— Public use —

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Sample assessment 2020

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 (25 marks)

- 25 multiple choice questions

Section 2 (35 marks)

- 8 short response questions

Clear zone — margin trimmed off after completion of assessment

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

Section 1

Instructions

- Choose the best answer for Questions 1–25.
- This section has 25 questions and is worth 25 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.	○	○	○	○
21.	○	○	○	○
22.	○	○	○	○
23.	○	○	○	○
24.	○	○	○	○
25.	○	○	○	○

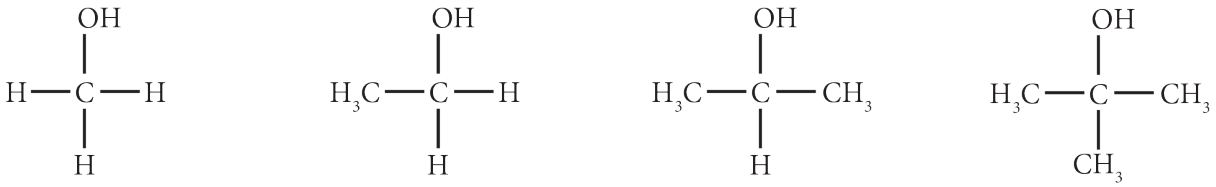
Section 2

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 35 marks.

QUESTION 26 (2 marks)

The structural formulas of four alcohols are shown below.



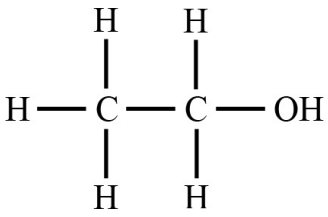
A **B** **C** **D**

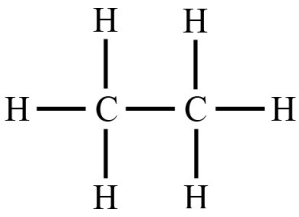
a) Determine which structure above (A, B, C or D) contains a tertiary carbon atom. *[1 mark]*

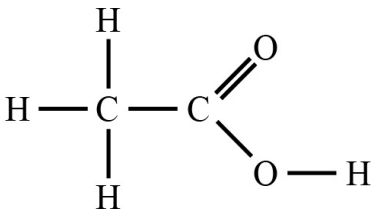
b) Apply the IUPAC rules to name the secondary alcohol shown above. *[1 mark]*

QUESTION 27 (3 marks)

The structural formulas of three organic compounds (ethanol, ethane and ethanoic acid) are shown below.







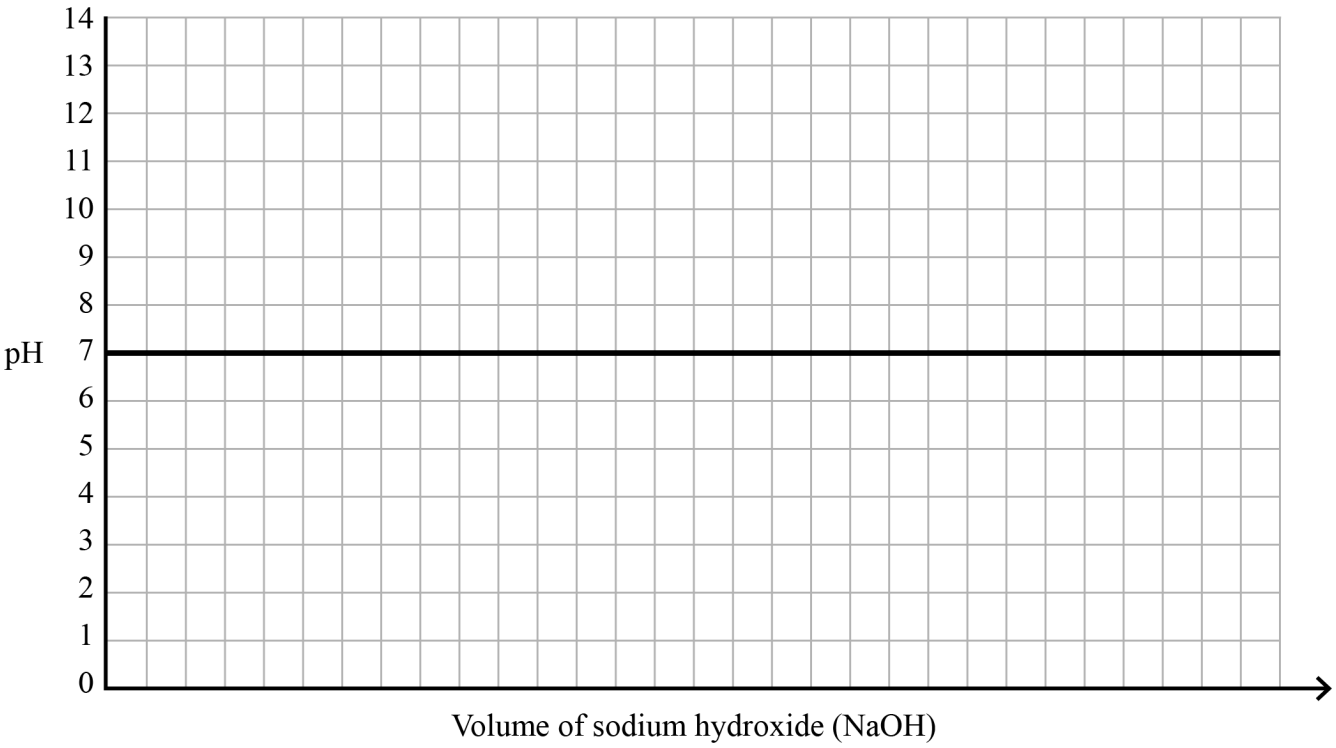
Explain the solubility in water of these three molecules in terms of intermolecular forces.

QUESTION 28 (3 marks)

On the axes below, sketch the titration curve when 0.1 M ethanoic acid (CH_3COOH) is titrated with 0.1 M sodium hydroxide (NaOH) and circle the:

- initial pH of the acid
- equivalence point
- buffer region.

Note: If you make a mistake in the axes, cancel it by ruling a single diagonal line through your work and use the additional axes on page 13 of this question and response book.



QUESTION 29 (6 marks)

The contact process is an important industrial process for making sulfuric acid (H_2SO_4). This process occurs in three stages.

Stage 1: sulfur + oxygen ⟶ sulfur dioxide

$$S(s) + O_2(g) \longrightarrow SO_2(g)$$

Stage 2: sulfur dioxide + oxygen ⇌ sulfur trioxide

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Stage 3: sulfur trioxide + water ⟶ sulfuric acid

$$SO_3(g) + H_2O(l) \longrightarrow H_2SO_4(l)$$

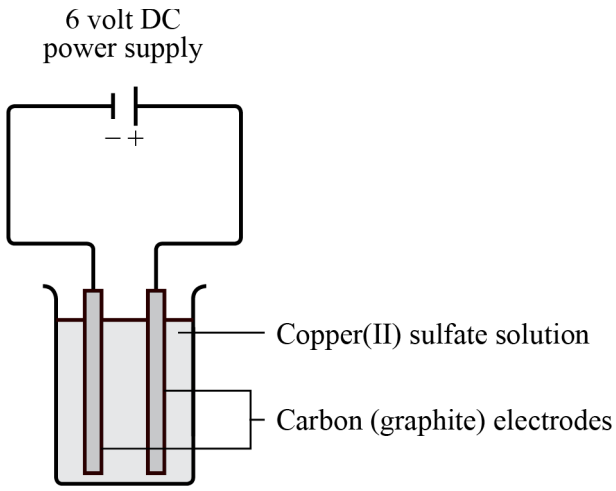
a) Explain which stage of the process would be affected by a change in pressure. *[2 marks]*

b) Calculate the mass of sulfur required to produce 1100 kg of sulfuric acid if the yield of sulfur trioxide in the contact process is 97%. Show your working. *[4 marks]*

Mass = _____ kg

QUESTION 30 (5 marks)

The following diagram shows the electrolysis of a 0.5 M solution of copper(II) sulfate ($CuSO_4$).



a) Predict the product formed at the anode. *[1 mark]*

b) Explain which product would be formed at the cathode. *[3 marks]*

c) Identify one limitation associated with the use of standard reduction potentials. *[1 mark]*

QUESTION 31 (6 marks)

Phenolphthalein is an organic compound often used as an acid-base indicator. In its colourless form (H_2In) it is a weak acid that dissociates in water to form pink anions (In^{2-}).

a) Determine the equilibrium equation for phenolphthalein. *[1 mark]*

b) Identify the conjugate base in the equilibrium equation determined above. *[1 mark]*

c) Explain why phenolphthalein does not change colour in an acidic solution when titrated with a small amount of NaOH. *[4 marks]*

QUESTION 32 (5 marks)

a) Calculate the concentration of hydroxide ions (OH^-) at pH 12.3. Show your working. *[2 marks]*

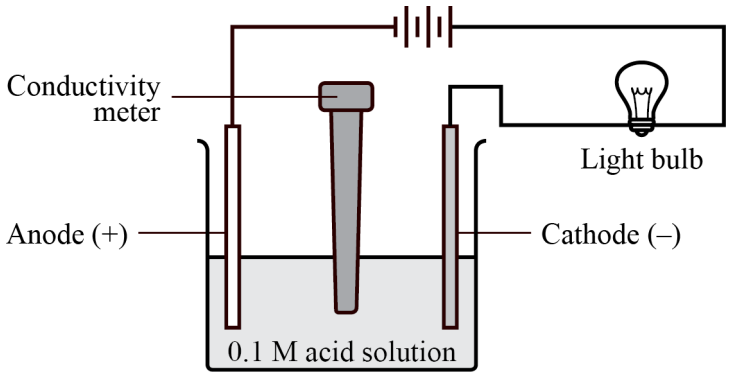
Concentration = _____ mol/L

b) If 15.55 mL of a 0.10 M standardised solution of sodium hydroxide (NaOH) is required to neutralise 10.00 mL of sulfuric acid (H_2SO_4), calculate the concentration of the sulfuric acid solution (in mol/L). Show your working. *[3 marks]*

Concentration = _____ mol/L

QUESTION 33 (5 marks)

The experiment shown below was set up to investigate the relative strengths of two unknown acids. The power supply was connected to two graphite rods.



The brightness of the bulb and the electrical conductance for each acid are recorded in the table below.

Acid solution (0.1 M)	**Bulb brightness**	**Electrical conductance** (micromho/cm) at 25 °C
A	dim	4.2
B	very bright	11.7

a) Analyse the experimental data to determine which acid is strongest. *[1 mark]*

b) Explain the relationship between the brightness of the bulb, conductivity and the strength of the acids. *[4 marks]*

END OF PAPER

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

ADDITIONAL PAGE FOR STUDENT RESPONSES

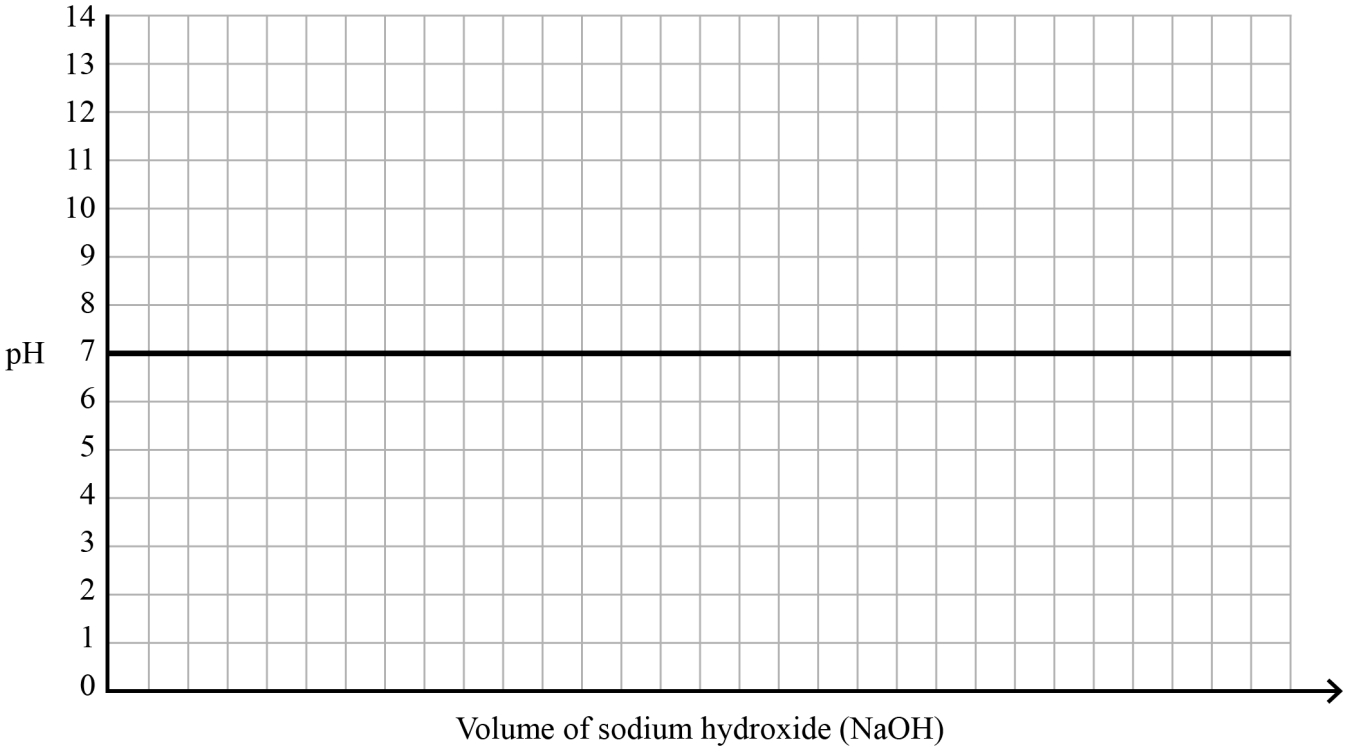
Write the question number you are responding to.

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

ADDITIONAL RESPONSE SPACE FOR OUESTION 28

If you want these axes to be marked, rule a diagonal line through the axes on page 4.



DO NOT WRITE ON THIS PAGE

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