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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Chemistry 2026

91166 Demonstrate understanding of chemical reactivity

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of chemical reactivity.	Demonstrate in-depth understanding of chemical reactivity.	Demonstrate comprehensive understanding of chemical reactivity.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

A periodic table and other reference material are provided in the Resource Booklet L2–CHEMR.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

Do not write in the margins (////). This area will be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

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QUESTION ONE

(a) Catalytic converters have been used in fuel vehicles to help convert toxic by-products into safer alternatives. One reaction involves the conversion of toxic carbon monoxide, $CO(g)$, to the less harmful carbon dioxide, $CO_2(g)$.

The reaction for this process is represented below:

$$2CO(g) + O_2(g) \rightleftharpoons 2CO_2(g)$$

(i) Write the K_c expression for this reaction:

Explain the effect on the position of equilibrium if:

(ii) the pressure in the catalytic converter system is decreased

(iii) the reaction is performed without using the catalyst.

(iv) This process is performed by heating the reaction to 450 °C. At this higher temperature, the value of K_c increases.

Justify, using equilibrium principles, whether the forward reaction is exothermic or endothermic.

(b) The equilibrium constant expression for another reaction occurring in the converter is:

$$K_c = \frac{[N_2][H_2O]^2}{[H_2]^2[NO]^2} \qquad K_c = 650$$

(i) Give the equation for this step of the reaction (assume all species are gases).

(ii) For the above reaction, the value for K_c at 25 °C is 650.

At the concentrations below, the reaction is not at equilibrium.

Gas	N_2	H_2	H_2O	NO
Concentration (mol L^{-1})	0.0190	0.0290	0.0510	0.0380

Show by calculation that this reaction is NOT at equilibrium.

(iii) To reach equilibrium, would the forward or reverse reaction need to be favoured?

Justify your answer.

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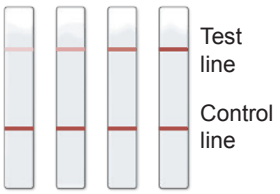
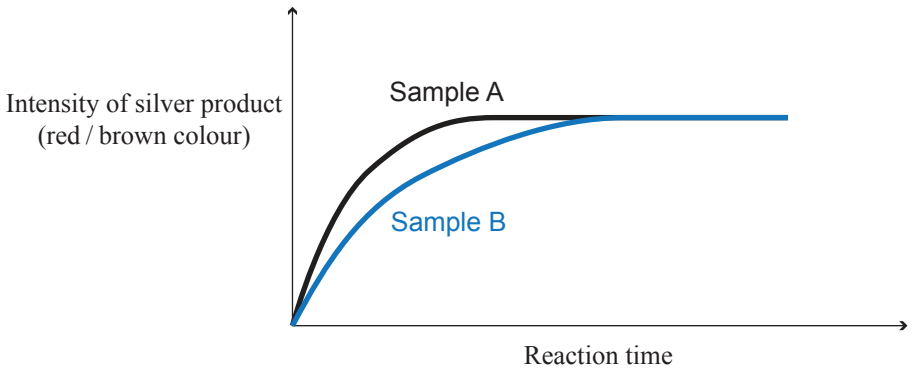
The assessment continues on the following page.

QUESTION TWO



Many COVID-19 test strips use a silver product to indicate a positive result for the COVID-19 virus. The strips change from colourless to the red / brown silver product when the virus is present in a high concentration.

The graph below shows two different test samples, Sample A and Sample B.



(a) Explain whether Sample A or Sample B has a higher concentration of the virus.

Refer to the shape of the graph in your answer.

(b) Explain, with reference to principles of collision theory, how the following conditions could allow the silver product to be produced faster:

(i) increasing the temperature

(ii) using a catalyst (you may include a diagram in your answer).

Optional diagram:

(c) 0.0700 mol L^{-1} of hydrochloric acid, HCl(*aq*), is reacted with a solution of potassium hydroxide, KOH(*aq*).

(i) Calculate the pH of the HCl solution used in the reaction.

(ii) Calculate the concentration of the potassium hydroxide, KOH(*aq*), if the pH is 12.8.

(iii) The potassium hydroxide solution, KOH(*aq*), reacts with a new solution of hydrochloric acid, HCl(*aq*), which has a concentration of 0.0250 mol L^{-1}.

Elaborate on changes to the rate of reaction.

In your answer, refer to principles of collision theory.

QUESTION THREE

(a) Solutions were made of each of the following three substances:

	$NH_4Cl(aq)$	**$NaCl(aq)$**	**$HCl(aq)$**
Concentration	0.100 mol L^{-1}	0.100 mol L^{-1}	0.100 mol L^{-1}
pH	4.5	7	1
Electrical conductivity	Good	Good	Good

(i) Explain why all three of the solutions can act as good conductors of electricity.

(ii) Justify why each of the solutions in the table have the same concentration, but a different pH. Use equations to support your answer.

Question Three continues on the following page.

(b) (i) Identify the conjugate acid of the weak base ammonia, $NH_3(aq)$.

(ii) Explain how ammonia, $NH_3(aq)$, can act as a weak base.

In your answer, you should include:

- a definition for acids and bases referring to proton transfer
- an explanation of base strength
- a prediction for the approximate pH of a weak base solution.

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER