

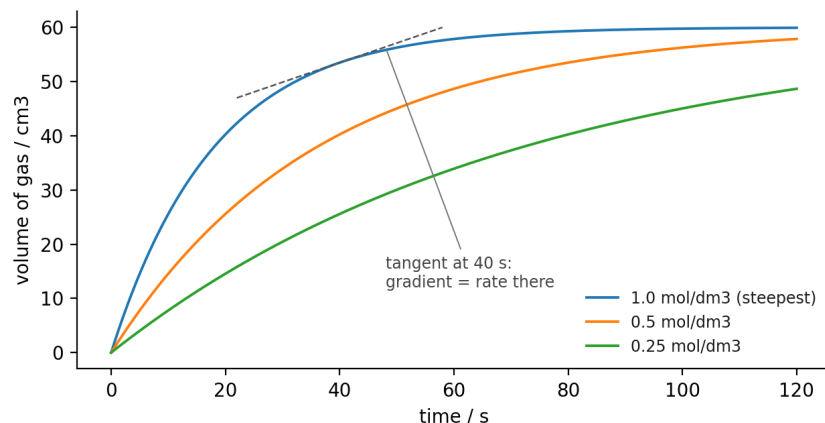
Exercise walk-through

6.2

Reversible reactions and dynamic equilibrium (4.6.2.1–4.6.2.3)

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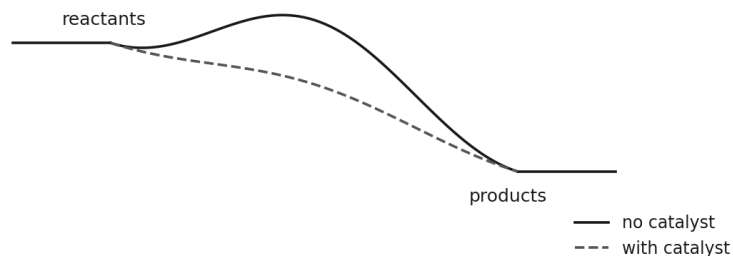
Measuring rates



- Rate = quantity used or formed, over time.
- Units — g/s, cm³/s; higher tier mol/s.
- Steeper graph, faster reaction; tangent gradient = instantaneous rate.

Catalysts

a catalyst lowers the activation energy,
not the overall energy change



- Not used up; not in the equation; reaction-specific.
- A different pathway with lower activation energy.
- Enzymes catalyse biological systems.

Exercises 2.1·2.3

2.1 What arrow shows a reversible reaction? [1]

2.2 What is equal at equilibrium? [1]

2.3 (*HT*) $2 \text{SO}_2 + \text{O}_2 \rightleftharpoons 2 \text{SO}_3$ – which side has fewer gas molecules? [1]

Exercises 2.1·2.3

2.1 What arrow shows a reversible reaction? [1]

2.1 The equilibrium ($\rightleftharpoons$) arrow.

2.2 What is equal at equilibrium? [1]

2.2 The rates of the forward and reverse reactions.

2.3 (*HT*) $2 \text{SO}_2 + \text{O}_2 \rightleftharpoons 2 \text{SO}_3$ – which side has fewer gas molecules? [1]

2.3 The right-hand side – 2 molecules of SO_3 against 3 of reactants.

Exercises 3.1·3.3

3.1 Explain what is meant by dynamic equilibrium in a closed system. [4]

3.2 (*HT*) For $\text{H}_2 + \text{I}_2 \rightleftharpoons 2 \text{HI}$ (endothermic forward), predict and explain the effect of (a) adding more hydrogen; (b) cooling the mixture. [4]

3.3 (*HT*) Why do industries sometimes use a moderate temperature rather than a low one for an exothermic equilibrium process? [3]

Exercises 3.1-3.3

3.1 Explain what is meant by dynamic equilibrium in a closed system. [4]

3.1 A closed system prevents reactants or products escaping; both forward and reverse reactions continue to occur; their rates become exactly equal; so the concentrations of all substances remain constant – equilibrium is dynamic, not static.

3.2 (*HT*) For $\text{H}_2 + \text{I}_2 \rightleftharpoons 2 \text{HI}$ (endothermic forward), predict and explain the effect of (a) adding more hydrogen; (b) cooling the mixture. [4]

3.2 (a) The system counteracts the added hydrogen by using it up – the position shifts right, more HI forms until equilibrium is restored. (b) The forward reaction is endothermic, so cooling shifts the position in the exothermic direction – to the left, less HI; because the system releases energy to counteract the fall in temperature.

3.3 (*HT*) Why do industries sometimes use a moderate temperature rather than a low one for an exothermic equilibrium process? [3]

3.3 A low temperature favours the exothermic forward direction and the yield; but rate falls steeply with temperature, so production would be too slow; a moderate temperature compromises yield against rate, keeping the process economic.