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CHEMISTRY
PHYSICAL CHEMISTRY II

Level & Board	AQA (A-LEVEL)

TOPIC:	ACIDS AND BASES

PAPER TYPE:	QUESTION PAPER - 1

TOTAL QUESTIONS	10

TOTAL MARKS	33

Acids and Bases - 1

1. A solution of chlorine in water is acidic.

Swimming pool managers maintain pool water at a constant pH by using a buffer.

They do so by adding sodium hydrogencarbonate and sodium carbonate.

(a) Hydrogen carbonate ions (HCO_3^-) act as a weak acid in aqueous solution.

Write an equation for this equilibrium.

(1)

(b) Use the equation to explain how a solution containing sodium hydrogencarbonate and sodium carbonate can act as a buffer when small amounts of acid or small amounts of alkali are added.

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(3)

2. What is the pH of a 0.020 mol dm^{-3} solution of a diprotic acid which is completely dissociated?

A. 1.00
B. 1.40
C. 1.70
D. 4.00

(1)

3. Methanoic acid (HCOOH) dissociates slightly in aqueous solution.

    (a) Write an equation for this dissociation.

    (1)

    (b) Write an expression for the acid dissociation constant Ka for methanoic acid.

    (1)

    (c) The value of Ka for methanoic acid is 1.78×10^{-4} mol dm^{-3} at 25 °C.

       Calculate the pH of a 0.0560 mol dm^{-3} solution of methanoic acid.

    (3)

    (d) The dissociation of methanoic acid in aqueous solution is endothermic.

       Deduce whether the pH of a solution of methanoic acid will increase, decrease or stay the same if the solution is heated.

       Explain your answer.

(3)

4. The acid dissociation constant, Ka, of a weak acid HA has the value 2.56×10^{-4} mol dm^{-3}.

What is the pH of a 4.25×10^{-3} mol dm^{-3} solution of HA?

A. A 5.96
B. 3.59
C. 2.98
D. 2.37

(1)

5. A 25.0 cm^3 sample of 0.620 mol dm^{-3} nitric acid was placed in a beaker and 38.2 cm^3 of 0.550 mol dm^{-3} aqueous sodium hydroxide were added.

Calculate the pH of the solution formed. Give your answer to 2 decimal places.

The ionic product of water Kw = 1.00×10^{-14} mol^2 dm^{-6} at 25 °C.

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(6)

6. Which statement about pH is correct?

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.

(1)

7. This question is about alkalis and carboxylic acids.

In this question, all data are quoted at 25 °C.

(a) Carboxylic acids are weak acids.

State the meaning of the term weak as applied to carboxylic acids.

(1)

(b) Write an equation for the reaction of propanoic acid with sodium carbonate.

(1)

(c) Calculate the pH of a 0.0120 mol dm^{-3} solution of calcium hydroxide.

The ionic product of water Kw = 1.00 × 10^{-14} mol^2 dm^{-6} .

Give your answer to 2 decimal places.

(3)

8. What is the pH of a 0.46 mol dm^{-3} solution of potassium hydroxide at 298 K?

(K_w = 1.0 × 10^{-14} mol^2 dm^{-6} at 298 K)

A. 0.34
B. 13.66
C. 13.96
D. 14.34

(1)

9. In order to obtain a pH curve, you are provided with a conical flask containing 25.0 cm^3 of a 0.100 mol dm^{-3} carboxylic acid solution and a burette filled with 0.100 mol dm^{-3} sodium hydroxide solution.

You are also provided with a calibrated pH meter.

(a) State why calibrating a pH meter just before it is used improves the accuracy of the pH measurement.
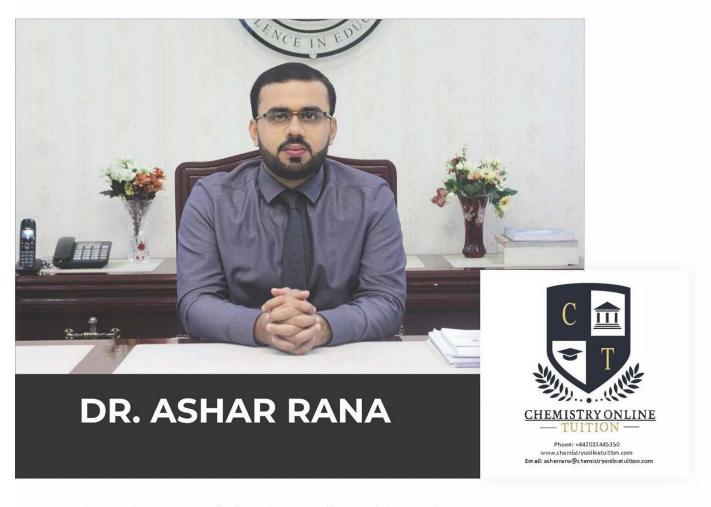
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(1)

(b) Describe how you would obtain the pH curve for the titration.

(4)

10. Which indicator should be used in a titration to find the concentration of a solution of methylamine using $0.010 \text{ mol dm}^{-3}$ hydrochloric acid?

    A. Thymol blue   (pH range 1.2–2.8)
    B. Bromophenol blue   (pH range 3.0–4.6)
    C. Phenol red.   (pH range 6.8–8.4)
    D. Phenolphthalein   (pH range 8.3–10.0)

(1)

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