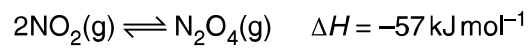


- 7 Dinitrogen tetroxide, $\text{N}_2\text{O}_4(\text{g})$, and nitrogen dioxide, $\text{NO}_2(\text{g})$, coexist in the following equilibrium.



A chemist adds 4.00 mol NO_2 to a container with a volume of 2.00 dm^3 . The container is sealed, heated to a constant temperature and allowed to reach equilibrium.

The equilibrium mixture contains 3.20 mol NO_2 .

- (a) Calculate the value for K_c under these conditions.

[5]

- (b) The experiment is repeated but the pressure in the container is doubled.

Explain in terms of K_c the effect on the concentrations of NO_2 and N_2O_4 when the mixture has reached equilibrium.

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..... [3]

[Total: 8]

- 5 Methanol can be prepared industrially by reacting together carbon monoxide and hydrogen. This is a reversible reaction:



- A chemist mixes together 0.114 mol CO(g) and 0.152 mol H₂(g) in a container.
- The container is pressurised and then sealed. The total volume is 200 cm³.
- The mixture is heated to 500 K and left to reach equilibrium.
The volume of the sealed container is kept at 200 cm³.
- The chemist analyses the equilibrium mixture and finds that 0.052 mol CH₃OH has formed.

- (a) Calculate the value of K_c , including units, for the equilibrium at 500 K.

Give your answer to **three** significant figures.

$K_c = \dots\dots\dots$ units $\dots\dots\dots$ [6]

- (b) The chemist repeats the experiment using the same initial amounts of CO and H₂. The same procedure is used but the mixture is heated in the 200 cm³ sealed container to a higher temperature than 500 K.

As the gas volume is kept at 200 cm³, the increased temperature also increases the pressure.

- Explain why it is difficult to predict how the yield of CH₃OH would change.
- Explain what happens to the value of K_c .

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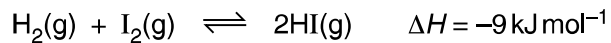
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..... [4]

[Total: 10]

- 3 Hydrogen and iodine react together in a reversible reaction:



A chemist mixes together $2.00 \times 10^{-3} \text{ mol H}_2(\text{g})$ and $4.00 \times 10^{-3} \text{ mol I}_2(\text{g})$ in a 1.00 dm^3 container.
The chemist seals the container.

The mixture is heated and left to reach equilibrium.

At equilibrium, the mixture contains $3.00 \times 10^{-4} \text{ mol}$ of H_2 .

- (a) Calculate the equilibrium constant, K_c , including units, if any, for this equilibrium.

Give your answer to **three** significant figures.

$K_c = \dots\dots\dots \text{ units } \dots\dots\dots$ [5]

- (b) The chemist repeats the experiment several times. In each experiment, the chemist makes one change.

- (i) The chemist uses $3.00 \times 10^{-3} \text{ mol H}_2(\text{g})$ instead of $2.00 \times 10^{-3} \text{ mol H}_2(\text{g})$.

Predict whether the amounts of $\text{H}_2(\text{g})$, $\text{I}_2(\text{g})$ and $\text{HI}(\text{g})$ in the equilibrium mixture would be greater, smaller or the same as in the original experiment.

Answer by placing ticks in the appropriate boxes of the table below.

	$\text{H}_2(\text{g})$	$\text{I}_2(\text{g})$	$\text{HI}(\text{g})$
Greater			
Smaller			
The same			

[2]

- (ii) The chemist heats the mixture to a higher temperature at constant pressure.

Explain whether the value of K_c would be greater, smaller or the same.

.....

 [1]

- (iii) The chemist increases the pressure of the mixture at constant temperature.

Explain whether the value of K_c would be greater, smaller or the same.

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 [1]

[Total: 9]