

Q1. (a) At 50°C, the ionic product of water, K_w , has the value $5.48 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$.

(i) Define the term K_w

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(ii) Define the term pH

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(iii) Calculate the pH of pure water at 50 °C. Explain why pure water at 50 °C is still neutral even though its pH is not 7.

Calculation

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Explanation

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(5)

(b) At 25°C, K_w has the value $1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$. Calculate the pH at 25 °C of

(i) a $0.150 \text{ mol dm}^{-3}$ solution of sodium hydroxide,

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(ii) the solution formed when 35.0 cm^3 of this solution of sodium hydroxide is mixed with 40.0 cm^3 of a $0.120 \text{ mol dm}^{-3}$ solution of hydrochloric acid.

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(8)

(c) In a $0.150 \text{ mol dm}^{-3}$ solution of a weak acid HX at $25 \text{ }^\circ\text{C}$, 1.80% of the acid molecules are dissociated into ions.

(i) Write an expression for K_a for the acid HX.

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(ii) Calculate the value of K_a for the acid HX at this temperature and state its units.

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(5)

(Total 18 marks)

Q2. Which one of the following is the change in units of pH which occurs when 10.0 cm^3 of a 1.0 M solution of a strong monoprotic acid are made up to 1.0 dm^3 with water?

- A** 1
- B** 2
- C** 3

D 5

(Total 1 mark)

Q3. The pH of 0.001 M NaOH at 25°C is

A 13

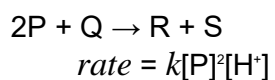
B 11

C 9

D 3

(Total 1 mark)

Q4. The equation and rate law for the reaction of substance P with substance Q are given below.



Under which one of the following conditions, all at the same temperature, would the rate of reaction be slowest?

	[P] / mol dm ⁻³	pH
A	0.1	0
B	1	2
C	3	3
D	10	4

(Total 1 mark)

Q5. Addition of which one of the following to 10 cm³ of 1.0 M NaOH would result in the pH being halved?

A 10 cm³ of water

B 100 cm³ of water

C 5 cm³ of 1.0 M HCl

D 10 cm³ of 1.0 M HCl

(Total 1 mark)

Q6. A $0.210 \text{ mol dm}^{-3}$ solution of potassium hydroxide was added from a burette to 25.0 cm^3 of a $0.160 \text{ mol dm}^{-3}$ solution of ethanoic acid in a conical flask. Given that the value of the acid dissociation constant, K_a , for ethanoic acid is $1.74 \times 10^{-5} \text{ mol dm}^{-3}$, calculate the pH at $25 \text{ }^\circ\text{C}$ of the solution in the conical flask at the following three points:

before any potassium hydroxide had been added;

after 8.0 cm^3 of potassium hydroxide solution had been added;

after 40.0 cm^3 of potassium hydroxide solution had been added.

(Total 16 marks)