AQA – Acids and bases – A2 Chemistry P1

1. June/ 2020/Paper_1/No.4

0 4 Propanoic acid (C_2H_5COOH) is a weak acid.

The acid dissociation constant (K_a) for propanoic acid is 1.35×10^{-5} mol dm^{-3} at 25 °C

0 4 . 1 State the meaning of the term weak acid.

[1 mark]

_____

_____

0 4 . 2 Give an expression for the acid dissociation constant for propanoic acid.

[1 mark]

K_a

0 4 . 3 A student dilutes 25.0 cm^3 of 0.500 mol dm^{-3} propanoic acid by adding water until the total volume is 100.0 cm^3

Calculate the pH of this diluted solution of propanoic acid.

Give your answer to 2 decimal places.

[4 marks]

pH _____

0 4 . 4 A buffer solution with a pH of 4.50 is made by dissolving x g of sodium propanoate (C_2H_5COONa) in a solution of propanoic acid. The final volume of buffer solution is 500 cm^3 and the final concentration of the propanoic acid is 0.250 mol dm^{-3}

Calculate x in g
For propanoic acid, $K_a = 1.35 \times 10^{-5}$ mol dm^{-3}

[6 marks]

x _____ g

2. June/ 2019/Paper_1/No.9

0 9 This question is about different pH values.

0 9 . 1 For pure water at 40 °C, pH = 6.67
A student thought that the water was acidic.

Explain why the student was incorrect.

Determine the value of K_w at this temperature.

[4 marks]

Explanation _____

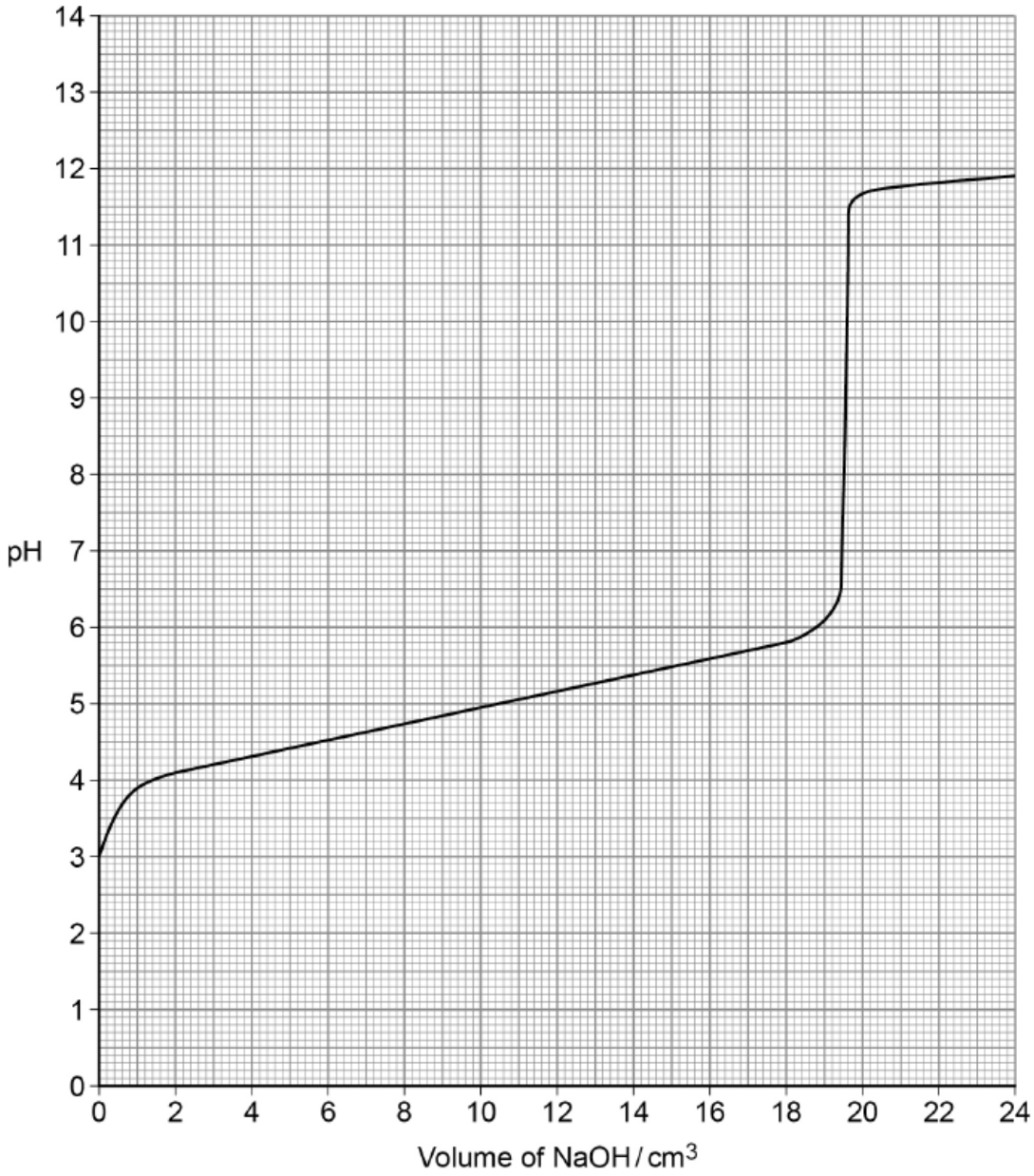
_____

K_w _____ $mol^2\ dm^{-6}$

0 9 . 2 Sodium hydroxide solution was added gradually from a burette to 25 cm^3 of 0.080 mol dm^{-3} propanoic acid at 25 °C
The pH was measured and recorded at regular intervals.

The results are shown in **Figure 4**.

Figure 4



Use **Figure 4** to determine the value of K_a for propanoic acid at 25 °C

Show your working.

[3 marks]

K_a _____ mol dm^{-3}

0 9 . 3 Suggest which indicator is the most appropriate for the reaction in Question **09.2**? Tick (✓) **one** box.

[1 mark]

Indicator	**pH range**	**Tick (✓) one box**
methyl orange	3.1 – 4.4	
bromothymol blue	6.0 – 7.6	
cresolphthalein	8.2 – 9.8	
indigo carmine	11.6 – 13.0	

0 9 . 4 A student prepared a buffer solution by adding 0.0136 mol of a salt KX to 100 cm^3 of a 0.500 mol dm^{-3} solution of a weak acid HX and mixing thoroughly.

The student then added 3.00×10^{-4} mol of potassium hydroxide to the buffer solution.

Calculate the pH of the buffer solution after adding the potassium hydroxide.

For the weak acid HX at 25 °C the value of the acid dissociation constant, $K_a = 1.41 \times 10^{-5}$ mol dm^{-3}.

Give your answer to two decimal places.

[6 marks]

pH _____

0 9 . 5 A buffer solution has a constant pH even when diluted.

Use a mathematical expression to explain this.

[1 mark]

3. June/ 2021/Paper_1/No.6

0 6 This question is about pH.

Pure water dissociates slightly.

$$H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq) \qquad \Delta H = +57 \text{ kJ mol}^{-1}$$

The equilibrium constant, $K_c = \dfrac{[H^+][OH^-]}{[H_2O]}$

The ionic product of water, $K_w = [H^+][OH^-]$

0 6 . 1 Explain why $[H_2O]$ is not shown in the K_w expression.

[1 mark]

Table 5 shows how K_w varies with temperature.

Table 5

Temperature / °C	K_w / mol² dm⁻⁶
10	2.93×10^{-15}
20	6.81×10^{-15}
25	1.00×10^{-14}
30	1.47×10^{-14}
50	5.48×10^{-14}

0 6 . 2 Explain why the value of K_w increases as the temperature increases.

[2 marks]

0 6 . 3 Give the expression for pH.

Calculate the pH of pure water at 50 °C
Give your answer to 2 decimal places.

Explain why water is neutral at 50 °C

[4 marks]

Expression _____

Calculation

pH _____

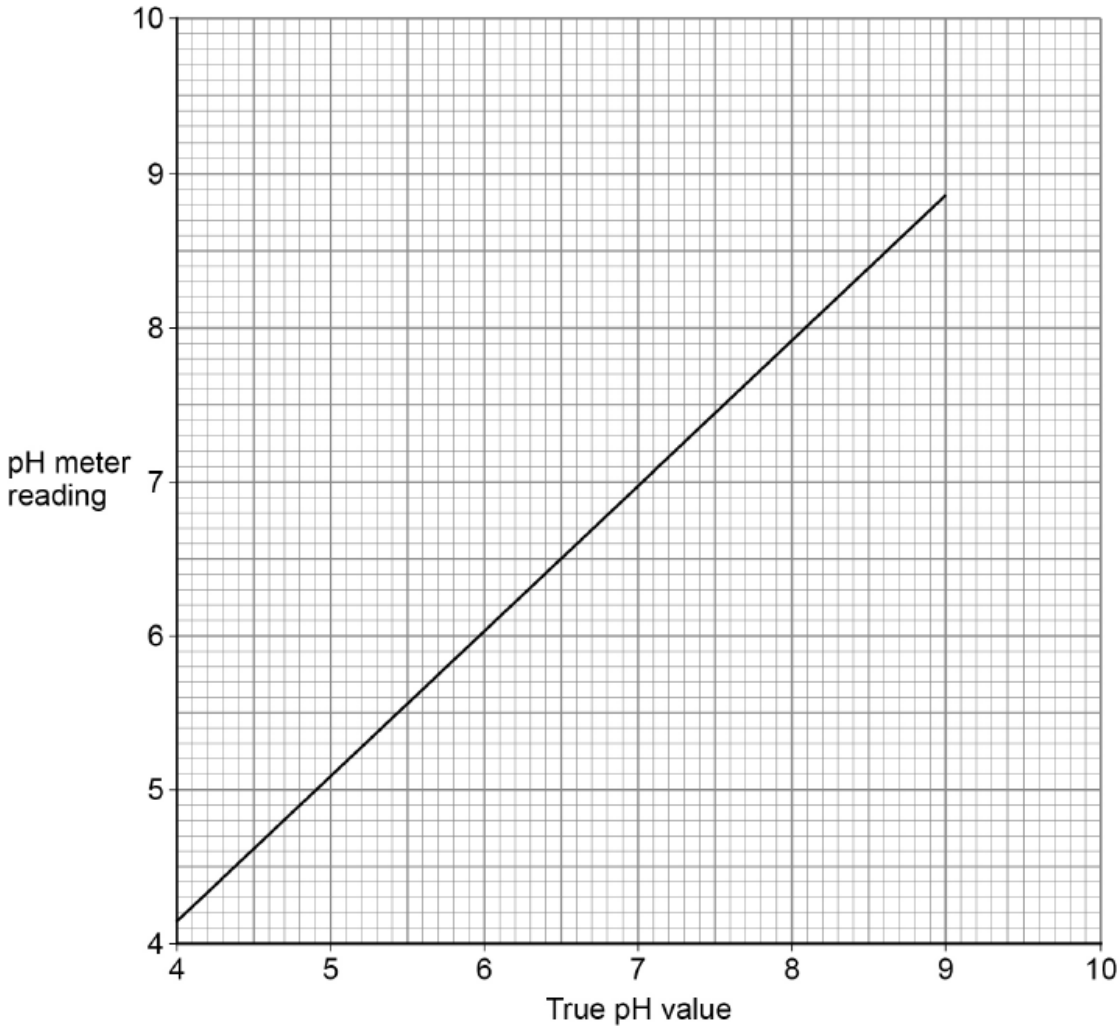
Explanation _____

_____

A pH meter is calibrated using a calibration graph.
To create the calibration, the pH meter is used to measure the pH of separate solutions, each with a known, accurate pH.

Figure 3 shows the calibration graph.

Figure 3



0 6 . 4 Use **Figure 3** to give the true pH value when the pH meter reading is 5.6

[1 mark]

0 6 . 5 Suggest why the pH probe is washed with distilled water between each of the calibration measurements.

[1 mark]

0 6 . 6 The calibrated pH meter is used to monitor the pH during a titration of hydrochloric acid with sodium hydroxide.

Explain why the volume of sodium hydroxide solution added between each pH measurement is smaller as the end point of the titration is approached.

[1 mark]

Figure 4 shows the pH curve for a titration of hydrochloric acid with sodium hydroxide solution.

Figure 4

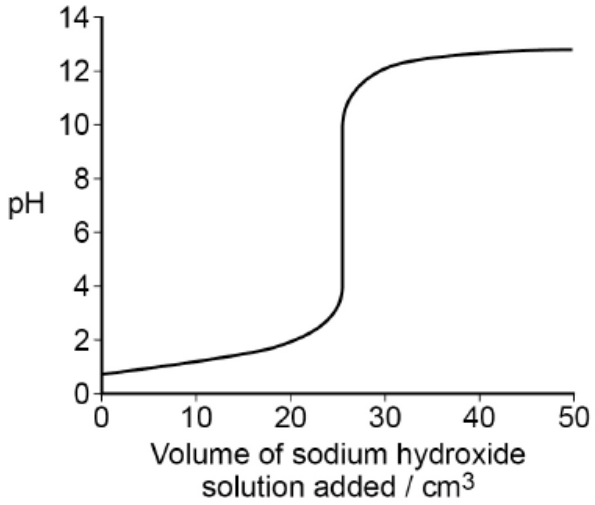


Table 6 shows data about some indicators.

Table 6

Indicator	pH range	Colour at low pH	Colour at high pH
Bromocresol green	3.8 – 5.4	yellow	blue
Phenol red	6.8 – 8.4	yellow	red
Thymolphthalein	9.3 – 10.5	colourless	blue

The student plans to do the titration again using one of the indicators in **Table 6** to determine the end point.

0 6 . 7 State why all three of the indicators in **Table 6** are suitable for this titration.

[1 mark]

0 6 . 8 36.25 cm^3 of 0.200 mol dm^{-3} sodium hydroxide solution are added to 25.00 cm^3 of 0.150 mol dm^{-3} hydrochloric acid.

Calculate the pH of the final solution at 25 °C

$K_w = 1.00 \times 10^{-14}$ $mol^2\ dm^{-6}$ at 25 °C

[5 marks]

pH _____