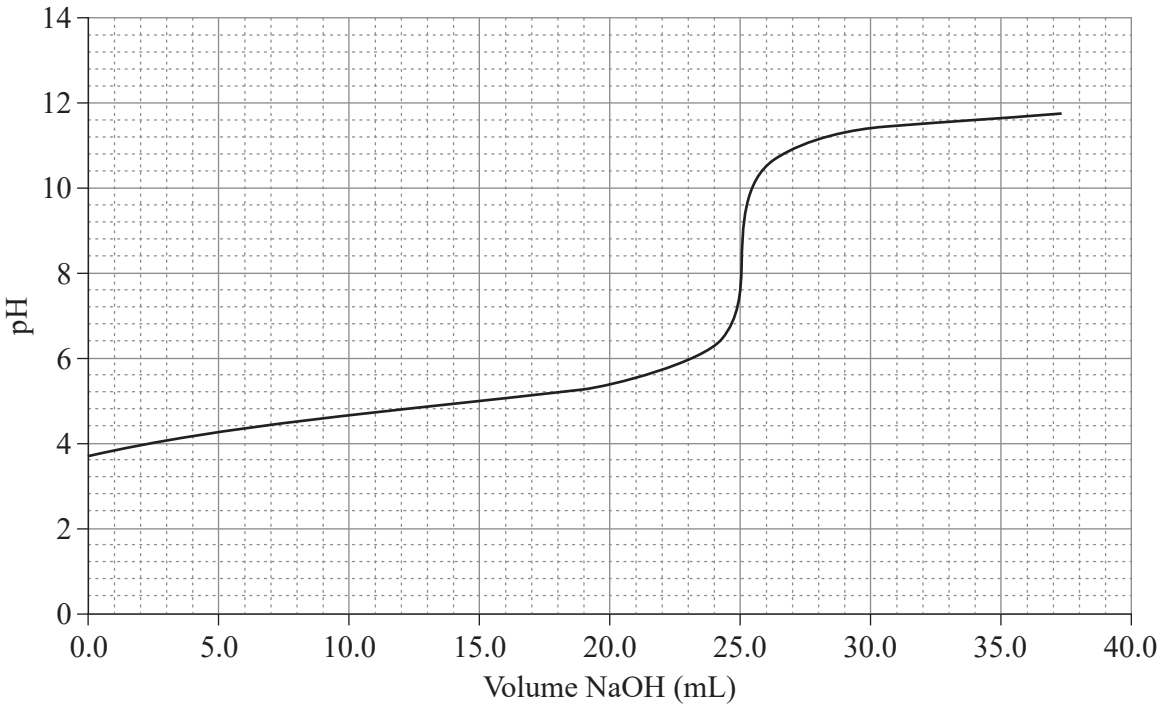
QUESTION 23 (5 marks)

An aqueous solution of sodium hydroxide (NaOH) was titrated against a 30.0 mL aliquot of a 0.012 M potassium hydrogen phthalate (KHP) standard aqueous solution. The balanced chemical equation for the reaction is shown.

$$KHP(aq) + NaOH(aq) \rightarrow KNaP(aq) + H_2O(l)$$

The results are shown in the titration curve.



a) Determine whether KHP is a strong or weak acid. Identify one feature from the titration curve to support your reasoning. *[2 marks]*

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b) Explain why KHP(aq) is used as the standard solution rather than NaOH(aq). *[1 mark]*

c) Calculate the concentration of NaOH(aq). Show your working. *[2 marks]*

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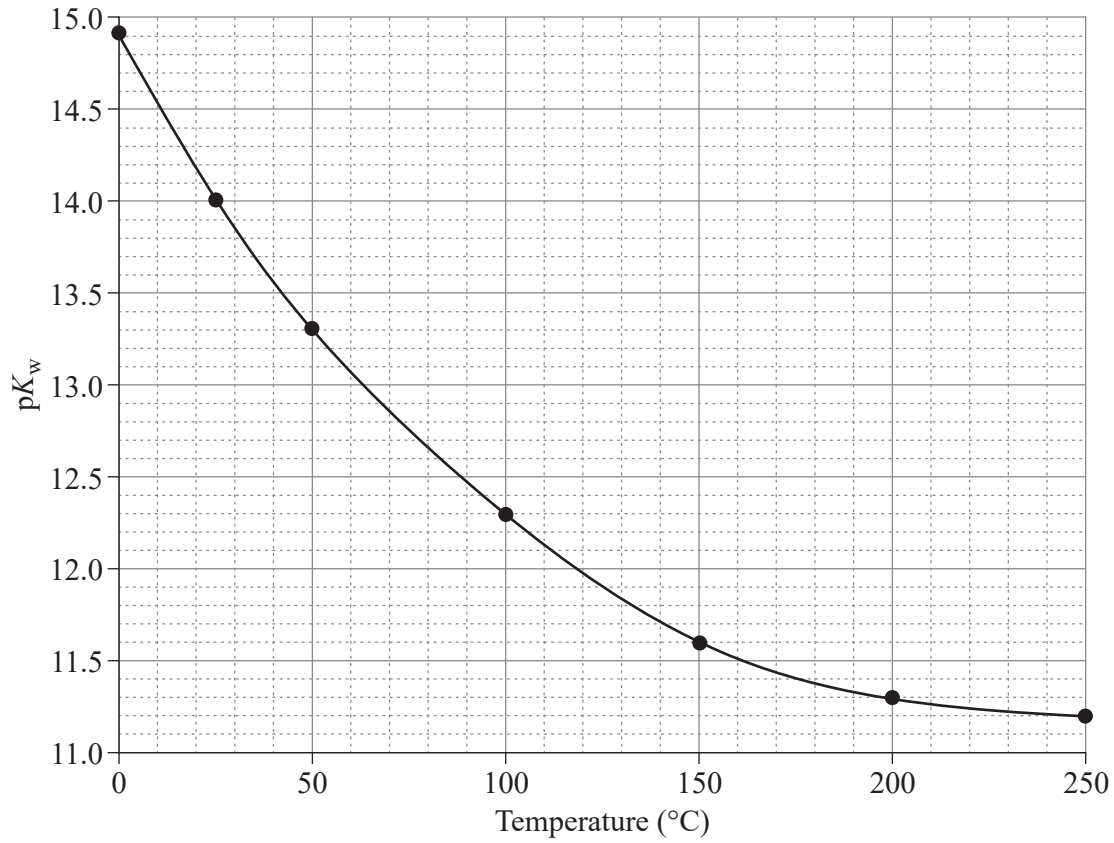
QUESTION 24 (4 marks)

The pK_w of pure water at various temperatures was determined, to investigate the effect of temperature on the equilibrium position of self-ionisation of water.

The results are shown.



Explain the effect of increasing the temperature on the pH of water by considering the enthalpy of the forward reaction.

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QUESTION 25 (3 marks)

Maltose is a disaccharide formed when two monomers of α-glucose are joined.

a) Identify whether α-glucose is an aldose or ketose monosaccharide. *[1 mark]*

b) Distinguish between α-glucose and β-glucose. *[2 marks]*

QUESTION 26 (5 marks)

Aqueous potassium iodate (KIO_3) reacts with aqueous potassium iodide (KI) in the presence of dilute HCl(aq) to form solid iodine (I_2). The overall balanced equation is shown.

$$KIO_3(aq) + 5KI(aq) + 6HCl(aq) \rightarrow 6KCl(aq) + 3I_2(s) + 3H_2O(l)$$

a) Identify the reducing agent. Explain your reasoning. *[2 marks]*

b) Determine the reduction half-equation. *[3 marks]*

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QUESTION 27 (8 marks)

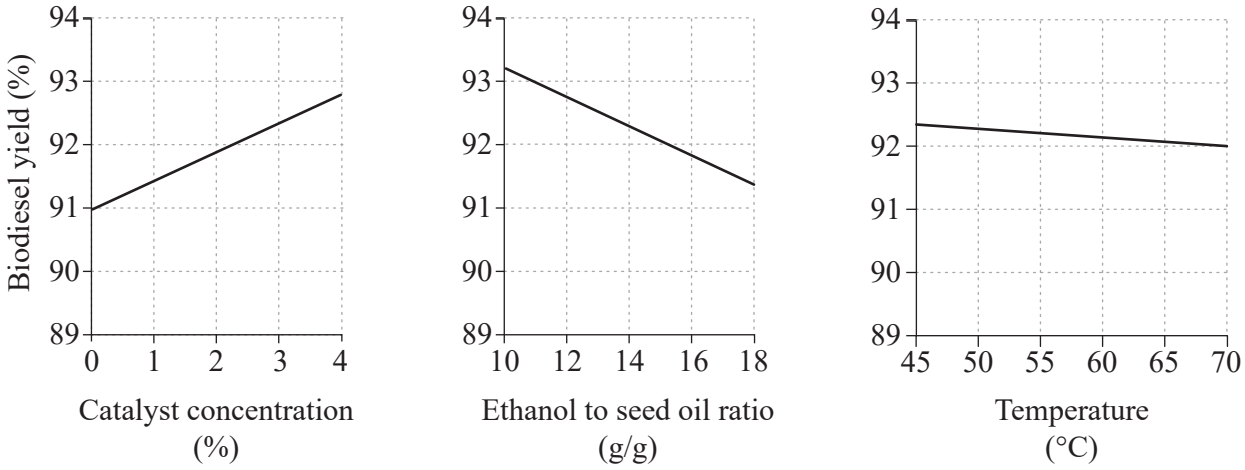
A series of experiments was performed to investigate the optimum reaction conditions to produce biodiesel from seed oils using a two-step process.

Step 1: acid esterification using an acid catalyst (H_2SO_4)

Step 2: transesterification using ethanol as a solvent and magnesium oxide as a nanocatalyst

The experiments measured the effect of the catalyst concentration, ethanol to seed oil ratio and temperature on biodiesel yield. Temperature was held constant when investigating the effect of catalyst concentration and ethanol to seed oil ratio.

The results are shown.



a) Identify the optimal reaction conditions to maximise biodiesel production. *[1 mark]*

Catalyst concentration (%): _____

Ethanol to seed oil ratio (g/g): _____

Temperature (°C): _____

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b) Explain why both esterification and transesterification reactions are used to optimise biodiesel production. *[3 marks]*

c) Determine the effect that catalyst concentration, ethanol to seed oil ratio and temperature have on biodiesel production. Use data to support your reasoning. *[4 marks]*

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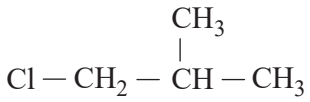
QUESTION 28 (4 marks)

One structural isomer of C_4H_9Cl is shown.



a) Explain why the isomer is a saturated compound. *[1 mark]*

b) Identify whether the isomer is a primary or secondary haloalkane. *[1 mark]*

c) Determine the structural formula of another isomer of C_4H_9Cl that is a tertiary haloalkane, and apply IUPAC rules to name this isomer. *[2 marks]*

IUPAC name:

Note: If you make a mistake, 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.

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QUESTION 29 (3 marks)

Methylamine is a weak base that forms a buffer solution when mixed with methylammonium ($CH_3NH_3^+$)(aq).

$$\text{methylamine} + H_2O(l) \rightleftharpoons CH_3NH_3^+(aq) + OH^-(aq)$$

a) Describe, using a diagram, the structural formula of methylamine. *[1 mark]*

Note: If you make a mistake, 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.

b) Apply Le Châtelier's principle to explain how the methylamine–methylammonium buffer solution would resist a change in pH if a small amount of NaOH was added. *[2 marks]*

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ADDITIONAL PAGE FOR STUDENT RESPONSES

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References

Question 27

Adapted from figure 3 in Hundie KB & Akuma DA 2022, 'Optimization of biodiesel production parameters from Prosopisjulifera seed using definitive screening design', Heliyon, vol. 8, no. 2, www.ncbi.nlm.nih.gov/pmc/articles/PMC8857467/#:~:text=Optimum%20biodiesel%20conversion%20efficiency%20of,and%201000%20rpm%20agitation%20rate.