

SNC2D CHEMISTRY

CHEMICAL REACTIONS

Acids & Bases (P.198-201)

Activity: Introduction to ... (2DCHEM-ASG3)

INSTRUCTIONS

- Read the activity "2DCHEM - ASG3 (Introduction to Acids & Bases)".
- Follow the instructions given (i.e. method 1 to 10).
- Answer the questions given (i.e. conclusion and analysis 1 to 6).

NOTE!

- This is a formal lab report. Be sure to use complete sentences, particularly when it asks you to explain, discuss, describe, ...

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2DCHEM - Acids & Bases

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Introduction to Acids & Bases

Acids and bases are two classes of chemicals that are important in many consumer products and environmental problems. There are a variety of methods that can be used to distinguish between them. For example:

- when blue litmus paper is dipped in an acid it will turn red.



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Introduction to Acids & Bases

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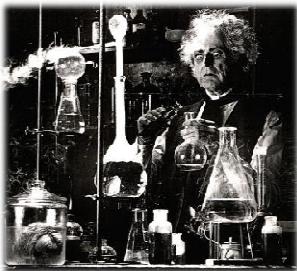
- *when red litmus paper is dipped in a base it will turn blue.*



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Introduction to Acids & Bases

As you can see, acids and bases have characteristic reactions with indicators. What are some other properties of these substances? Can we look at the name or formula of a substance and decide whether it will behave as an acid or base?



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Properties of Acids


Acids are sour-tasting, water-soluble **molecular** substances that turn blue litmus paper red. Acids are found in many common products (see below).

Common Acid	Formula	Source/Use
hydrochloric acid	HCl _(aq)	stomach acid
acetic acid (vinegar)	HC ₂ H ₃ O ₂ _(aq)	salad dressing
citric acid	HC ₆ H ₇ O ₇ _(aq)	oranges, lemons
lactic acid	HC ₃ H ₅ O ₃ _(aq)	sour milk
carbonic acid	H ₂ CO ₃ _(aq)	carbonated drinks
sulphuric acid	H ₂ SO ₄ _(aq)	car batteries

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Properties of Acids


In addition, acids are so reactive that they can combine with many other substances. For example, acids react with some metals such as zinc to produce hydrogen gas.

$$\text{Zn}_{(s)} + \text{HCl}_{(aq)} \rightarrow \text{H}_{2(g)} + \text{ZnCl}_{2(aq)}$$


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Properties of Acids


Acids also react with compounds that contain carbonate and hydrogen carbonate groups such as marble to produce carbon dioxide gas. For example,

$$\text{HCl}_{(aq)} + \text{CaCO}_{3(s)} \rightarrow \text{CO}_{2(g)} + \text{H}_2\text{O}_{(l)} + \text{CaCl}_{2(aq)}$$


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Properties of Acids

Another characteristic property of acid solutions is that they are good conductors of electricity. This is because all acids release hydrogen ions (H^+) when they dissolve in water. For example,


$$HCl_{(aq)} \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$$


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Uses of Acids

Strong acids release many more hydrogen ions than weak acids. Because of this difference, strong and weak acids have different uses.

- Some weak acids are safe enough to eat. Phosphoric acid, for example, gives carbonated soft drinks their taste. Without sweeteners, soft drinks would be almost as sour as vinegar! Citric acid is found in citrus fruits such as oranges and in sour candies.




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Uses of Acids

Strong acids release many more hydrogen ions than weak acids. Because of this difference, strong and weak acids have different uses.

- Stronger acids, such as sulphuric acid, are used to make steel, plastics, and detergents. These acids are so important that their production has become a multi-billion-dollar industry.



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Uses of Acids

NOTE!

Acids are very useful in the food industry: they act as a preservative. Harmful microorganisms cannot survive in acid. Acids such as vinegar and lemon juice act as preservatives. Pickles, barbecue sauce, and ketchup all have long shelf-lives because they contain a lot of vinegar.



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Properties of Bases

On the other hand, **bases** are bitter-tasting, water-soluble **ionic** substances that turn red litmus paper blue. They feel slippery when in aqueous solution and are found in many common products (see below).

Common Base	Formula	Source/Use
sodium hydroxide	NaOH _(aq)	drain cleaner
potassium hydroxide	KOH _(aq)	soap, cosmetics
aluminum hydroxide	Al(OH) _{3(aq)}	antacids
ammonium hydroxide	NH ₄ OH _(aq)	window cleaner
sodium bicarbonate	NaHCO _{3(aq)}	baking soda
potassium sulphite	K ₂ SO _{3(aq)}	food preservatives

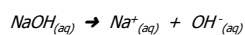
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Properties of Bases

Bases, like acids, are also good conductors of electricity. However, they release hydroxide ions (OH⁻) when they dissolve in water. For example,



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Uses of Bases

Bases also vary in their strength depending on how many hydroxide ions they release.

- Weak bases are safe enough to be consumed. For example, medicines used to treat heartburn and indigestion contain weak bases such as magnesium hydroxide, $Mg(OH)_2$.




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Uses of Bases

Bases also vary in their strength depending on how many hydroxide ions they release.


- Stronger bases are used to make cleaning products. Soap, for example, is made by cooking animal fat or vegetable oil with potassium hydroxide, KOH . Many household cleaning products contain strong bases.



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Uses of Bases


NOTE! Substances that are described as bases may also be described as **alkaline**. Bases react with proteins to break them down into smaller molecules. A hair-clogged drain may be cleared by treating it with a drain cleaner that contains sodium hydroxide because the sodium hydroxide breaks down the protein in the hair.



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Dangers of Acids & Bases


Acids and bases can sometimes be harmful. For instance, if water in the environment becomes too acidic or too basic, it can harm the living organisms in it.



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Dangers of Acids & Bases

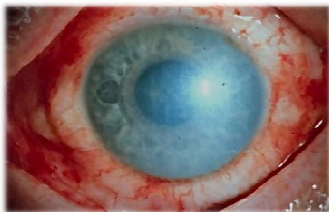
Solutions that are very acidic can be extremely dangerous. For example, the sulphuric acid in an automobile battery is very acidic ($pH = 0.5$) – if this were to touch your skin it would quickly cause severe burns.




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Dangers of Acids & Bases

Solutions that are very basic can be equally dangerous. For example, sodium hydroxide, or drain cleaner, is very basic ($pH = 13.5$). If this were to get it in your eye it would react with protein molecules in the eye and cause blindness if untreated.




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 **Formulas for Acids & Bases**

Common acids are easily recognized because their formulas either (i) begin with H or (ii) end with COOH. For example,

- hydrochloric acid **HCl**
- carbonic acid **H₂CO₃**
- acetic acid **CH₃COOH**

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 **Formulas for Acids & Bases**

Deciding whether a substance is a base from its formula is more complicated. Most bases are compounds that contain the hydroxide ion (OH⁻). But some bases are more difficult to recognize. Substances that contain the bicarbonate ion (HCO₃⁻) are bases because they react with water to form hydroxide ions. For example,

- sodium hydroxide **NaOH**
- sodium bicarbonate **NaHCO₃**

RECALL!
Bicarbonate ions are also known as hydrogen carbonate ions.


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 **Activity: Comparing Acids & Bases**

INSTRUCTIONS

A. Complete the following charts comparing (i) the similarities and (ii) the differences between acids and bases.


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 Activity: Comparing Acids & Bases

SIMILARITIES

Statement	Acid	Base
dissolve in water?		✓
conduct electricity in solution?		✓
irritate/burn skin?		✓


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 Activity: Comparing Acids & Bases

DIFFERENCES

Statement	Acid	Base
type of compound?	molecular	ionic
taste?	sour	bitter
feel slippery?	x	✓
pH?	< 7	> 7
litmus paper?	blue to red	red to blue
in solution they release?	H ⁺	OH ⁻
corrode metals?	✓	x
react with metals to produce?	H _{2(g)}	CO _{2(g)}
formulas?	begins with H or ends with COOH	contains the ion OH ⁻ or HCO ₃ ⁻


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 Check Your Learning

1. Identify each of the following substances as an acid, a base, or neither:

(a) potassium hydroxide **base** ⇨ hydroxide in name
 (b) HClO₃ **acid** ⇨ H at start
 (c) Mg(OH)₂ **base** ⇨ OH in formula
 (d) HNO₃ **acid** ⇨ H at start
 (e) MgO **neither**
 (f) potassium bicarbonate **base** ⇨ bicarbonate in name
 (g) CH₃COOH **acid** ⇨ COOH in formula
 (h) NaHCO₃ **base** ⇨ HCO₃ in formula


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 **Check Your Learning**

2. What is meant by the term "acid indigestion"?

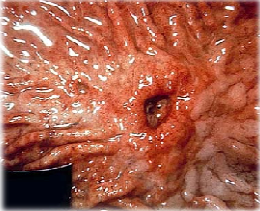
Acid indigestion or heartburn is the burning sensation in the chest caused by the regurgitation of stomach acid.

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 **Check Your Learning**

3. What is an "ulcer" and how do people get them?

Stomach acid is a solution of hydrochloric acid. The inside lining of the stomach is acid-resistant. However, if this lining is damaged, the acid can attack the stomach wall and cause ulcers to form.

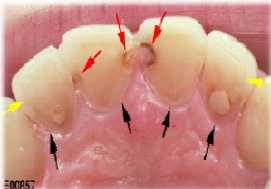


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 **Check Your Learning**

4. People who suffer from bulimia sometimes self-induce vomiting to prevent weight gain. Why do the teeth of people with bulimia often appear worn or eroded?

stomach acid erodes the teeth (which are made of calcium)



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 ✓ Check Your Learning

5. The fluid inside an alkaline battery can be corrosive.

- From the description, do you think the fluid is acidic or basic?
- Describe a chemical test that you could perform to determine if the substance is an acid or a base.
- What safety precautions must you take when conducting this test?

(a) basic since "alkaline" is another name for basic
 (b) litmus paper, natural indicators, ... (recall the properties of acids and bases)
 (c) goggles, apron, small samples, ...


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 ✓ Check Your Learning

6. A property of acids is that they taste sour. A property of bases is that they feel slippery. Would you use either of these properties to identify an unknown substance? Why or why not?

no – it could be a strong acid or base which could hurt you

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 ✓ Check Your Learning

TEXTBOOK
 P.203 Q.4,7-10

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