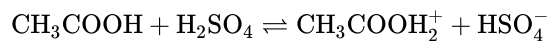


# HL Paper 1

According to the Brønsted-Lowry theory, how does each species act in the equilibrium below?



	$\text{CH}_3\text{COOH}$	$\text{H}_2\text{SO}_4$	$\text{CH}_3\text{COOH}_2^+$	$\text{HSO}_4^-$
A.	acid	base	base	acid
B.	acid	base	acid	base
C.	base	acid	base	acid
D.	base	acid	acid	base

Aqueous solutions of a weak acid and a strong acid of equal concentration are compared. Which statements are correct?

- I. The weak acid is less dissociated than the strong acid.
- II. The strong acid reacts with a metal oxide but the weak acid does not.
- III. The strong acid has greater conductivity than the weak acid.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

What is the pH of  $1.0 \times 10^{-3} \text{ mol dm}^{-3}$  sodium hydroxide,  $\text{NaOH(aq)}$ ?

$$K_w = 1.0 \times 10^{-14}$$

- A. 3
- B. 4
- C. 10
- D. 11

Which solutions have a pH less than 7?

- I.  $\text{Na}_2\text{CO}_3(\text{aq})$
- II.  $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_3(\text{aq})$
- III.  $(\text{NH}_4)_2\text{SO}_4(\text{aq})$

- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III
- 

What is the correct expression for the ionic product constant of water,  $K_w$ ?

- A.  $K_w = \frac{[\text{H}^+]}{[\text{OH}^-]}$
  - B.  $K_w = \frac{[\text{H}_2\text{O}]}{[\text{H}^+][\text{OH}^-]}$
  - C.  $K_w = [\text{H}^+] + [\text{OH}^-]$
  - D.  $K_w = [\text{H}^+][\text{OH}^-]$
- 

Which of the following is an example of a Lewis acid–base reaction, but not a Brønsted–Lowry acid–base reaction?

- A.  $2\text{CrO}_4^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
  - B.  $\text{Co}(\text{H}_2\text{O})_6^{2+}(\text{aq}) + 4\text{HCl}(\text{aq}) \rightarrow \text{CoCl}_4^{2-}(\text{aq}) + 4\text{H}^+(\text{aq}) + 6\text{H}_2\text{O}(\text{l})$
  - C.  $\text{NH}_3(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{NH}_4^+(\text{aq})$
  - D.  $\text{CH}_3\text{COO}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{CH}_3\text{COOH}(\text{aq}) + \text{OH}^-(\text{aq})$
- 

What is the pH of a solution in which the hydroxide ion concentration is  $1 \times 10^{-11} \text{ mol dm}^{-3}$  at 298 K?

$$K_w = 1 \times 10^{-14} \text{ at } 298 \text{ K}$$

- A. 3
  - B. 7
  - C. 11
  - D. 14
- 

Which species acts as a Lewis and Brønsted–Lowry base?

- A.  $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$
  - B.  $\text{BF}_3$
  - C.  $\text{NH}_4^+$
  - D.  $\text{OH}^-$
-

The table below shows data for the  $K_a$  and  $pK_b$  values for some acids and bases at 298 K.

Acid	$K_a$	Base	$pK_b$
HClO	$2.9 \times 10^{-8}$	$\text{NH}_3$	4.75
$\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$	$4.9 \times 10^{-5}$	$\text{C}_6\text{H}_5\text{NH}_2$	9.13

Which two formulas represent the weakest acid and the weakest base in the table?

- A. HClO and  $\text{C}_6\text{H}_5\text{NH}_2$
- B.  $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$  and  $\text{NH}_3$
- C.  $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$  and  $\text{C}_6\text{H}_5\text{NH}_2$
- D. HClO and  $\text{NH}_3$

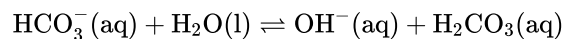
Which species produced by the successive dissociations of phosphoric acid,  $\text{H}_3\text{PO}_4$ , are amphiprotic?

- A.  $\text{HPO}_4^{2-}$  and  $\text{PO}_4^{3-}$
- B.  $\text{H}_2\text{PO}_4^-$  and  $\text{HPO}_4^{2-}$
- C.  $\text{H}_2\text{PO}_4^-$  and  $\text{PO}_4^{3-}$
- D.  $\text{HPO}_4^{2-}$  only

What is the conjugate base of phenol,  $\text{C}_6\text{H}_5\text{OH}$ ?

- A.  $\text{C}_6\text{H}_4^-\text{OH}$
- B.  $\text{C}_6\text{H}_5-\overset{+}{\text{O}}\text{H}_2$
- C.  $\text{C}_6\text{H}_5-\text{O}^-$
- D.  $\text{C}_6\text{H}_6^+-\text{OH}$

What are the conjugate acid–base pairs in the following reaction?



	Brønsted–Lowry acid	Brønsted–Lowry base	Conjugate acid	Conjugate base
A.	$\text{HCO}_3^-(\text{aq})$	$\text{H}_2\text{O}(\text{l})$	$\text{H}_2\text{CO}_3(\text{aq})$	$\text{OH}^-(\text{aq})$
B.	$\text{H}_2\text{CO}_3(\text{aq})$	$\text{OH}^-(\text{aq})$	$\text{HCO}_3^-(\text{aq})$	$\text{H}_2\text{O}(\text{l})$
C.	$\text{H}_2\text{O}(\text{l})$	$\text{HCO}_3^-(\text{aq})$	$\text{H}_2\text{CO}_3(\text{aq})$	$\text{OH}^-(\text{aq})$
D.	$\text{H}_2\text{O}(\text{l})$	$\text{HCO}_3^-(\text{aq})$	$\text{OH}^-(\text{aq})$	$\text{H}_2\text{CO}_3(\text{aq})$

If 20 cm<sup>3</sup> samples of 0.1 mol dm<sup>-3</sup> solutions of the acids below are taken, which acid would require a different volume of 0.1 mol dm<sup>-3</sup> sodium hydroxide for complete neutralization?

- A. Nitric acid
- B. Sulfuric acid
- C. Ethanoic acid
- D. Hydrochloric acid

Which group of three compounds contains only weak acids and bases?

A.	Ba(OH) <sub>2</sub>	CH <sub>3</sub> NH <sub>2</sub>	CH <sub>3</sub> COOH
B.	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> COOH	CH <sub>3</sub> CH <sub>2</sub> NH <sub>2</sub>	HCOOH
C.	NH <sub>3</sub>	HNO <sub>3</sub>	CH <sub>3</sub> CH <sub>2</sub> COOH
D.	NH <sub>3</sub>	NaOH	H <sub>2</sub> CO <sub>3</sub>

Which salts will dissolve in water to give solutions with a pH above 7?

- I. Na<sub>2</sub>CO<sub>3</sub>
  - II. CH<sub>3</sub>COONa
  - III. Na<sub>2</sub>SO<sub>4</sub>
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III

What describes HPO<sub>4</sub><sup>2-</sup>?

- A. Amphiprotic but not amphoteric
- B. Amphoteric but not amphiprotic
- C. Amphiprotic and amphoteric
- D. Neither amphiprotic nor amphoteric