

AQA – Acids and bases – A2 Chemistry P1

1. No.4

0 4

Propanoic acid ($\text{C}_2\text{H}_5\text{COOH}$) is a weak acid.

The acid dissociation constant (K_a) for propanoic acid is $1.35 \times 10^{-5} \text{ mol dm}^{-3}$ 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 $0.500 \text{ mol dm}^{-3}$ 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 ($\text{C}_2\text{H}_5\text{COONa}$) 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, $K_a = 1.35 \times 10^{-5}\text{ mol dm}^{-3}$

[6 marks]

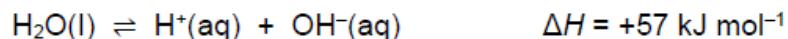
x _____ g

2. No.6

0 6

This question is about pH.

Pure water dissociates slightly.



The equilibrium constant, $K_c = \frac{[\text{H}^+][\text{OH}^-]}{[\text{H}_2\text{O}]}$

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

0 6 . 1

Explain why $[\text{H}_2\text{O}]$ is not shown in the K_w expression.

[1 mark]

Table 5 shows how K_w varies with temperature.

Table 5

Temperature / °C	$K_w / \text{mol}^2 \text{ dm}^{-6}$
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
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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

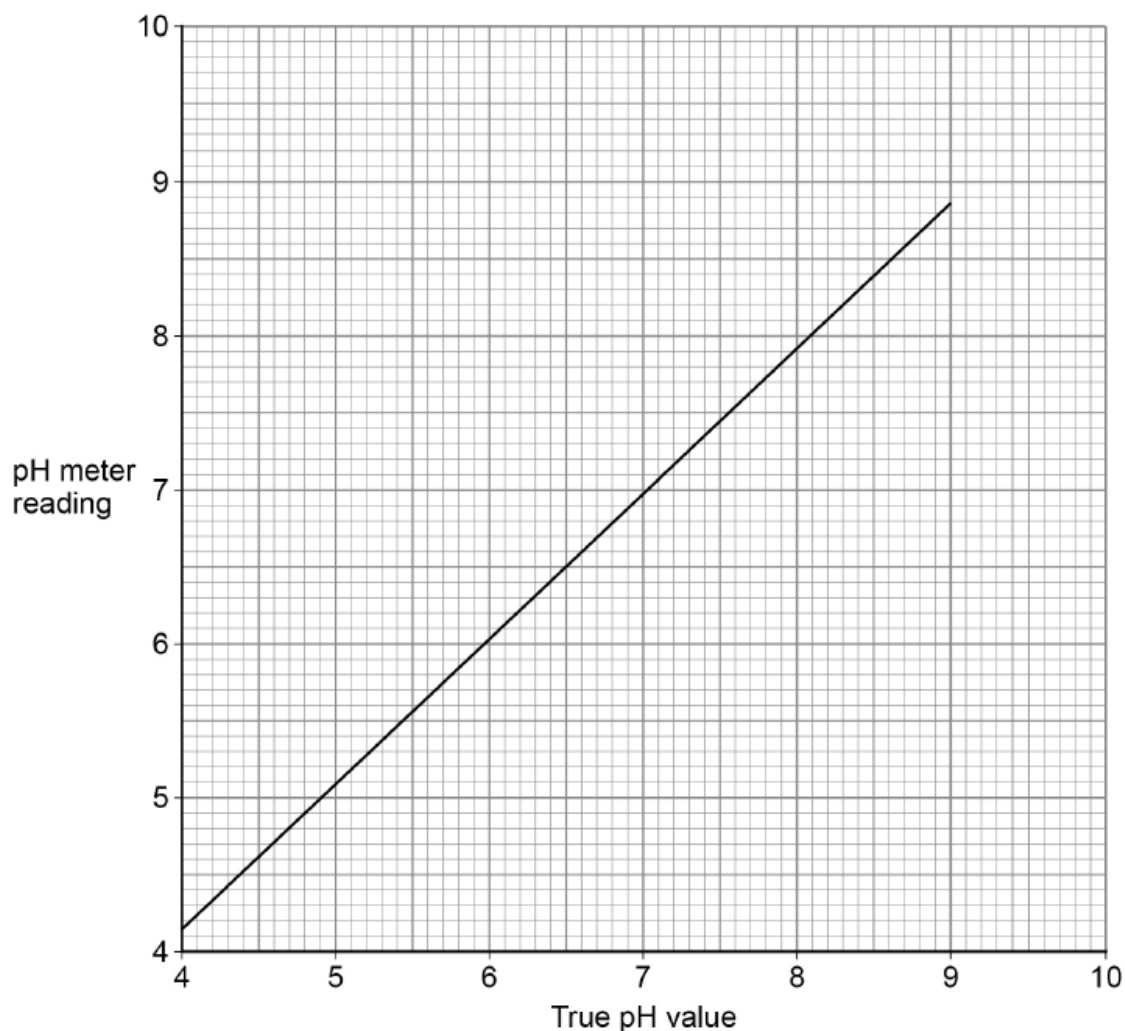
pH _____

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

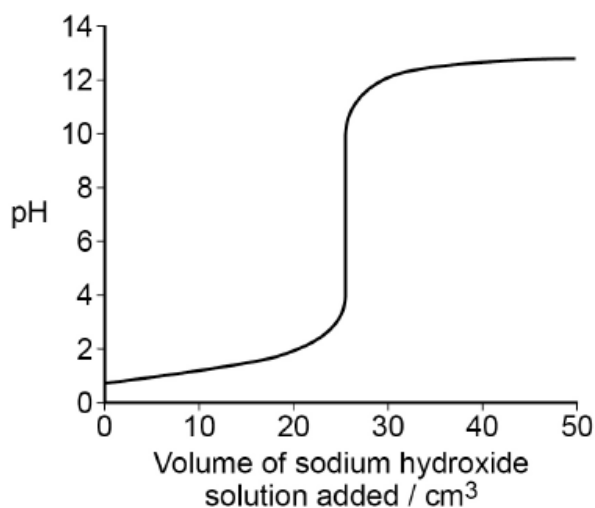


Table 6 shows data about some indicators.

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
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36.25 cm³ of 0.200 mol dm⁻³ sodium hydroxide solution are added to 25.00 cm³ of 0.150 mol dm⁻³ hydrochloric acid.

Calculate the pH of the final solution at 25 °C

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

[5 marks]

pH _____

3. No.7

When heated, a sample of potassium chlorate(V) (KClO_3) produced 67.2 cm^3 of oxygen, measured at 298 K and 110 kPa



What is the amount, in moles, of potassium chlorate(V) that has decomposed?

The gas constant, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

[1 mark]

A 9.95×10^{-4} ☐B 1.99×10^{-3} ☐C 2.99×10^{-3} ☐D 4.48×10^{-3} ☐

4. No.13

Which statement about pH is correct?

[1 mark]

A The pH of a weak base is independent of temperature.

☐

B At temperatures above 298 K, the pH of pure water is less than 7.

☐C The pH of 2.0 mol dm^{-3} nitric acid is approximately 0.30☐D The pH of 0.10 mol dm^{-3} sulfuric acid is greater than that of 0.10 mol dm^{-3} hydrochloric acid.☐

5. No.14

A 0.10 mol dm^{-3} aqueous solution of an acid is added slowly to 25 cm^3 of a 0.10 mol dm^{-3} aqueous solution of a base.

Which acid–base pair has the highest pH at the equivalence point?

[1 mark]

A CH_3COOH and NaOH ☐B CH_3COOH and NH_3 ☐C HCl and NaOH ☐D HCl and NH_3 ☐

6. No.32

Which is the concentration of NaOH(aq) , in mol dm^{-3} , that has $\text{pH} = 14.30$?

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

[1 mark]

A -1.16 ☐B 5.01×10^{-15} ☐C 2.00×10^{14} ☐D 2.00 ☐

7. No.34

What is the pH of $0.015 \text{ mol dm}^{-3}$ sulfuric acid?

[1 mark]

A -1.82 ☐B -1.52 ☐C 1.52 ☐D 1.82 ☐

8. No.36

A student rinsed the apparatus before starting an acid-base titration. The results of the titration showed that the volume of acid added from the burette was larger than expected.

Which is a possible reason for this?

[1 mark]

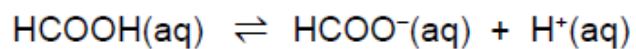
- A** The conical flask was rinsed with water before the titration.
- B** The walls of the conical flask were rinsed with water during the titration.
- C** The pipette was rinsed only with water.
- D** The burette was rinsed only with water.

☐☐☐☐

9. No.5

A mixture of methanoic acid and sodium methanoate in aqueous solution acts as an acidic buffer solution.

The equation shows the dissociation of methanoic acid.



Calculate the mass, in g, of sodium methanoate (HCOONa) that must be added to 25.0 cm^3 of $0.100 \text{ mol dm}^{-3}$ methanoic acid to produce a buffer solution with $\text{pH} = 4.05$ at 298 K

For methanoic acid, $\text{p}K_{\text{a}} = 3.75$ at 298 K

Assume that the volume of the solution remains constant.

[5 marks]

Mass _____ g