Exam Papers Practice

8.1 Theories & Reactions of Acids & Bases

Mark Schemes

Course	DP IB Chemistry
Section	8. Acids & Bases
Topic	8.1 Theories & Reactions of Acids & Bases
Difficulty	Medium

To be used by all students preparing for DP IB Chemistry SL
Students of other boards may also find this useful

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The correct answer is **A** because:

- Acids react with hydrogen carbonates to form a salt, water and carbon dioxide
- Acids react with magnesium to form a salt and hydrogen
- Copper is too low in the reactivity series to react with dilute acids

Extra info:

Although metals generally react with most acids, copper is an exception. Other familiar metals that would also **not** react with acids are silver, mercury and gold

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The correct answer is **D** because:

- A Brønsted–Lowry base is defined as a proton (H^+) acceptor
- The HNO_3 gains a proton to become $H_2NO_3^+$ so it must be acting as a base
- In the reverse reaction, the HSO_4^- gains a proton to become H_2SO_4 so it must also be acting as a base

A is incorrect as $H_2NO_3^+$ acts as Brønsted–Lowry acid because it is donating a proton to HSO_4^-

B is incorrect as $H_2NO_3^+$ acts as Brønsted–Lowry acid because it is donating a proton to HSO_4^-

C is incorrect as H_2SO_4 acts as Brønsted–Lowry acid because it is donating a proton to HNO_3

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The correct answer is **D** because:

- A proton is transferred from the HCl to CH_3COOH making the HCl an acid and CH_3COOH a base
- In the back reaction, a proton is transferred from $CH_3COOH_2^+$ to Cl^- making the $CH_3COOH_2^+$ an acid and Cl^- a base

A is incorrect as both the acid and base in the reactants and products are the wrong way around

B is incorrect as the acid and base in the reactants are the wrong way around

C is incorrect as the acid and base in the products are the wrong way around

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The correct answer is **C** because:

- You are told that perbromic acid is a strong acid, so by definition it must be fully dissociated in solution

A is incorrect as this would be a feature of weak acids, not strong ones

B is incorrect as a strong acid would react with weak or strong bases

D is incorrect as a strong or weak acid would have a pH below 7

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The correct answer is **C** because:

- To form a conjugate base, a species must lose a proton
- When K_2HPO_4 loses a proton it forms $K_2PO_4^-$
- However, this does not seem to be one of the answers
    - **Remember:** The potassium ion is a spectator ion and positively charged so the anion corresponds to PO_4^{3-} ($K_2PO_4^- = 2K^+ + PO_4^{3-}$)

A is incorrect as this is the conjugate acid of the hydrogen phosphate ion $K_2HPO_4 + H^+ \rightarrow KH_2PO_4$ ($H_2PO_4^-$ is the anion)

B is incorrect as this ion does not make sense

D is incorrect as this is the full formula of the conjugate acid of the hydrogen phosphate ion

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The correct answer is **D** because:

- To be a Brønsted-Lowry acid, a species must lose a proton
- In the forward reaction, H_3NSO_3, loses protons and in the backward reaction each NH_4^+ loses a proton

A is incorrect as this is a Brønsted-Lowry acid-base pair

B is incorrect as this is a Brønsted-Lowry acid and a Brønsted-Lowry base, respectively

C is incorrect as this is a Brønsted-Lowry acid-base pair

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The correct answer is **D** because:

- Calcium oxide is classified as a base
- When an acid reacts with a base a salt and water are formed
- Salts of hydrochloric acid are chlorides

A is incorrect as there is no gas given off in the reaction and water is a missing product

B is incorrect as there is no gas given off in the reaction

C is incorrect as calcium and hydrogen are incorrect products

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The correct answer is **D** because:

- The correctly balanced equation is:
  $2HNO_3\,(aq) + Mg(HCO_3)_2\,(s) \rightarrow Mg(NO_3)_2\,(aq) + 2H_2O\,(l) + 2CO_2\,(g)$
- The sum of the coefficients = 2 + 1 + 1 + 2 + 2 = 8

A, B & C are incorrect as as they do not have the right sum of coefficients

It is a favourite examiner's trick to ask for the sum of the coefficients knowing that some candidates will forget that the absence of a number in front of a formula means the coefficient is 1. Don't get caught out!

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The correct answer is **A** because:

- Calcium oxide is classified as a base
- Only oxides that are acidic can react with calcium oxide
- Sulfur dioxide and nitrogen dioxide are acidic oxides

B is incorrect as nitrogen dioxide reacts with calcium oxide, but potassium oxide does not

C is incorrect as sulfur dioxide and nitrogen dioxide react with calcium oxide, but potassium oxide does not

D is incorrect as potassium oxide does not react with calcium oxide

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The correct answer is **B** because:

- Neutralisation reactions are always exothermic as there is net bond formation when hydrogen ions react with hydroxide ions to form water:

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

- Bond formation is always an exothermic process

A is incorrect as metal displacement reactions are generally exothermic, but they can be either

C is incorrect as combustion is always an exothermic reaction

D is incorrect as melting is an endothermic process as it is a bond breaking process