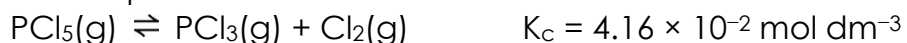


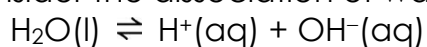
Quiz (Equilibrium Constant and Reaction Quotient)

1. The following equilibrium was established in a 1 dm³ sealed container at a certain temperature.



However, the equilibrium has been disturbed and there are now 0.45 mol of PCl₅(g), 0.15 mol of PCl₃(g) and 0.15 mol of Cl₂(g).

- (a) Explain what would happen to the position of equilibrium in terms of the value of reaction quotient.
- (b) Calculate the equilibrium concentrations when a new state of equilibrium was established.
2. Consider the dissociation of water:

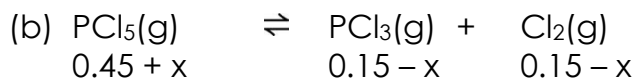


The values of equilibrium constant is 1.00×10^{-14} at 25°C mol² dm⁻⁶ and 2.95×10^{-14} mol² dm⁻⁶ at 40°C. Calculate the neutral pH at 25 °C and 40 °C.

Suggested Answer

1. (a) $Q_c = (0.15)(0.15) / 0.45$
 $= 0.05 \text{ mol dm}^{-3}$

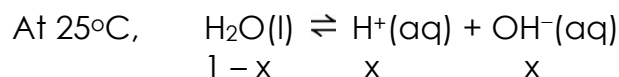
As $Q_c > K_c$, there is net Backward Reaction, the equilibrium position shifts to the left.



$$K_c = 0.0416 = (0.15 - x)^2 / (0.45 + x)$$
$$x^2 - 0.3416x + 0.00378 = 0$$
$$x = 0.01145 \quad \text{or} \quad x = 0.3302 \text{ (reject)}$$

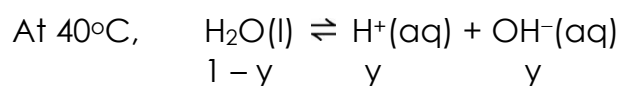
$$[\text{PCl}_3] = 0.15 - 0.01145 = 0.1386 \text{ mol dm}^{-3}$$
$$[\text{Cl}_2] = 0.15 - 0.01145 = 0.1386 \text{ mol dm}^{-3}$$
$$[\text{PCl}_5] = 0.45 + 0.01145 = 0.4615 \text{ mol dm}^{-3}$$

2. **Neutral: $[\text{H}^+] = [\text{OH}^-]$**



$$x^2 / (1 - x) = 1 \times 10^{-14}$$
$$\Rightarrow x = 1 \times 10^{-7}$$
$$\Rightarrow [\text{H}^+] = 1 \times 10^{-7} \text{ mol dm}^{-3}$$

$$\text{pH} = -\log [\text{H}^+] = 7$$



$$y^2 / (1 - y) = 2.95 \times 10^{-14}$$
$$\Rightarrow y = 1.718 \times 10^{-7}$$
$$\Rightarrow [\text{H}^+] = 1.718 \times 10^{-7} \text{ mol dm}^{-3}$$

$$\text{pH} = -\log [\text{H}^+] = 6.77$$