

Equilibrium constants and shifting equilibria

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test covers Kc and Kp expressions, calculations, Le Chatelier's principle, the reaction quotient and the effect of temperature on K. Show your working and include units where needed.

Level: Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB R2.3

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Writing Kc (2 marks)

For $2\text{CO(g)} + \text{O}_2\text{(g)} \rightleftharpoons 2\text{CO}_2\text{(g)}$:

- Write the Kc expression. (1 mark)
- State the units of Kc. (1 mark)

Question 2 Calculating Kc (3 marks)

At equilibrium $\text{A(g)} + 2\text{B(g)} \rightleftharpoons \text{C(g)}$ has $[\text{A}] = 0.10$, $[\text{B}] = 0.20$ and $[\text{C}] = 0.60 \text{ mol/dm}^3$. Calculate Kc with units.

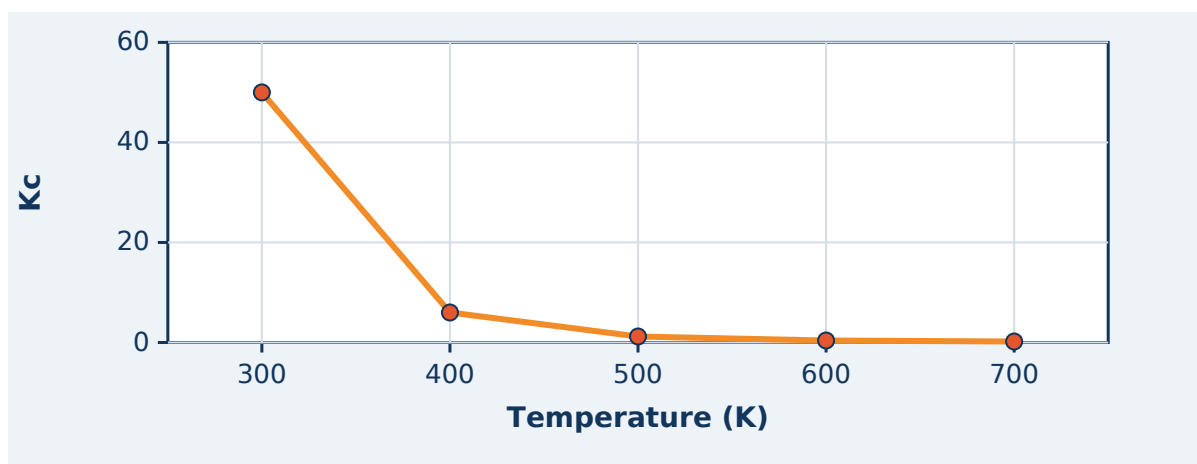
Question 3 Butane isomerisation (3 marks)

Butane $\rightleftharpoons$ methylpropane has $K_c = 2.5$. Starting from 1.00 mol of butane only, calculate the moles of each isomer at equilibrium.

Question 4 Nitrogen monoxide yield (3 marks)

$\text{N}_2\text{(g)} + \text{O}_2\text{(g)} \rightleftharpoons 2\text{NO(g)}$ has $\Delta H = +180 \text{ kJ/mol}$. State and explain the effect on the equilibrium yield of NO of (a) raising the temperature and (b) raising the pressure.

Question 5 Kc and temperature (3 marks)



K_c for a reaction at five temperatures.

- State whether the forward reaction is exothermic or endothermic. (1 mark)
- Explain your answer using Le Chatelier's principle. (1 mark)
- Predict the trend of K_c above 700 K. (1 mark)

Question 6 Calculating K_p (2 marks)

At equilibrium $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ has $p(\text{N}_2\text{O}_4) = 25 \text{ kPa}$ and $p(\text{NO}_2) = 50 \text{ kPa}$. Calculate K_p with units.

Question 7 Role of a catalyst (2 marks)

Explain why a catalyst does not change the position of equilibrium but reduces the time needed to reach it.

Question 8 Direction of change (2 marks)

A reaction has $K = 4.0$. A mixture has $Q = 1.5$. State the direction in which the mixture changes and explain.