08 Acids and Bases

Set B **Answer key**

A Multiple choice

5 MARKS

1 **B** I and IV only [1]

II is wrong: strength is how much of the acid ionises, not how much is dissolved. III is wrong: a strong acid turns Universal Indicator red. In IV, H^+ ions gain electrons to form hydrogen gas.

2 **A** 1 only [1]

Strength is about the extent of ionisation. A dilute strong acid can be less concentrated than a weak acid, and can then have a higher pH, so 2 and 3 are not always true.

3 **C** basic, amphoteric, neutral, acidic [1]

W reacts with acid only (basic), X with both (amphoteric), Y with neither (neutral) and Z with alkali only (acidic).

4 **B** Calcium hydroxide will react with ammonium nitrate to release ammonia gas. [1]

A base reacts with an ammonium salt to give off ammonia, so the nitrogen the farmer added is lost to the air.

5 **A** barium carbonate [1]

Barium carbonate is insoluble in water, but it reacts with the acid in the stomach to form soluble barium chloride. Barium chloride and barium nitrate dissolve in rainwater, and barium sulfate does not react with acid.

B Structured questions

28 MARKS

6 **(a)(i)** Barium sulfate is insoluble, so it does not produce barium ions. [1]

(ii) Although barium carbonate is insoluble, it reacts with the acid in gastric juice (hydrochloric acid) in the stomach [1]

to form soluble barium chloride, which produces barium ions and causes poisoning. [1]

(b) Bubble the gas through limewater [1]

and a white precipitate forms (*or* the limewater turns milky). [1]

(c)(i)

In a strong acid such as HCl, the molecules ionise completely in water, releasing a higher concentration of H^+ ions. [1]

In a weak acid, the molecules ionise partially, giving a lower concentration of H^+ ions. [1]

(ii)

Strong acid: pH low, pK_a low. Weak acid: pH high, pK_a high. [2]

One mark for every two correct.

(d)

Carbonic acid is the weakest. [1]

It has the highest pK_a, 6.3, so it ionises to produce the fewest H^+ ions. [1]

So there are fewer H^+ ions to react with the carbonate, and the least carbon dioxide, 0.95 cm^3, is produced. [1]

(e)

Carbon monoxide is a neutral oxide. [1]

7 **(a)**

$$\text{Moles} = \frac{0.45}{2(12) + 2(1) + 4(16)} = \frac{0.45}{90} = 0.00500 \text{ mol}$$ [1]

(b)

Sulfuric acid is a strong acid: it ionises completely in water to form a high concentration of H^+ ions, so its pH is lower. [1]

Oxalic acid is a weak acid: it ionises partially, giving a lower concentration of H^+ ions. [1]

(c)

Hydrochloric acid and ethanoic acid each have one hydrogen per molecule that forms an H^+ ion, so they contain the same amount of hydrogen ions and need the same volume of NaOH to neutralise. [1]

Sulfuric acid has two, so the same volume and concentration contains twice the amount of hydrogen ions [1]

and needs twice the volume of NaOH to neutralise. [1]

(d)

$$\frac{25.0}{1000} \times 0.40 = 0.0100 \text{ mol}$$ [1]

(e)

16.70 cm^3: 0.00500 mol of oxalic acid contains 0.0100 mol of H^+, the same as the hydrochloric acid in (d). [1]

8 **(a)**

$2CH_3COOH + CaCO_3 \rightarrow (CH_3COO)_2Ca + CO_2 + H_2O$ [2]

(b)(i)

Add a few drops of Universal Indicator to separate samples of hydrochloric acid and ethanoic acid. [1]

Hydrochloric acid turns it red, so it is the strong acid. Ethanoic acid turns it orange, so it is the weak acid. [1]

Both colours are needed for this mark.

(ii)

Strong acids ionise completely in water to form H^+ ions [1]

while weak acids ionise partially in water. [1]

(iii)

Hydrochloric acid is a strong acid that will also react with the iron in the steel and damage the pipes. [1]