

GCSE Chemistry A (Gateway Science)

J248/02 C4-C6 and C7 Foundation (Foundation Tier)

Question Set 5

- 1 The reversible reaction between carbon dioxide and hydrogen makes methane and water.



- (a) In a sealed container, this reversible reaction forms a **dynamic equilibrium**.

What is meant by the term dynamic equilibrium?

Refer to both concentration and rate of reaction in your answer.

In the closed system the rate of the forward and backward reactions are equal that the concentration of reactants and products are constant (not equal to each other) [2]

- (b) A student investigates this reaction between carbon dioxide and hydrogen. He predicts that 11.0 g of carbon dioxide should make 4.0 g of methane. In an experiment, he finds that 11.0 g of carbon dioxide makes 2.2 g of methane.

Calculate the percentage yield of methane.

$$\begin{aligned} \% \text{ yield} &= \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 \\ &= \frac{2.2}{4} \times 100 = \boxed{55\%} \end{aligned}$$

Answer = 55 % [2]

- (c)* The student investigates the effect of changing pressure and changing temperature on this reaction.



The table shows the percentage yield of methane in the equilibrium mixture under different conditions.

		Pressure (in atmospheres)			
		100	200	300	400
Temperature (in °C)	300	35%	52%	65%	80%
	600	30%	46%	58%	74%
	900	23%	37%	47%	62%
	1200	14%	25%	36%	48%

Describe what happens to the percentage yield as the pressure and temperature change and explain the effect of increasing the pressure on the rate of reaction.

[6]

- As pressure increases, the percentage yield increases
- $\text{CO}_2 + 4\text{H}_2 \rightleftharpoons \text{CH}_4 + 2\text{H}_2\text{O}$
- This is because equilibrium shifts to the right with increased pressure as less gaseous moles on RHS (3 moles while LHS has 5 moles)
- As temperature increases, the percentage yield decreases.
- This is because equilibrium shifts to the left with increased temperature favouring the backwards exothermic reaction

Total Marks for Question Set 5: 10

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