**Unit 2 Test 2: Acids and bases**

**SECTION A: Multiple-choice questions (1 mark each)**

**Question 1**

*Answer:* C

*Explanation:*

A base will turn red litmus blue. Option A is incorrect as the liquid might be neutral or non-polar.

**Question 2**

*Answer:* D

*Explanation:*

Standard definition of an acid.

**Question 3**

*Answer:* D

*Explanation:*

HCl hydrochloric acid, HNO3 nitric acid, HF hydrofluoric acid, CH3COOH ethanoic acid

**Question 4**

*Answer:* B

*Explanation:*

NH3  as NH4+, as will donate a H+ when acting as an acid.

**Question 5**

*Answer:* B

*Explanation:*

The self-ionisation of water is H2O(l) + H2O(l) ⇄ H3O+(aq) + OH-(aq)

The reaction is not extensive but will allow water to conduct slightly.

**Question 6**

*Answer:* C

*Explanation:*

Solution C is a weak acid. A concentration of 0.01 will produce a pH of 2 if it was a strong acid.

**Question 7**

*Answer:* D

*Explanation:*

Solution D must be diprotic or triprotic. A concentration of 0.001 M will lead to a pH of 3 for a monoprotic acid. Since the pH is lower, it is diprotic.

**Question 8**

*Answer:* A

*Explanation:*

Indicators are weak acids, where the conjugate acid and base have different colours.

.

**Question 9**

*Answer:* B

*Explanation:*

HI must be a weak acid as the percentage of HI donating a proton is low.

**Question 10**

*Answer:* D

*Explanation:*

Extra CO2 dissolving in the ocean increases its acidity leading to a lower pH. Marine organisms with CaCO3 shells are in danger of their shells dissolving.

**SECTION B: Short-answer questions**

**Question 1** (10 marks)

**a**. Complete the table below by labelling each chemical as acid, base or neither.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| KOH | HNO3 | CH4 | CH3COOH | Mg(OH)2 |
| base | acid | neither | acid | base |

3 marks

**b. i**. An acid is a substance that can donate a proton.

**ii**. HSO4-(aq) + H2O(l) 🡪 H3O+(aq) + SO42-(aq)

1 + 1 = 2 marks

**c**. **i**. It can act as an acid by donating a proton or a base by accepting a proton.

**ii**. HSO4-(aq) + H2O(l) 🡪 OH-(aq) + H2SO4(aq)

2 marks

**d**. Sour taste, react with metal to give off hydrogen, turn blue litmus red ( 2 of these answers)

2 marks

**e**. No, NaOH is a base and CH4 is neither. It is the ability to donate hydrogen that counts.

1 mark

**Question 2**. (7 marks)

**a. i**. Zn(s) + 2HCl(aq) 🡪 ZnCl2(aq) + H2(g)

**ii**. The zinc will gradually disappear and a gas will be evolved.

**ii**. salt and hydrogen gas 1 + 1 + 1 = 3 marks

**b. i**. ZnCO3(s) + 2HCl(aq) 🡪 ZnO(s) + H2O(l) + CO2(g)

**ii**. acid + carbonate gives an oxide and water and carbon dioxide

1 + 1= 2 marks

**c. i**. HCl(aq) + LiOH(aq) 🡪 LiCl(aq) + H2O(l)

**ii**. An acid and base reaction that leads to a neutral solution.

1 + 1 = 2 marks

**Question 3** (5 marks)

The scale used for measuring acidity is the pH scale.

|  |  |  |
| --- | --- | --- |
| Solution | [H3O+] | pH |
| 0.01 M HCl | 0.01 | 2 |
| 0.05 M HCl | 0.05 | 1.3 |
| 0.01 M NaOH | 10-12 | 12 |
| Water at 25 0C | 10-7 | 7 |
| 0.05 M Mg(OH)2 | 10-13 | 13 |

½ mark for each correct answer.

**Question 4** (5 marks)

**a. i**. H2SO4(aq) + H2O(l) 🡪 HSO4-(aq) + H3O+(aq)

HSO4-(aq) + H2O(l) 🡪 H3O+(aq) + SO42-(aq)

**ii**. H2SO4(aq) + 2H2O(l) 🡪 SO42-(aq) + 2H3O+(aq)

2 + 1 = 3 marks

**b**. The pH of a 0.1 M solution of sulfuric acid will be less than 1\*. As it is diprotic, the

concentration of H3O+ will be greater than 0.1 leading to a pH less than 1.\*

2 marks

**Question 5** (5 marks)

**a**. Is ammonia acting as an acid or a base in this equation? base

**b**. What is the conjugate of ammonia? NH4+

**c**. What is the other conjugate pair in this equation? H2O / OH-

**d**. Name the conjugate base of HCO3- CO32-

**Question 6** (9 marks)

**a**. **i**. Phenolphthalein can be used to identify an acid or a base. It will be colourless in an acidic solution and pink in a base. Its transition is close to a pH of 7, helping distinguish an acid from a base. It is often used in titrations to identify an endpoint. 2 marks

**ii**. Thymol blue has two transition points so potentially can provide more information about the likely pH of a solution. 1 mark

**iii**. Methyl orange is likely to be yellow in a weak acid solution due to its low pH transition.

1 mark

**iv.** Thymophthalein has a transition that corresponds to the pH difference between a weak base and a strong base. 1 mark

**b**. **i**. CO2(aq) + H2O(l) ⇌ H2CO3(aq) 1 mark

**ii**. Many small marine creatures incorporate CaCO3 in their shells. They obtain the calcium and carbonate ions from sea-water. This process of forming calcium carbonate is calcification. 1 mark

**iii**. Sea snails and other small organisms are part of the diet of larger fish. They are necessary to maintain the numbers of these larger species. 2 marks