InkChemistry

QUESTION WORKBOOK

The equilibrium constant Kc

Chemical equilibria · Unit C06

AQA 3.1.6.2 · OCR A 3.2.3 (f) and (g), 5.1.2

15 questions · 58 marks

PRINT EDITION

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SECTION B · Standard, 3 to 5 marks

B1 ECK-Q26

Show that two 20.0 cm³ portions of an organic solvent extract more of a solute from 50.0 cm³ of water than one 40.0 cm³ portion does. The water holds 1.00 g of the solute, and Kpc (organic ÷ aqueous) is 9.00. [5]

B2 ECK-Q1

Give the expression for Kc, and its units, for $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ and for $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$. [4]

B3 ECK-Q6

Calculate Kc for $CH_3COOH(l) + CH_3CH_2OH(l) \rightleftharpoons CH_3COOCH_2CH_3(l) + H_2O(l)$ from this experiment: 1.00 mol of ethanoic acid and 1.50 mol of ethanol are mixed with a catalyst and left to reach equilibrium, and 0.230 mol of ethanoic acid remains. [4]

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B4 ECK-Q8 Calculate Kc for $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ from this experiment: 0.250 mol of PCl_5 is heated in a sealed 5.00 dm^3 vessel, and at equilibrium the vessel contains 0.0950 mol of Cl_2. [4]

B5 ECK-Q9 Calculate the amount of HI at equilibrium when 0.500 mol of H_2 and 0.500 mol of I_2 are sealed in a flask at a temperature at which Kc for $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is 49.0. [4]

B6 ECK-Q13 Explain why the volume of the flask is not needed to calculate Kc for the esterification of ethanoic acid from equilibrium amounts but is needed for $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$, and why doubling the volume of an equilibrium mixture of H_2, I_2 and HI leaves the amount of HI unchanged. [4]

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B7 ECK-Q18 Evaluate a student's statement that, since Kc for $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is 46.0 at 763 K, Kc for $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ is also 46.0 and Kc for $HI(g) \rightleftharpoons \frac{1}{2}H_2(g) + \frac{1}{2}I_2(g)$ is 23.0 at 763 K. [4]

B8 ECK-Q19 Explain how Kc is written for $Fe^{2+}(aq) + Ag^{+}(aq) \rightleftharpoons Fe^{3+}(aq) + Ag(s)$, with its units, and why the solid silver is filtered off before the silver ions in the equilibrium mixture are titrated with thiocyanate. [4]

B9 ECK-Q22 Explain why water is left out of Kc for the chromate–dichromate equilibrium $2CrO_4^{2-}(aq) + 2H^{+}(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + H_2O(l)$ in dilute solution but is included in Kc for the esterification of ethanoic acid with ethanol, and give Kc for the chromate equilibrium with its units. [4]

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B10 ECK-Q4 Suggest what each of these values of Kc at 298 K tells you about the equilibrium mixture: 1.0×10^{12} for reaction A, 4.0 for reaction B and 1.0×10^{-12} for reaction C. [3]

B11 ECK-Q5 Calculate Kc for $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ from an equilibrium mixture containing N_2O_4 at 0.0450 mol dm^{-3} and NO_2 at 0.0300 mol dm^{-3}. [3]

B12 ECK-Q11 Explain why adding more ethanol to an equilibrium mixture of ethanoic acid, ethanol, ethyl ethanoate and water increases the amount of ester but does not change Kc. [3]

B13 ECK-Q14 Suggest the reason for each of these steps in finding the amount of ethanoic acid in an esterification mixture at equilibrium: a sample is run into ice-cold water and titrated with sodium hydroxide, and a second titration is done on the sulfuric acid catalyst alone. [3]

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B14 ECK-Q27 Show that Kc = 4.0 for $CH_3COOH(l) + C_2H_5OH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$, given that 1.00 mol of ethanoic acid and 1.00 mol of ethanol, left with an acid catalyst until equilibrium is reached, give 0.667 mol of ethyl ethanoate. [3]

SECTION C · Long, 6 marks or more

C1 ECK-Q23 Explain how each of these changes affects the position of equilibrium and the value of Kc for $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$, $\Delta H = -197$ kJ mol^{-1}: adding more oxygen, raising the pressure, adding a catalyst, and raising the temperature. [6]

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