Neutralization Reactions Chemistry Questions with Solutions

Q1: What will be the salt of the given reaction?

$$Zn(OH)_2 + HNO_3 \rightarrow$$

a. HNO_3
b. $Zn(OH)_2$
c. H_2O
d. $Zn(NO_3)_2$

Answer: (d.)

Explanation: The given reaction is a neutralization reaction. The base $Zn(OH)_2$ and acid HNO_3 react together to form salt and water.

Q2. Complete the following reaction:

$$HCl + Mg(OH)_2 \rightarrow$$

a. $MgCl_2 + O_2$
b. $MgCl_2 + CO_2$
c. $MgCl_2 + H_2O$
d. $MgCl_2 + CO_2 + H_2O$

Answer: (c.)

Explanation: The given reaction is the neutralization reaction between an acid and a base. The product of the neutralization reactions are always salt and water.

Q3. What is the pH range of acidic solutions?

a. 0-2
b. 7-14
c. 5-7
d. 0-7

Answer: (d.)

Explanation: The acidic solution lies in the wide pH range of 0-7. A solution with a pH = 7 is a neutral solution and the solutions with a pH higher than 7 uptill 14 are the basic solutions.

Q4. A neutral solution contains

a. No free ions
b. Salts of metals
c. Electrons and protons

d. Equal number of H^+ and OH^- ions

Answer: (d.)

Explanation: The neutral solutions contain a balanced amount of H^+ and OH^- ions.

Q5. Neutralizations reactions are
a. Displacement reactions
b. Double displacement reactions
c. Decomposition reactions
d. Combination reactions

Answer: (b.)

Explanation: In an acid-base reaction i.e. neutralization reaction, the acids and bases in their solutions exchange their ions forming a salt and water. Hence, the neutralization reaction is always a double-displacement reaction.

Q6. Predict the products of the following reaction:
a. HNO_3 + KOH
b. $Mg(OH)_2$ + $HClO_2$
c. NaOH + HF

Answer: Since in each set of the given reactions, an acid and a base are present. The given reactants will undergo a neutralization reaction. In this reaction, the cation from the base and the anion from the acid combine to form a salt along with the formation of water.

a. In this neutralization reaction, the anion (NO_3^-) from the acid and the cation (K^+) from the base combine to form a salt. The H^+ and OH^- ions combine to form water.

$$HNO_3\ (aq) + KOH\ (aq) \rightarrow KNO_3\ (aq) + H_2O\ (l)$$

b. In this neutralization reaction, the anion (ClO_2^-) from the acid and the cation (Mg^{2+}) from the base combine to form a salt. The H^+ and OH^- ions combine to form water.

$$Mg(OH)_2\ (aq) + 2HClO_2\ (aq) \rightarrow Mg(ClO_2)_2\ (aq) + 2H_2O\ (l)$$

c. In this neutralization reaction, the anion (F^-) from the acid and the cation (Na^+) from the base combine to form a salt. The H^+ and OH^- ions combine to form water.

$$NaOH\ (aq) + HF\ (aq) \rightarrow NaF\ (aq) + H_2O\ (l)$$

Q7. Which indicator gives a colour change from yellow to blue in between the pH range of 6-8?

Answer: Bromothymol Blue (BTB) gives a colour change from yellow to blue. This indicator helps to determine the approximate amount of CO_2 dissolved within the solution. BTB shows a yellow colour in slightly acidic solutions and a blue colour in slightly basic solutions.

Q8. What will be the colours of bromothymol blue, bromocresol green, litmus paper and methyl orange respectively in a solution of Aspirin? Given the pH of Aspirin is 3.9.

Answer: Bromothymol blue, methyl orange and bromocresol green give a yellow colour in the pH range of at the pH 3.9. A red litmus paper remains unchanged in an acidic solution. A blue litmus paper turns red in the acidic solution.

Q9. What volume of the 2.0 M HNO_3 solution is needed to neutralize 40 mL of 5.0 M NaOH solution completely?

Answer: The balanced chemical equation between the given base and acid is:

$$HNO_3\ (aq) + NaOH\ (aq) \rightarrow NaNO_3\ (aq) + H_2O\ (l)$$

Hence, 1 mole of HNO_3 neutralizes 1 mole of NaOH completely.
Given: 1000 mL of 5 M NaOH solution contains moles = 5 mol
40 mL of 5 M NaOH solution contains moles = (5/1000) mol mL^{-1} x 40 mL = 0.2 mol
Hence, 0.2 moles of HNO_3 are required.
Given: 2 moles of 2 M HNO_3 solution are contained in volume = 1000 mL
0.2 moles of 2 M HNO_3 solution are contained in volume = (1000/2) mL mol^{-1} x 0.2 mol = 100 mL
Hence, 100 mL of 2.0 M HNO_3 solution is needed to neutralize 40 mL of 5.0 M NaOH solution completely.

Q10. During a titration, 17.6 mL of H_2SO_4 solution neutralized 27.4 mL of 0.0165 M LiOH solution. What was the estimated molarity of the aqueous H_2SO_4 solution?

Answer: The Molarity formula is as: M_AV_A(number of H^+ ions) = M_BV_B(number of OH^- ions)
Where M_A = molarity of acidic solution = ?
V_A = volume of the acidic solution = 17.6 mL
M_B = molarity of basic solution = 0.0165 M
V_B = volume of the basic solution = 27.4 mL
Number of H^+ ions from diprotic acid = 2
Number of OH^- ions from LiOH = 1
Hence, M_A x 17.6 mL x 2 = 0.0165 M x 27.4 mL x 1
M_A = 0.4521 M mL / 35.2 mL = 0.0128 M
Hence, the molarity of the H_2SO_4 solution must have been 0.0128 M.

Q11. How many moles of hydrogen ions will react with 1 mole of hydroxide ions during an acid-base neutralization reaction?

Answer: In a neutralization reaction, the hydrogen ions and hydroxide ions neutralize each other completely. This happens only when the H^+ ions are equal in number with the OH^- ions. Hence, in order to neutralize 1 mole hydroxide ions, 1 mole of hydrogen ions are needed.

Q12. Write the products of the given neutralization reaction. Determine whether the equilibrium will favour the products or the reactants.

a. $NH_3 + NH_3$
b. $CH_3OH + NH_4^+$

Answer: The products and the favoured sides are described hereunder.

a. $NH_4^+ + NH_2^-$; both the reactants and the products are favoured as the products formed include a stronger acid and a stronger base.
b. $CH_3OH_2^+ + NH_3$; the reactants are favoured more than the products because the dissociation constant of ammonia is greater than that of the ammonium ion.

Q13. What is the principle behind taking antacid for indigestion?

Answer: During indigestion, the stomach acids having the concentrated HCl get produced in excess amount. Indigestion may also lead to heartburn. Since, a strong acid is involved in the problem. Basic solutions (antacids) are consumed for quick relief from indigestion. The basic antacid solution neutralizes the stomach acids. The antacids may include a mixture of salts of aluminium, magnesium and calcium.

Q14. What reaction takes place when baking powder is added to the flour for baking purpose?

Answer: Baking powder is sodium bicarbonate. It requires an acidic medium to begin the reaction and evolve carbon dioxide as its product. The carbon dioxide molecules produced as a product of the reaction remain trapped in the flour dough. Upon heating the trapped gas comes out and the bread turns out to be spongy. Due to the evolution of excess of carbon dioxide, the dough might taste bitter sometimes. Hence, some amount of baking soda is also mixed with the baking powder.

Q15. Write a neutralization reaction between H_3PO_4 (aq) and $Ca(OH)_2$.

Answer: Neutralization is a double-displacement reaction in which both the acid and the base exchange their counter-ions to form a salt and water. Hence, the neutralization reaction for the given acid and base is as follows:

$$2H_3PO_4\ (aq) + 3Ca(OH)_2\ (aq) \rightarrow Ca_3(PO_4)_2\ (s) + 6H_2O\ (l)$$

Practise Questions on Neutralization Reactions

Q1. A 4 mL solution of NaOH neutralizes 10 mL of 2 M HCL. What is the molarity of the base?

a. 0.14 M
b. 12 M
c. 5 M
d. 0.5 M

Answer: (c.)

Explanation: The Molarity formula is as: M_AV_A(number of H^+ ions) = M_BV_B(number of OH^- ions)
Where M_A = molarity of acidic solution = 2 M
V_A = volume of the acidic solution = 10 mL
M_B = molarity of basic solution = ?
V_B = volume of the basic solution = 4 mL
Number of H^+ ions from diprotic acid = 1
Number of OH^- ions from LiOH = 1
Hence, 2 M x 10 mL x 1 = 4 mL x M_B x 1
M_B = 20 M ml / 4 mL = 5 M
Hence, the molarity of NaOH is 5 M.

Q2. Why does a yellow turmeric stain on the cloth turns read after getting washed with detergent?

Answer: This is because turmeric is a natural indicator. It has an acidic pH and remains yellow in acidic medium. However, when clothes stained with turmeric spots are washed with detergent, the stains turn red. This is because the detergents are basic in nature and turmeric being a natural indicator turns its colour from yellow to red. Hence, the change of colour is due to the change in pH of the solution.

Q3. Write a neutralization reaction between H_2SO_4 and $Sr(OH)_2$.

Answer: The acid and base undergo a double-displacement reaction: AB + CD → AD + CB
Hence the complete reaction is as follows:

$$H_2SO_4\ (aq) + Sr(OH)_2\ (aq) \rightarrow SrSO_4\ (sq) + 2H_2O\ (l)$$

Q4. Write the net ionic equation for the reaction between oxalic acid ($H_2C_2O_4$) and $Ca(OH)_2$, given that both of these are solid and react very slowly.

Answer: The reaction involves two solid reactants undergoing a neutralization reaction forming a salt and water. Since the salt formed as a result of this reaction is insoluble in water, there are no ionic species formed. Hence, the overall ionic equation involves a solid and a liquid phase only.

$$H_2C_2O_4\ (s) + Ca(OH)_2\ (s) \rightarrow CaC_2O_4\ (s) + 2H_2O\ (l)$$

Q5. What is the Arrhenius definition of an acid?

Answer: According to the Arrhenius definition, an acid provides the H^+ ions in the aqueous solution..