Access Tuition

A-Level Chemistry

Acids and Bases (Multiple Choice)

Question Paper

Time available: 31 minutes
Marks available: 29 marks

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1. 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.

(Total 1 mark)

2. 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?

A CH_3COOH and NaOH

B CH_3COOH and NH_3

C   HCl and NaOH

D   HCl and NH_3

(Total 1 mark)

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

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

A   −1.16

B 5.01×10^{-15}

C 2.00×10^{14}

D   2.00

(Total 1 mark)

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4. Which indicator should be used in a titration to find the concentration of a solution of methylamine using 0.010 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)   ◯

(Total 1 mark)

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

($K_W = 1.0 \times 10^{-14}$ mol^2 dm^{-6} at 298 K)

    A   0.34   ◯

    B   13.66   ◯

    C   13.96   ◯

    D   14.34   ◯

(Total 1 mark)

6. 2,4,6-Trichlorophenol is a weak monoprotic acid, with $K_a = 2.51 \times 10^{-8}$ mol dm^{-3} at 298 K.
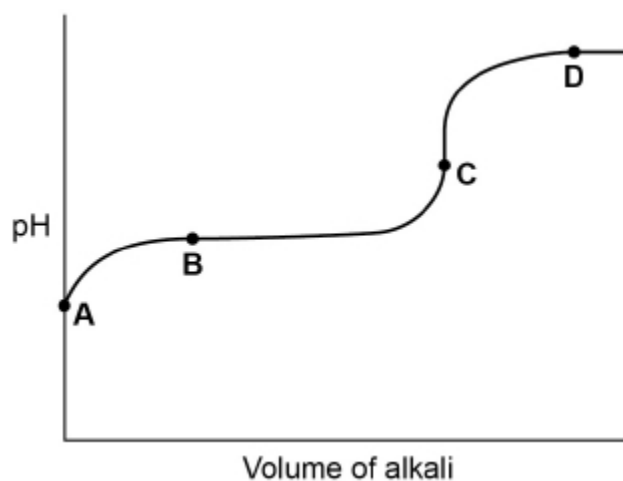
What is the concentration, in mol dm^{-3}, of hydrogen ions in a 2.00×10^{-3} mol dm^{-3} solution of 2,4,6-trichlorophenol at 298 K?

    A 5.02×10^{-11} ◯

    B 7.09×10^{-6} ◯

    C 1.26×10^{-5} ◯

    D 3.54×10^{-3} ◯

(Total 1 mark)

7. The diagram shows a pH curve produced by adding a strong alkali to a weak acid.

Volume of alkali

Which point on the curve represents a solution that can act as a buffer?

A ☐

B ☐

C ☐

D ☐

(Total 1 mark)

8. The rate equation for the acid-catalysed reaction between iodine and propanone is:

$$\text{rate} = k\,[H^+]\,[C_3H_6O]$$

The rate of reaction was measured for a mixture of iodine, propanone and sulfuric acid at pH = 0.70

In a second mixture the concentration of the sulfuric acid was different but the concentrations of iodine and propanone were unchanged. The new rate of reaction was a quarter of the original rate.

What was the pH of the second mixture?

A   1.00   ○

B   1.30   ○

C   1.40   ○

D   2.80   ○

(Total 1 mark)

9. The table shows the pK_a values for two acids.

Name of acid	pK_a
Propanoic acid	4.87
Butanoic acid	4.82

Which statement is correct?

A   Propanoic acid is a stronger acid than butanoic acid.   ○

B   The value of K_a for propanoic acid is greater than that for butanoic acid.   ○

C   The value of K_a for propanoic acid is 1.35×10^{-5} mol dm^{-3} ○

D   The value of K_a for butanoic acid is 6.61×10^4 mol dm^{-3} ○

(Total 1 mark)

10. 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

(Total 1 mark)

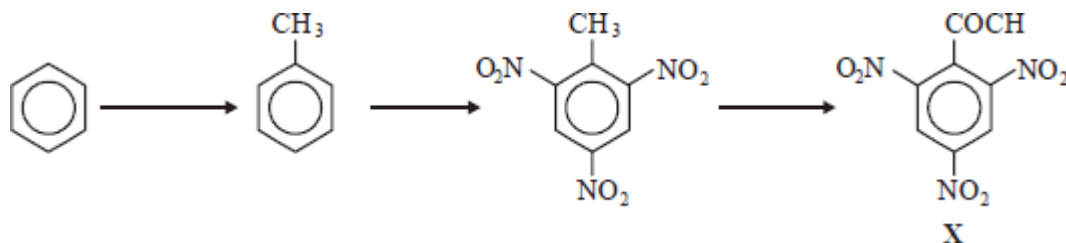**11.** The acid dissociation constant, K_a, of a weak acid HA has the value 2.56×10^{-4} mol dm^{-3}.

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

A 5.96

B 3.59

C 2.98

D 2.37

(Total 1 mark)

12. This question is based on the reactions and compounds shown in the scheme below.

A 0.100 mol dm^{-3} solution of **X** is found to have a pH of 2.50. The value of K_a in mol dm^{-3} is

A 3.16×10^{-2}

B 3.16×10^{-3}

C 1.00×10^{-4}

D 1.00×10^{-5}

(Total 1 mark)

13. Use the information about the following solutions to answer the question below.

Solution F: This is a mixture of 1 mol of propanoic acid, 1 mol of methanol and 2 mol of water.

Solution G: This was originally the same mixture as solution **F** but it has been left to reach equilibrium.
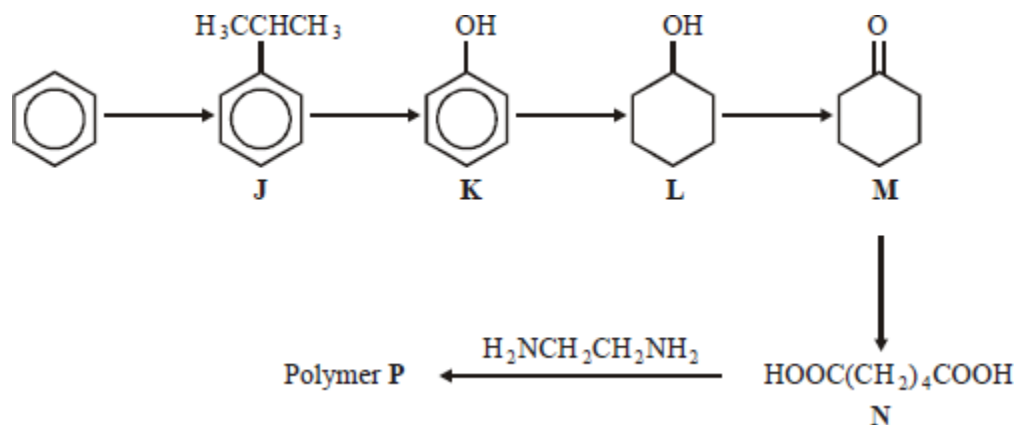
Compared to the pH of solution **F**, the pH of solution **G** will be

A   considerably lower.

B   slightly lower.

C   slightly higher.

D   exactly the same.

(Total 1 mark)

14. This question is about the following reaction scheme which shows the preparation of polymer **P**.

K is a weak acid with a pK_a of 9.95. The pH of a 0.10 mol dm^{-3} solution of **K** is

A   4.48

B   4.98

C   5.48

D   5.98

(Total 1 mark)

15. In which one of the following reactions is the role of the reagent stated correctly?

|	Reaction	Role of reagent
A	$TiO_2 + 2C + 2Cl_2 \rightarrow TiCl_4 + 2CO$	TiO_2 is an oxidising agent
B	$HNO_3 + H_2SO_4 \rightarrow H_2NO_3^+ + HSO_4^-$	HNO_3 is a Brønsted-Lowry acid
C	$CH_3COCl + AlCl_3 \rightarrow CH_3CO^+ + AlCl_4^-$	$AlCl_3$ is a Lewis base
D	$2CO + 2NO \rightarrow 2CO_2 + N_2$	CO is a reducing agent

(Total 1 mark)

16. Use the information below to answer this question.

A saturated solution of magnesium hydroxide, $Mg(OH)_2$, contains 0.1166 g of $Mg(OH)_2$ in 10.00 dm^3 of solution. In this solution the magnesium hydroxide is fully dissociated into ions.

Which one of the following is the pH of a solution of magnesium hydroxide containing 4.0×10^{-5} mol dm^{-3} of hydroxide ions at 298 K?
($K_w = 1.0 \times 10^{-14}$ mol^2 dm^{-6} at 298 K)

A 9.6

B 9.5

C 8.6

D 8.3

(Total 1 mark)

17. This question refers to the reaction sequence below.
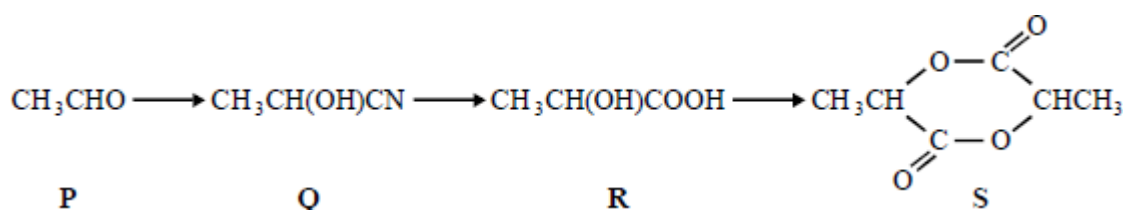
HCN is a weak acid with a pK_a value of 9.40. If a 0.010 mol dm^{-3} solution of HCN was used in the first step, the concentration of cyanide ions, in mol dm^{-3}, would be
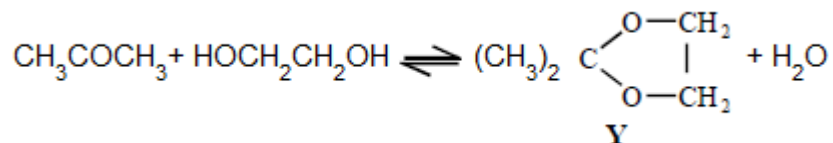
A 2.0×10^{-6}

B 6.4×10^{-5}

C 2.0×10^{-5}

D 3.1×10^{-1}

(Total 1 mark)

18. This question is about the reaction between propanone and an excess of ethane-1,2-diol, the equation for which is given below.

$$CH_3COCH_3 + HOCH_2CH_2OH \rightleftharpoons (CH_3)_2\ C\left\langle \begin{array}{c} O-CH_2 \\ | \\ O-CH_2 \end{array} \right. + H_2O$$

Y

In a typical procedure, a mixture of 1.00 g of propanone, 5.00 g of ethane-1,2-diol and 0.100 g of benzenesulphonic acid, $C_6H_5SO_3H$, is heated under reflux in an inert solvent. Benzenesulphonic acid is a strong acid.

If 0.100 g of the strong monoprotic acid, benzenesulphonic acid, was dissolved in 100 cm^3 of water, the pH of the solution would be

A   0.20

B   1.20

C   2.20

D   3.20

(Total 1 mark)

19. An aqueous solution contains 4.0 g of sodium hydroxide in 250 cm^3 of solution.
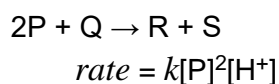($K_w = 1.00 \times 10^{-14}$ mol^2 dm^{-6})

The pH of the solution is

A   13.0

B   13.3

C   13.6

D   13.9

(Total 1 mark)

20. 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)

21. 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)

22. A solution of sodium ethanoate has a pH of 8.91 at 25 °C. The hydrogen ion and hydroxide ion concentrations in this solution are

A $[H^+] = 1.00 \times 10^{-9}$ mol dm^{-3} $[OH^-] = 1.00 \times 10^{-5}$ mol dm^{-3}

B $[H^+] = 1.00 \times 10^{-9}$ mol dm^{-3} $[OH^-] = 8.13 \times 10^{-6}$ mol dm^{-3}

C $[H^+] = 1.23 \times 10^{-9}$ mol dm^{-3} $[OH^-] = 1.00 \times 10^{-5}$ mol dm^{-3}

D $[H^+] = 1.23 \times 10^{-9}$ mol dm^{-3} $[OH^-] = 8.13 \times 10^{-6}$ mol dm^{-3}

(Total 1 mark)

23. A weak acid HA dissociates in aqueous solution as shown below

$$HA(aq) \rightleftharpoons H^+(aq) + A^-(aq) \qquad \Delta H = +20 \text{ kJ mol}^{-1}$$

Which one of the following changes will result in a decrease in the pH of an aqueous solution of the acid?

A   addition of a little aqueous sodium hydroxide solution

B   raising the temperature of the solution

C   dissolving a little of the sodium salt, NaA, in the solution

D   adding a platinum catalyst to the solution

(Total 1 mark)

24. The pH of 0.001 M NaOH at 25°C is

A   13

B   11

C   9

D   3

(Total 1 mark)

25. Which one of the following could be true in an aqueous solution of sodium hydroxide?

A $[H^+] = (OH^-]$

B $pH = -\log_{10}[OH^-]$

C $pH = 1.2$

D $pH = 12.8$

(Total 1 mark)

26. 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)

27. Which can **not** function as a Brønsted-Lowry acid?

    A CH_3COO^- ⬭

    B HCO_3^- ⬭

    C H_3O^+ ⬭

    D NH_4^+ ⬭

(Total 1 mark)

28. A strong acid H_2X dissociates in aqueous solution.

$$H_2X(aq) \rightarrow 2\,H^+(aq) + X^{2-}\,(aq)$$
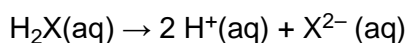
What is the pH of a 0.020 mol dm^{-3} solution of this acid?

    A   1.00   ⬭

    B   1.40   ⬭

    C   1.70   ⬭

    D   2.00   ⬭

(Total 1 mark)

29. Equal volumes of two solutions, each with the same concentration, are mixed together at 298 K

Which two solutions, when mixed, form a solution with a pH >7?

    A   HCOOH and HCOOK   ⬭

    B   KOH and CH_3COOH ⬭

    C NH_3 and HCl   ⬭

    D NH_4Cl and KCl   ⬭

(Total 1 mark)