1 Calculate the pH of a 0.500 mol dm^{-3} aqueous solution of propanoic acid. (K_a for propanoic acid = 1.34 x 10^{-5} mol dm^{-3})

$[H^+]^2 = K_a [HA]$

$[H^+] = \sqrt{K_a [HA]} = \sqrt{(1.34 \times 10^{-5}) \times 0.500} = 2.59 \times 10^{-3}$

$pH = -\log[H^+] = -\log 2.59 \times 10^{-3} = 2.59$

2 The acid dissociation constant for two acids are shown.

acid	ethanoic acid	chloroethanoic acid
K_a / mol dm^{-3}	1.76 x 10^{-5}	1.40 x 10^{-3}

a Which acid is stronger? **chloroethanoic acid**

b Calculate pK_a for chloroethanoic acid.

$pK_a = -\log K_a = -\log 1.40 \times 10^{-3} = 2.86$

3 Calculate the pH of a mixture of 20 cm^3 of 0.200 mol dm^{-3} methanoic acid (pK_a = 3.75) and 50 cm^3 of 0.040 mol dm^{-3} sodium hydroxide solution.

mol HA = $0.200 \times \frac{20}{1000} = 0.0040$

mol OH^- = $0.040 \times \frac{50}{1000} = 0.0020$

HA is half neutralised ∴ $pH = pK_a$

pH = 3.75

4 Calculate the pH of a mixture of 30 cm^3 of 0.100 mol dm^{-3} lactic acid (pK_a = 3.86) and 10 cm^3 of 0.080 mol dm^{-3} calcium hydroxide solution.

mol HA = $0.100 \times \frac{30}{1000} = 0.00300$

mol OH^- = $2 \times 0.080 \times \frac{10}{1000} = 0.00160$

	HA	+ OH^-	→ A^-	+ H_2O
start	0.00300	0.00160		lots
end	0.00140	none	0.00160	lots

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$[H^+] = \frac{K_a [HA]}{[A^-]} = \frac{10^{-3.86} \left[\frac{0.00140}{\frac{40}{1000}}\right]}{\left[\frac{0.00160}{\frac{40}{1000}}\right]} = 1.21 \times 10^{-4}$$

$pH = -\log[H^+] = -\log 1.21 \times 10^{-4} = 3.92$