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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

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of

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books used

External assessment

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 (40 marks)

- 7 short response questions



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:	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	A	B	C	D
1.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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 40 marks.
-

QUESTION 21 (5 marks)

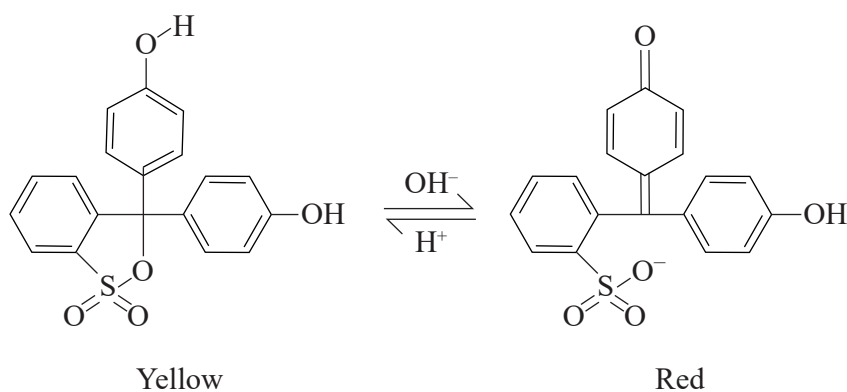
a) Glucose is an example of which type of carbohydrate? *[1 mark]*

b) Starch and cellulose are both polymers of glucose. Compare the structure of starch and cellulose in terms of their glycosidic links. *[4 marks]*

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QUESTION 22 (7 marks)

The structures of phenol red when in either an acidic or a basic solution are shown in the equation.



- a) Identify the species that acts as the conjugate base by circling it in the equation.

[1 mark]

Note: If you make a mistake, draw a line through this equation and use the additional equation provided on page 13 of this question and response book.

- b) A solution of phenol red at equilibrium and 50 °C was found to contain 2.0×10^{-4} M of the conjugate base and 0.034 M of the acid. Determine the pK_a for the system, assuming all the protons present come from dissociation of the acid.

[3 marks]

$pK_a =$ _____ (to two significant figures)

Do not write outside this box.

c) Explain the relationship between the pH range of phenol red and its pK_a value.

[3 marks]

QUESTION 23 (6 marks)

a) Identify the products of the electrolysis of

i) molten sodium chloride: _____ [1 mark]

ii) dilute aqueous sodium chloride solution: _____ [1 mark]

b) Explain how the nature of the electrolyte affects the products generated when a dilute aqueous solution of sodium chloride undergoes electrolysis.

[4 marks]

Do not write outside this box.

QUESTION 24 (5 marks)

This table shows the effect of temperature on the pH of pure water.

Temperature (°C)	pH
10	7.27
15	7.17
20	7.08
25	7.00
30	6.92
50	6.63

- a) Analyse the data to explain whether the self-ionisation of water is endothermic or exothermic. Explain your reasoning.

[3 marks]

- b) Calculate the K_w of pure water at 50 °C. Show your working.

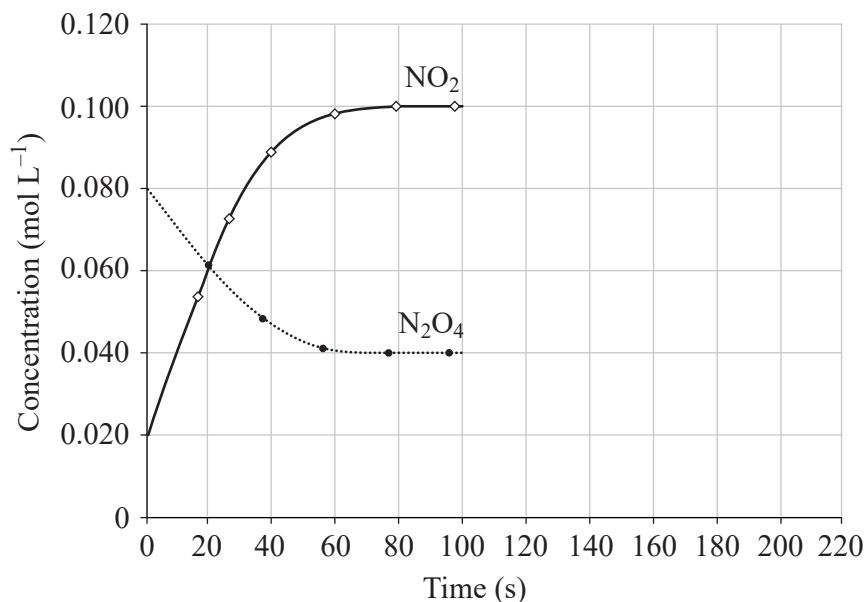
[2 marks]

$K_w =$ _____ (to three significant figures)
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QUESTION 25 (5 marks)

This graph depicts the changes in concentration over time for a nitrogen dioxide / dinitrogen tetroxide gaseous equilibrium in a closed system at constant temperature.



- a) Determine the balanced chemical equation for the reaction in this system. [1 mark]

- b) Identify the time at which equilibrium is reached. [1 mark]

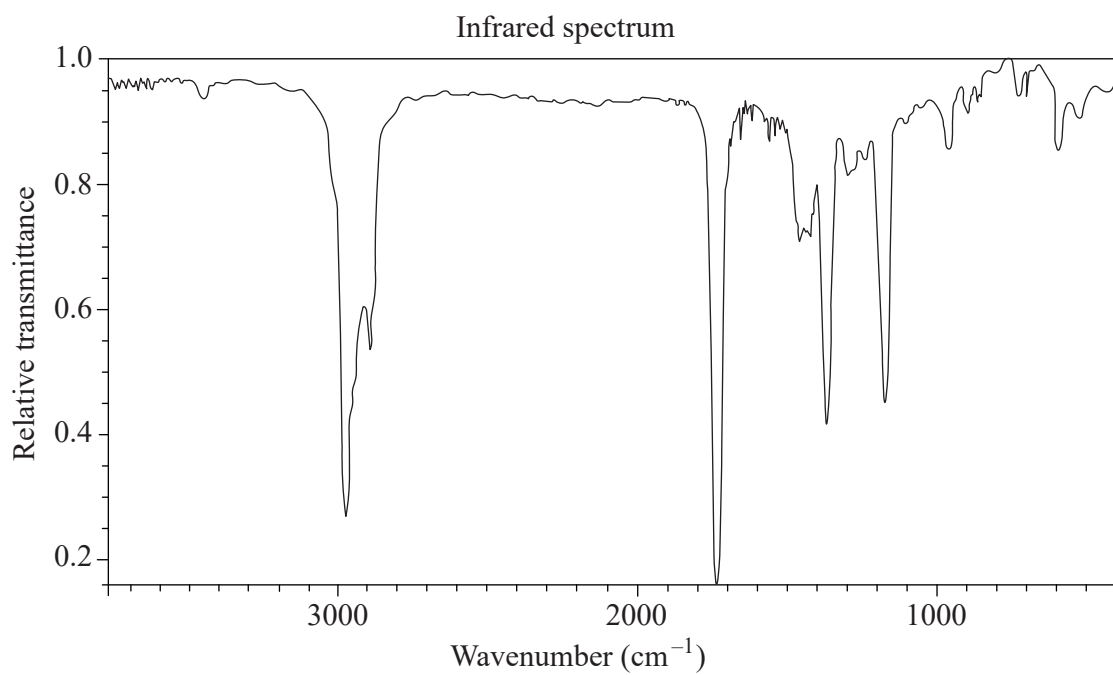
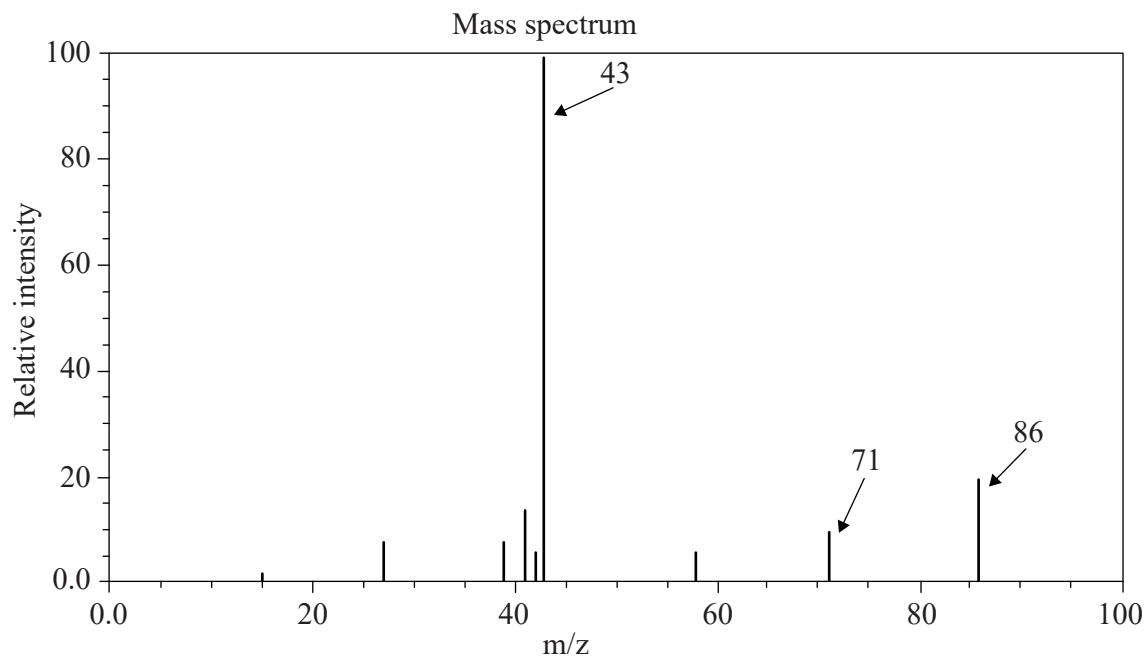
- c) If temperature is held constant, predict the effect that doubling the volume at 100 seconds would have on the closed system by sketching the change that would occur and the approximate position of the new equilibrium on the graph. [3 marks]

Note: If you make a mistake, draw a line through this graph and use the additional graph provided on page 13 of this question and response book.

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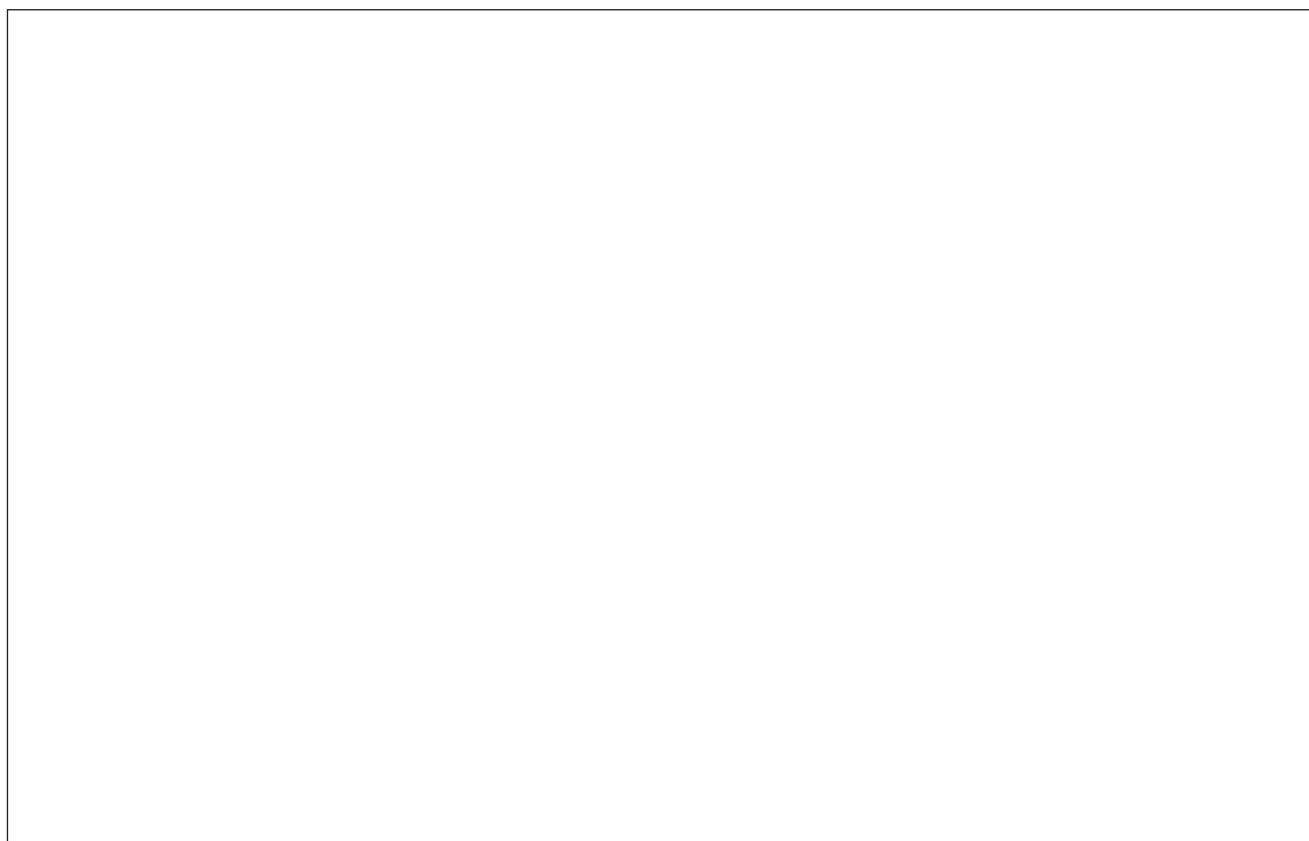
QUESTION 26 (5 marks)

The mass and infrared spectra for an organic compound, X, with the empirical formula $C_5H_{10}O$, are shown.



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Analyse the spectra to deduce the structural formula of X. Explain your reasoning.



Do not write outside this box.

QUESTION 27 (7 marks)

Four unknown metals Q, X, Z and A were placed into separate test tubes containing a 0.1 M solution of their respective nitrate solutions. The results are shown in the table.

Metal	Q(NO ₃) ₂ solution	X(NO ₃) ₂ solution	Z(NO ₃) ₂ solution	A(NO ₃) ₂ solution
Q	Not tested	No reaction	No reaction	No reaction
X	Coating formed	Not tested	No reaction	No reaction
Z	Coating formed	Coating formed	Not tested	Coating formed
A	Coating formed	Coating formed	No reaction	Not tested

a) Identify the species oxidised in the reaction between Z and X(NO₃)₂. [1 mark]

b) Identify the oxidising agent in the reaction between Z and Q(NO₃)₂. [1 mark]

c) Determine the products formed from the reaction between Z and A(NO₃)₂. [1 mark]

d) Predict the standard reduction potential table for the metals Q, X, Z and A by listing their reduction half-equations from strongest to weakest reducing agent. Explain your reasoning. [4 marks]

END OF PAPER

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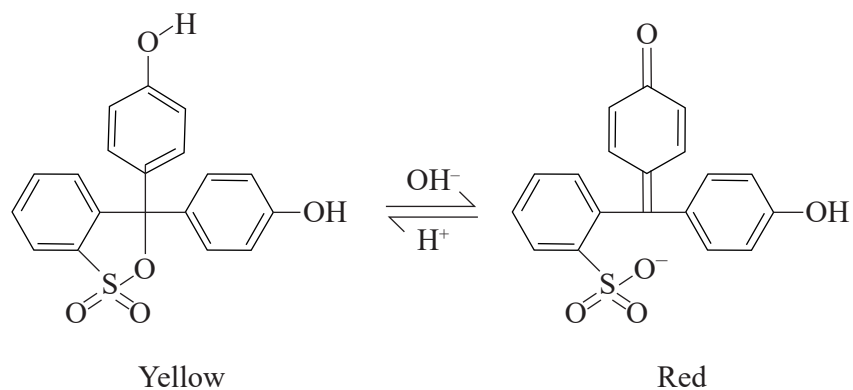
ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

Do not write outside this box.

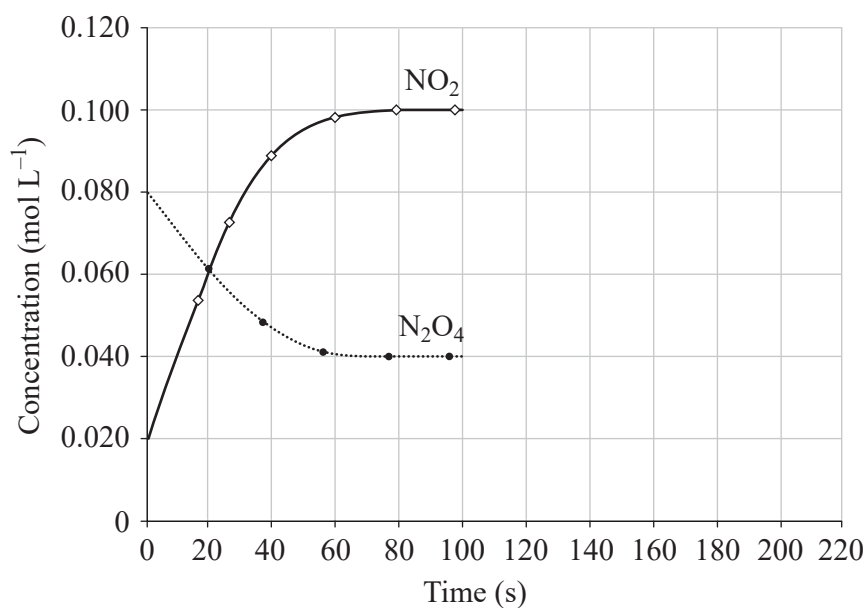
ADDITIONAL RESPONSE SPACE FOR QUESTION 22

If you want your response on this equation to be marked, rule a line through the equation provided on page 3.



ADDITIONAL RESPONSE SPACE FOR QUESTION 25

If you want your response on this graph to be marked, rule a line through the graph provided on page 6.



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References

Question 25

Pearson Education 2015, *Chemistry: Review questions*, <https://wps.pearsoned.com.au/ibcsl/89/22897/5861740.cw/index.html>.

Question 26

Coblentz Society 1964, 'Infrared spectrum', *National Institute of Standards and Technology*, U.S. Secretary of Commerce, <https://webbook.nist.gov/cgi/cbook.cgi?ID=C107879&Type=IR-SPEC&Index=1>.

National Institute of Standards and Technology 2018, *NIST Chemistry WebBook, SRD 69*, <https://webbook.nist.gov/cgi/cbook.cgi?ID=C107879&Mask=200#Mass-Spec>.



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