



Student Number:

Teacher's Name:

2022

Task 1: Depth Study

Weighting: 20%

Year 12 Chemistry

General Instructions

- Reading time - 5 minutes
- Working time - 40 minutes
- Write using black or blue pen
- Board-approved calculators may be used
- A data sheet, formulae sheets and Periodic Table are provided.
- Coloured diagrams for Qu 3 and 4 are provided on a separate sheet.
- This paper **MUST NOT** be removed from the assessment room.

Subject Teachers:

Ms Disney, Mrs Goddard,
Ms Dreesbeimdieke, Mr Pimentel,
Ms Banks, Mr Hall

Total marks - 27

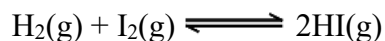
- Complete all questions (Qu 1-5).
- If you need extra space for a question, raise your hand and ask for an extra writing booklet.
- If you use an extra writing booklet, clearly indicate in this booklet where it has been used.
- Write your student number and question number clearly in the writing booklet.

Extra booklets used: _____

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Question 1 (4 marks)

The equilibrium system involving $\text{H}_2(\text{g})$ and $\text{I}_2(\text{g})$ is commonly used as it shows a clear colour change. $\text{I}_2(\text{g})$ is purple, $\text{H}_2(\text{g})$ and $\text{HI}(\text{g})$ are colourless.



- (a) Identify by circling the correct option below whether the final equilibrium system would be darker or lighter purple than the initial colour if more HI was added to the system. **1**

Darker purple

Lighter purple

- (b) A closed system initially contained $1.00 \times 10^{-3} \text{ mol L}^{-1} \text{ H}_2$ and $2.00 \times 10^{-3} \text{ mol L}^{-1} \text{ I}_2$ at 448°C . When the system reached equilibrium the concentration of HI was $1.87 \times 10^{-3} \text{ mol L}^{-1}$. **3**

Calculate K at 448°C for this system.

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Question 2 (4 marks)

Two students conducted an experiment to investigate the chromate ion / dichromate ion equilibrium system.

The aim of the experiment was to determine how changing the concentration of substances in the equilibrium affects the equilibrium position.

Student A set up an experiment and gathered the results shown in Table 1.

Student B set up an experiment and gathered the results shown in Table 2.

Both students used the same volumes and concentrations in test tubes 1-3.

Table 1: Student A

Test tube	Contents	External change	Observed colour change
1	chromate ions / dichromate ions	Adds chromate ions	Yellow to orange
2	chromate ions / dichromate ions	Adds acid	Yellow to orange
3	chromate ions / dichromate ions	Adds dichromate ions	Orange to yellow

Table 2: Student B

Test tube	Contents	External change	Observed colour change
1	chromate ions / dichromate ions	Adds chromate ions	Yellow to orange
2	chromate ions / dichromate ions	Adds acid	Yellow to orange
3	chromate ions / dichromate ions	Adds dichromate ions	Orange to yellow
4	chromate ions	Nothing added	None observed
5	dichromate ions	Nothing added	None observed

Question over page.

Compare the validity of Student A and Student B's experimental designs.

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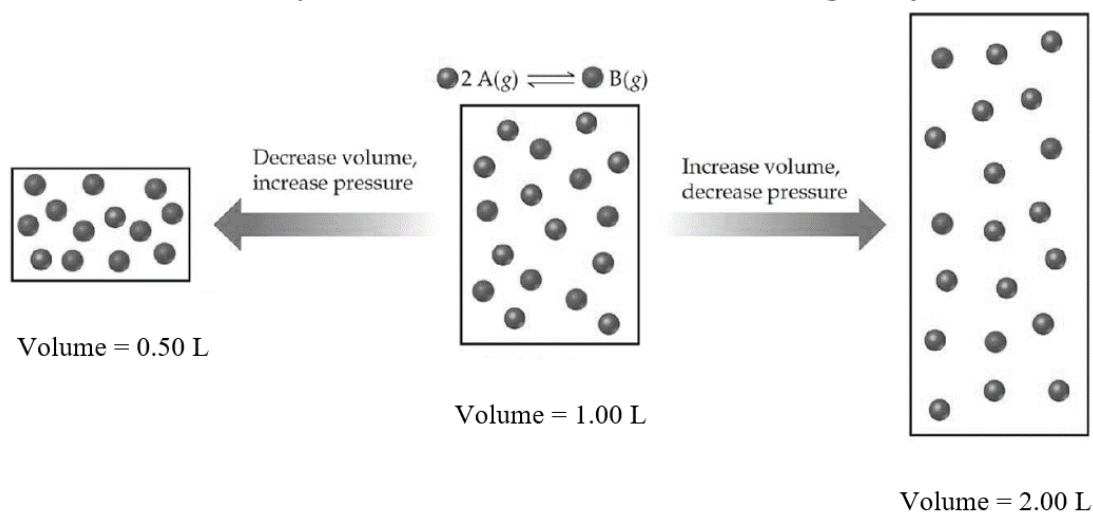
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Question 3 (4 marks)

The diagram below shows a model representing a gaseous equilibrium system undergoing pressure changes.

(A coloured version of this diagram is shown on the separate sheet).



Assess the model for accuracy. You should include an analysis of K in your answer.

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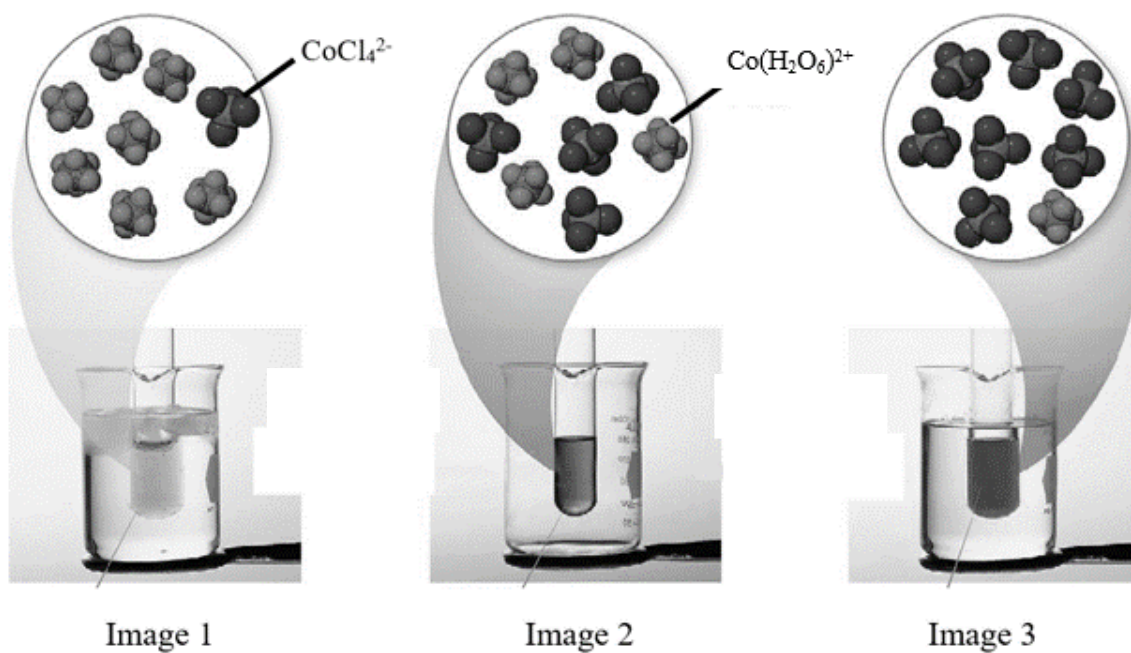
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Question 4 (8 marks)

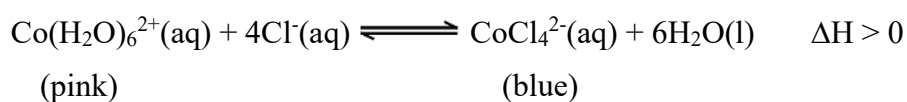
The diagram below shows an initial cobalt chloride equilibrium (Image 2).

Images 1 and 3 (in no particular order) show the results of heating and cooling the equilibrium system.

(A coloured version of this diagram is shown on the separate sheet).



The equation for the reaction is:



Questions over page.

- (a) Using the colours and molecules in the stimulus, explain which image, 1 or 3, shows heating of the solution.

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- (b) Explain, in terms of collision theory, why the K value changes when the equilibrium system is heated. Use a diagram or sketch graph as part of your answer.

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Question 5 (7 marks)

In Term 4, you conducted an experiment to create a solubility curve for potassium chloride.

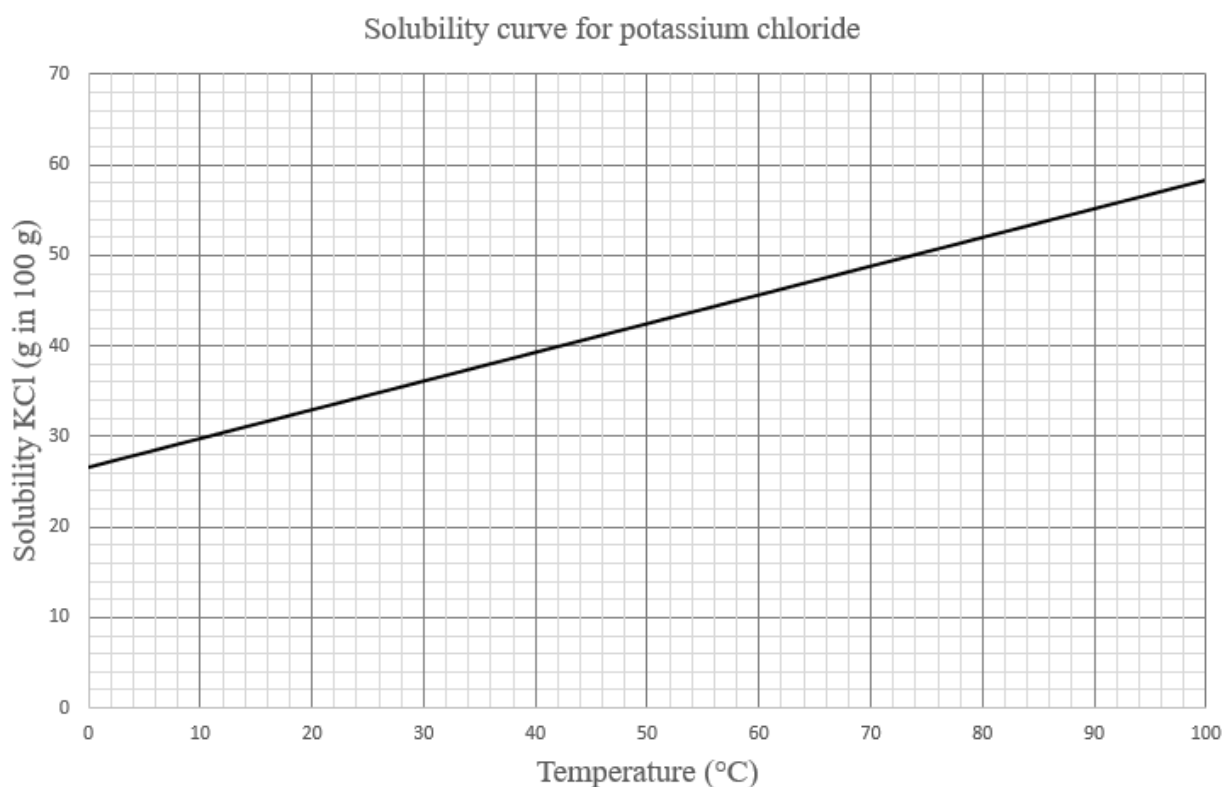
Different masses of potassium chloride were dissolved in 10 mL of water, heated, then cooled to determine the temperature at which a precipitate formed.

Data was collected from all Year 12 Chemistry classes in a spreadsheet. A selection of this data is shown below.

- The average temperature for each mass of potassium chloride was calculated using data from all classes.
- The highest temperature and lowest temperature for each mass of potassium chloride was identified.

Mass of potassium chloride added (g)	Average temperature precipitate formed (°C)	Highest temperature precipitate formed (°C)	Lowest temperature precipitate formed (°C)
3.80	39.5	60.6	24.1
4.20	46.5	56.4	35.5
4.60	55.9	74.2	40.0
5.00	86.7	94.4	72.3
5.20	91.1	100.0	84.4

The theoretical solubility curve for potassium chloride is provided below.



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This image shows a full page of white paper with horizontal dotted lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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END OF ASSESSMENT