8.2 More About Acids

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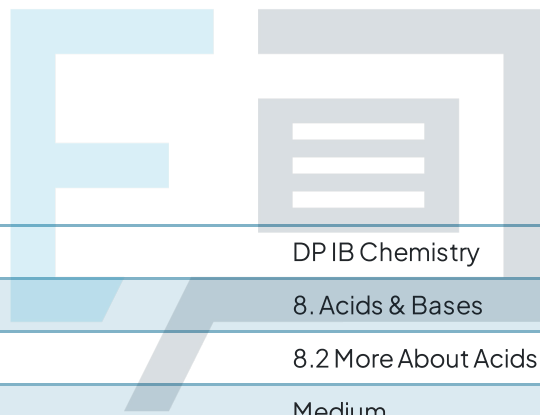
Course	DP IB Chemistry
Section	8. Acids & Bases
Topic	8.2 More About Acids
Difficulty	Medium

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

1

The correct answer is **D** because:

- Basic solutions have a pH greater than 7 and the hydrogen ion concentration lies between 1.0×10^{-7} and 1.0×10^{-14} mol dm^{-3}

A is incorrect as this solution is pH 2, since pH = –log[H$^+$] and –log[1.0×10^{-2}] = 2

B is incorrect as this solution is also pH 2. This is because [H$^+$] × [OH$^-$] = Kw = 1×10^{-14}, so [H$^+$] = $\dfrac{Kw}{[OH^-]}$ = 1×10^{-2} or pH 2

C is incorrect as the pH is below 7.00 so is acidic

2

The correct answer is **C** because:

- The concentration of hydroxide ions in NaOH would be 1×10^{-3} mol dm^{-3}
- This means the concentration of hydrogen ions would be 1×10^{-11} mol dm^{-3} since

$$Kw = [H^+] \times [OH^-] = 1 \times 10^{-14}$$

$$[H^+] = \frac{Kw}{[OH^-]}$$

$$= \frac{1 \times 10^{-14}}{1 \times 10^{-3}} = 1 \times 10^{-11} \text{ mol dm}^{-3}$$

$$\text{pH} = -\log[H^+] = -\log(1 \times 10^{-11}) = 11$$

Extra info:

It's handy to remember that [H$^+$] = $1 \times 10^{-\text{pH}}$

Exam Papers Practice

3

The correct answer is **B** because:

- According to **Le Chatelier's Principle** raising the pressure will cause an equilibrium to shift to the side with the fewer gas molecules
- In this case, the shift would be to the right since the only gas molecule is on the left
- The concentration of hydrogen ions would increase, so the pH would decrease

Exam tip:
You are not required to quote **Le Chatelier's Principle** in an exam, but you are required to apply it to solve problems

4

The correct answer is **C** because:

- The amount of hydrogen produced is determined by the number of moles of the acid
- Since the volume and concentration of the acids are the same, the number of moles of acid are equal, and so will be the moles and volume of gas produced

A is incorrect as although the hydrochloric acid will react faster, its pH will be lower than ethanoic acid

B is incorrect as the total volume of gas produced is determined by the moles of acid, not by whether the acid is strong or weak

D is incorrect as ethanoic acid will react more slowly but its pH will be higher than an equal volume and concentration of hydrochloric acid

5

The correct answer is **C** because:

- When the solution is diluted, the concentration of hydrogen ions decreases by a factor of 10 since the volume has changed from 50 cm^3 to 500 cm^3
- The pH scale is log_{10} scale so a tenfold change in the hydrogen ion concentration corresponds to a change in one pH number
- The pH must change from 11 to 10

6

The correct answer is **B** because:

- Carboxylic acids, RCOOH, and amines, RNH_2, are weak acids and bases

A is incorrect as $Ba(OH)_2$ is classified as a strong base. It is the only hydroxide in Group 2 that is a strong base – this is because $Ba(OH)_2$ is very soluble in water, so fully ionises and produces many OH– ions

C is incorrect as HNO_3 is a strong acid

D is incorrect as KOH is a strong base

7

The correct answer is **B** because:

- Converting the concentrations into pH

X. $0.100 \text{ mol dm}^{-3} = 1.00 \times 10^{-1} \text{ mol dm}^{-3} = \text{pH } 1$

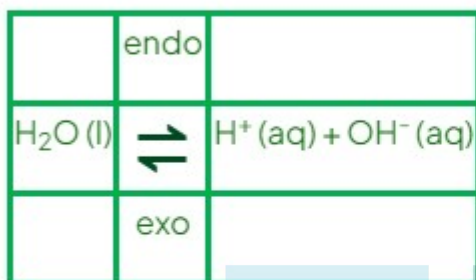Y. $0.001 \text{ mol dm}^{-3} = 1.00 \times 10^{-3} \text{ mol dm}^{-3} = \text{pH } 3$

Z. $0.010 \text{ mol dm}^{-3} = 1.00 \times 10^{-2} \text{ mol dm}^{-3} = \text{pH } 2$

- This gives the correct order as X< Z < Y

8

The correct answer is **A** because:

- The ionisation of water is a reversible process and therefore **Le Chatelier's** principle applies

	endo	
H_2O (l)	$\rightleftharpoons$	H^+ (aq) + OH^- (aq)
	exo	

- If the temperature of the water increases, then the equilibrium will move to oppose the change in temperature
  - Therefore, the forward reaction will be favoured
  - This produces more hydrogen ions and hydroxide ions
  - The higher the value for $[H^+]$, the lower the pH value

B is incorrect as a decrease in temperature will increase the pH of water

C is incorrect as pH of water is affected by temperature. An increase in temperature will decrease pH (becomes more acidic) and a decrease in temperature will increase pH (becomes more alkaline)

D is incorrect as despite the fact that pH will change with temperature, the concentration of H^+ ions and OH^- ion is always equal

9

The correct answer is **B** because:

- The pH can be found without a calculator using simple maths:

$Kw = [H^+] \times [OH^-] = 1 \times 10^{-14}$

$$[H^+] = \frac{Kw}{[OH^-]}$$

$$[H^+] = \frac{1 \times 10^{-14}}{1 \times 10^{-1}} = 1 \times 10^{-13} \, mol \, dm^{-3}$$

$[H^+] = 10^{-pH}, \therefore pH = 13$

- LiOH is a strong base so will contain lots of ions and be a good conductor
- A strong base of pH 13 will turn universal indicator purple

A is incorrect as the pH, conductivity and indicator colour are incorrect

C is incorrect as the pH, conductivity and indicator colour are incorrect

D is incorrect as the conductivity and indicator colour are incorrect

10

The correct answer is **A** because:

- The same volume and concentration of sodium hydroxide would neutralise the same number of moles of hydrochloric acid
- The most concentrated acid would be the beaker that has the lowest pH after addition of the sodium hydroxide
- This beaker has the most moles of acid left after neutralisation

B, C & D are incorrect as they are not the beaker with the lowest pH