



irritant !



corrosive !

What precautions should you take when working with acids?

Acid names	Formulae	Concentration mol/dm <sup>3</sup>	Colour of universal indicator	pH	Strong or Weak acid?
Hydrochloric acid	HCl	1.0			
Sulfuric acid	H <sub>2</sub> SO <sub>4</sub>	1.0			
Nitric acid	HNO <sub>3</sub>	1.0			
Ethanoic acid	CH <sub>3</sub> COOH	1.0			

### Conclusions

- ethanoic acid is a \_\_\_\_\_ acid
- hydrochloric, nitric and sulfuric acids are \_\_\_\_\_ acids
- strong acids have a \_\_\_\_\_ pH than weak acids of the same concentration

Why are some acids stronger than others?

- Acids are chemicals that \_\_\_\_\_ (dissociate) in water to produce \_\_\_\_\_ ions
- An acid is strong if it \_\_\_\_\_ ionises in water (100% of molecules ionise):

Higher  
LEARN

e.g.

100% →

- Weak acids only \_\_\_\_\_ ionise in water **note that there is an** \_\_\_\_\_

Higher  
LEARN

e.g.

less than

1% ⇌

you can see from the previous equation that the ionisation of a weak acid is an example of a \_\_\_\_\_ reaction and produces an equilibrium mixture

- \_\_\_\_\_ is a measurement of the number of moles of hydrogen ions, H<sup>+</sup> in solution  
the \_\_\_\_\_ the hydrogen ion concentration, the \_\_\_\_\_ the pH number

- So, the pH of a weak acid is much \_\_\_\_\_ than the pH of a strong acid of the \_\_\_\_\_ concentration.

### Higher Only

You must be able to explain the difference between acid strength and acid concentration:

**CONCENTRATION:** the concentration of an acid is a measure of

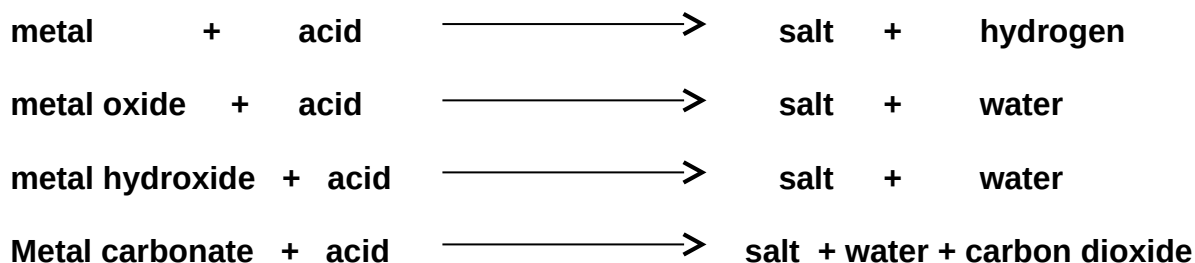
**STRENGTH:** How strong or weak an acid is i.e. its strength, is a measure of

strong =

weak =

## Comparing the Reactions of Strong and Weak Acids

Both Strong and weak acids will perform these reactions:



Experiment 1 – Compare the reaction of *magnesium* with  $\text{HCl}$  and  $\text{CH}_3\text{COOH}$  (ethanoic acid)

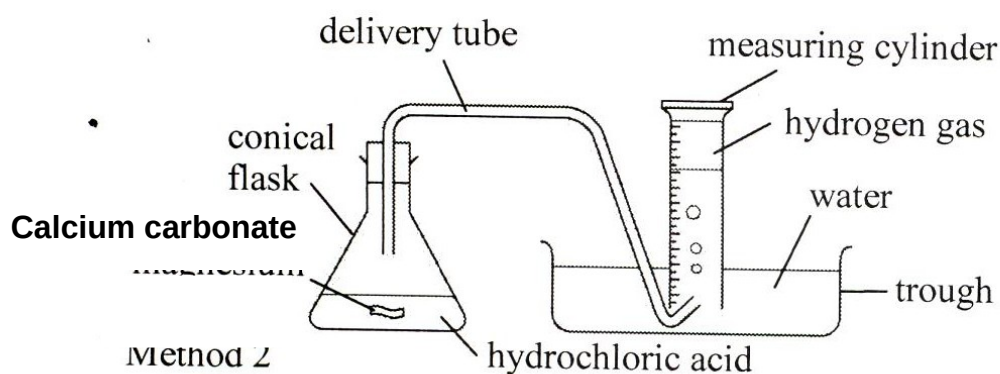
### Observations

1. The magnesium fizzes \_\_\_\_\_ with  $\text{HCl}$
2. The magnesium disappears \_\_\_\_\_ with  $\text{HCl}$
3. The test tube with  $\text{HCl}$  gets \_\_\_\_\_ (more exothermic)
4. Gas makes a \_\_\_\_\_ with a lighted splint

### Conclusion

- Both ethanoic acid and hydrochloric acid react with magnesium to give \_\_\_\_\_
- Ethanoic acid reacts \_\_\_\_\_ than hydrochloric acid because there are fewer \_\_\_\_\_ ( $\text{H}^+$ ). Fewer  $\text{H}^+$  means fewer \_\_\_\_\_ with  $\text{Mg}$  so the rate of reaction will be \_\_\_\_\_.

Experiment 2 – Compare the reaction of calcium carbonate,  $\text{CaCO}_3$  with  $\text{HCl}$  and  $\text{CH}_3\text{COOH}$  (ethanoic acid)



$$\text{Rate} = \frac{1}{\text{time}}$$

Results

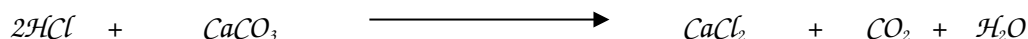
<i>Acid</i>	<i>1.0 mol/dm<sup>3</sup></i>	<i>Time to collect 10cm<sup>3</sup> of gas (s)</i>	<i>Rate (s<sup>-1</sup>)</i>
<i>Hydrochloric Acid</i>	<i>HCl</i>		
<i>Ethanoic acid</i>	<i>CH<sub>3</sub>COOH</i>		

*TOTAL volume produced by both gases = 24cm<sup>3</sup>*

### Conclusions

- Both ethanoic acid and hydrochloric acid react with calcium carbonate to give

\_\_\_\_\_.



- Magnesium and calcium carbonate react slower with ethanoic acid than with hydrochloric acid of the same

\_\_\_\_\_.

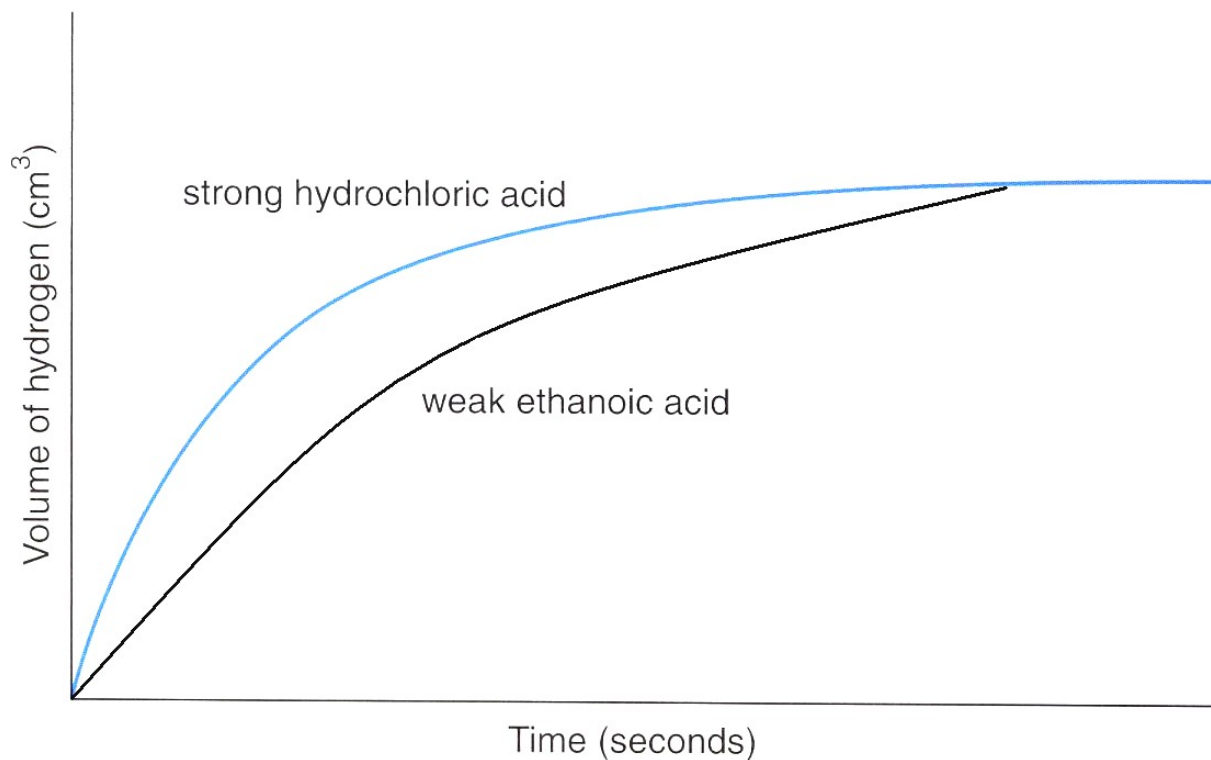
**Explanation:** the weak acid,  $\text{CH}_3\text{COOH}$  ionises less so fewer  $\text{H}^+$  means that there are fewer collisions with  $\text{CaCO}_3$  which results in a slower rate of reaction

### Summary (HIGH LEVEL)

Strong acid means almost \_\_\_\_\_ % ionisation therefore there is a greater \_\_\_\_\_ of hydrogen ions,  $\text{H}^+$ . This leads to a greater \_\_\_\_\_ frequency between reactant molecules and  $\text{H}^+$  so the rate of reaction is faster.

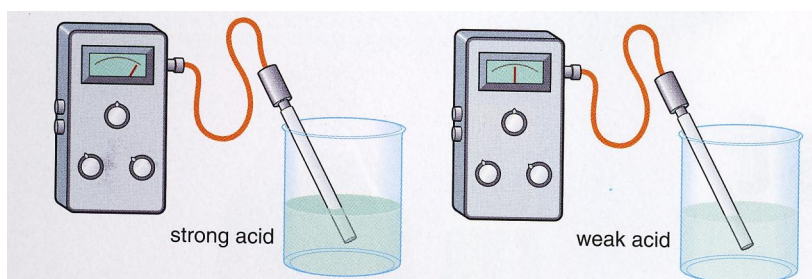
### IMPORTANT

If the \_\_\_\_\_ **mass** of solid is used and the \_\_\_\_\_ **volume** and **concentration** of acid, then the \_\_\_\_\_ **total volume of gas** is produced in experiment 1 and 2 but the weak acid produces it more \_\_\_\_\_ than the strong acid.



▲ Same amount of acid – different rate  
So, the volume of gas produced depends on the \_\_\_\_\_ of acid and NOT on the strength.

### Comparing the electrical conductivity of strong and weak acids



### Results

Acid	1.0 mol/dm <sup>3</sup>	Electrical conductivity
Hydrochloric Acid	HCl	
Ethanoic acid	CH <sub>3</sub> COOH	

### Conclusion

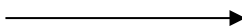
- ethanoic acid has a \_\_\_\_\_ electrical conductivity than hydrochloric acid of the same concentration

Why?

- electrolysis of both ethanoic acid and hydrochloric acid makes hydrogen at the negative electrode

Why?

+



reduction
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### ***Higher Only***

Ethanoic acid is \_\_\_\_\_ conductive than hydrochloric acid of the same concentration

because:

- ethanoic acid is \_\_\_\_\_ and hydrochloric acid is \_\_\_\_\_
- HCl has a \_\_\_\_\_ concentration of hydrogen ions to carry the charge

## Weak acids can be really useful



One use for weak acids is as **descalers** – removing limestone from metal surfaces e.g.  
sinks and washing machines

Weak acids can be more useful than dilute strong acids

1.

2.



### Higher Only

You must also be able to explain why a weak acid may be more useful  
than the more dilute strong acid but you must refer to the “hydrogen ion  
your answer.

concentration” in