Acids, Bases and Salts

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. What colour is phenolphthalein in dilute sulphuric acid?

(a) colourless **(b)** red **(c)** green **(d)** reddish-brown

2. Solutions P, Q, R and S have pH values of 13, 10, 9, 8 respectively. Which has the highest concentration of hydrogen ions?

(a) P **(b)** Q **(c)** S **(d)** R

3. Acids turn blue litmus:

(a) green **(b)** blue **(c)** colourless **(d)** red

4. Nitric acid reacts with potassium hydroxide. The salt formed is:

(a) KNO_3 **(b)** K_2SO_4 **(c)** K_2CO_3 **(d)** KCl

5. The chemical formula of common salt is:

(a) $CuSO_4 \cdot 5H_2O$ **(b)** NaOH **(c)** $Ca(OH)_2$ **(d)** NaCl

6. Which of these salts gives an acidic solution in water?

(a) potassium chloride (KCl) **(b)** sodium hydrogencarbonate ($NaHCO_3$)
(c) zinc sulphate ($ZnSO_4$) **(d)** sodium ethanoate (CH_3COONa)

7. How many molecules of water of crystallisation are there in one formula unit of blue vitriol (copper sulphate crystals)?

(a) 10 **(b)** 2 **(c)** 5 **(d)** 1

8. Assertion (A): A solution with a pH of 10 is acidic.
Reason (R): A pH below 7 means a solution is acidic, and a pH above 7 means it is basic.

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Section B — Short answer — 8 × 2 = 16 marks

9. Write the balanced equation for the reaction of nitric acid with potassium hydroxide. Name the salt formed.

10. Write the balanced equation for the reaction of calcium oxide (CaO) with dilute sulphuric acid. Name the products.

11. Zinc carbonate reacts with dilute nitric acid. Name the gas given off and write the balanced equation.

12. Why should water never be added to a concentrated acid?

13. 528.2 g of ferrous sulphate crystals ($FeSO_4 \cdot 7H_2O$) is heated until all its water of crystallisation is lost. Find the mass of water lost and the mass of the anhydrous salt left. (Atomic masses: H = 1 u, O = 16 u, S = 32 u, Fe = 56 u)

14. Solutions P, Q, R and S have pH values of 8, 9, 13, 1 respectively. Arrange them in increasing order of hydrogen-ion concentration. Which of them are acidic?

15. Will a solution of ammonium sulphate ($(NH_4)_2SO_4$) be acidic, basic or neutral? Give a reason.

16. Give the chemical name and formula of Epsom salt, and one use.

Section C — Word problems — 4 × 4 = 16 marks

17. What is the chlor-alkali process? Write the equation and give one use of each product.

18. 68 g of sodium hydroxide is exactly neutralised by hydrochloric acid. Write the balanced equation and find the mass of acid needed and the mass of salt formed. (Atomic masses: H = 1 u, O = 16 u, Na = 23 u, Cl = 35.5 u)

19. Three test tubes contain sodium chloride solution, dilute sulphuric acid, potassium hydroxide solution. For each, give the colour of (i) blue litmus, (ii) phenolphthalein and (iii) methyl orange, and say whether it is acidic, basic or neutral.

20. Write balanced equations to prepare zinc sulphate from (a) the metal and (b) its hydroxide, each with dilute sulphuric acid.

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Answer key

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Q	Answer	Working
1	**(a) colourless**	dilute sulphuric acid is acidic
2	**(c) S**	the lowest pH is the most acidic (most H^+ ions)
3	**(d) red**	—
4	**(a) KNO_3**	$HNO_3 + KOH \rightarrow KNO_3 + H_2O$
5	**(d) NaCl**	—
6	**(c) zinc sulphate ($ZnSO_4$)**	zinc sulphate comes from a strong acid and a weak base
7	**(c) 5**	—
8	**(d) A is false, but R is true.**	A is false: pH 10 is above 7, so the solution is basic. R is true.
9	**$HNO_3 + KOH \rightarrow KNO_3 + H_2O$; potassium nitrate**	acid + base → salt + water
10	**$CaO + H_2SO_4 \rightarrow CaSO_4 + H_2O$; calcium sulphate and water**	metal oxide + acid → salt + water
11	**Carbon dioxide; $ZnCO_3 + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2O + CO_2$**	carbonate + acid → salt + water + carbon dioxide
12	**Mixing gives out a lot of heat; adding water to the acid can make it boil and splash out. Always add acid slowly to water.**	—
13	**239.4 g of water; 288.8 g of $FeSO_4$**	$FeSO_4 \cdot 7H_2O$ = 278 u, of which water is 126 u
14	**R < Q < P < S; acidic: S**	the lower the pH, the more H^+ ions
15	**Acidic: it comes from a strong acid (sulphuric acid) and a weak base (ammonium hydroxide).**	—
16	**Magnesium sulphate heptahydrate, $MgSO_4 \cdot 7H_2O$; used in bath salts and as a laxative**	—
17	**The electrolysis of brine (sodium chloride solution): $2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$. Sodium hydroxide: soaps, detergents, paper. Chlorine: disinfecting water, PVC, bleaching powder. Hydrogen: fuels, margarine, ammonia.**	—
18	**$NaOH + HCl \rightarrow NaCl + H_2O$; 62.05 g of HCl; 99.45 g of NaCl**	1.7 mol of NaOH; use the ratio 1 : 1 : 1 : 1
19	**sodium chloride solution: blue, colourless, orange (neutral); dilute sulphuric acid: red, colourless, red**	—

Q	Answer	Working
	(acidic); potassium hydroxide solution: blue, pink, yellow (basic)	
20	**(a) $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$; (b) $Zn(OH)_2 + H_2SO_4 \rightarrow ZnSO_4 + 2H_2O$**	**—**

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