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

(i) Define the term K_w

.....

(ii) Define the term *pH*

.....

(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 .....

.....

.....

Explanation .....

.....

(5)

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

(i) a 0.150 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 mol dm^{-3} solution of hydrochloric acid.

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(8)

(c) In a 0.150 mol dm^{-3} solution of a weak acid HX at 25 °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.

$$2P + Q \rightarrow R + S$$
$$rate = k[P]^2[H^+]$$

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 cm^3 of 1.0 M NaOH would result in the pH being halved?

A 10 cm^3 of water

B 100 cm^3 of water

C 5 cm^3 of 1.0 M HCl

D 10 cm^3 of 1.0 M HCl

(Total 1 mark)

Q6. A 0.210 mol dm^{-3} solution of potassium hydroxide was added from a burette to 25.0 cm^3 of a 0.160 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 1.74×10^{-5} mol dm^{-3}, calculate the pH at 25 °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)