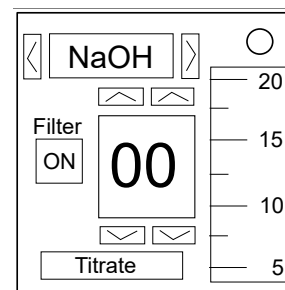


## On the Subject of Neutralization

*The rules are simple: neutralize or be neutralized.*

- The module is disarmed by successfully neutralizing an acid contained in a tube by titrating it with a chemical base.
- In order to solve the module, the type of base, amount of base, and filter state must all be correct.
- Once the appropriate conditions are set, press “Titrate” to confirm the solution.
- An incorrect input yields a strike. The correct answer remains unchanged.
- Useful info may be found in **Appendix NT27: Chemical Information**.



## Determining Titrants

The acid type can be determined using the following chart:

<u>Solution Color</u>	<u>Acid Type</u>
Red	Hydrogen bromide
Yellow	Hydrogen fluoride
Green	Hydrogen chloride
Blue	Hydrogen iodide

The base that must be used to titrate can be determined via the following ruleset:

- If the bomb has an NSA indicator and exactly 3 batteries, add ammonia.
- Otherwise, if the bomb has a lit CAR, FRQ, or IND indicator, add potassium hydroxide.
- Otherwise, if the bomb has no ports and the serial number has a vowel, add lithium hydroxide.
- Otherwise, if the acid's chemical formula has a letter in common with an indicator present on the bomb, add potassium hydroxide.
- Otherwise, if the number of D batteries is greater than the number of AA batteries, add ammonia.
- Otherwise, if the anion's atomic number is less than 20, add sodium hydroxide.
- Otherwise, add lithium hydroxide.

## Determining Concentrations

The concentration of the acid can be determined via the following process:

- Start with the atomic number of the anion of the acid.
- Subtract the atomic number of the cation of the base.
- If the anion or cation has a vowel in the chemical symbol, subtract 4.
- If the anion and cation's chemical symbols have the same number of characters, multiply by 3.
- Take the least significant digit of the result (removing negative signs).
- If the number is 0, the number becomes the volume of acid doubled then divided by 5.
- Divide by 10. This is the concentration of the acid.

The concentration of the base can be determined via the following ruleset:

- If there are more battery holders than port types and more battery holders than indicators, the concentration is 5.
- If there are more port types than battery holders and more port types than indicators, the concentration is 10.
- If there are more indicators than battery holders and more indicators than port types, the concentration is 20.
- If there are any ties for the most, the concentration is either 5, 10, and 20, whichever is closest to the cation's atomic number.
- However, if the titration combination is HI and KOH or HCl and NH<sub>3</sub>, the concentration is always 20.

## Determining Drop Count

- Start with 20 and divide by the concentration of the base.
- Multiply by the volume of acid and concentration of the acid.
- The result is the number of drops required to successfully titrate.

## Determining Solubility

- If the module's acid/base combination on the following chart has "NS" for "Not Soluble", the filter must be turned ON before the base is added.
- Otherwise, the filter must be turned OFF.

	<u>NH<sub>3</sub></u>	<u>KOH</u>	<u>LiOH</u>	<u>NaOH</u>
<u>HBr</u>	S	NS	NS	S
<u>HF</u>	NS	S	NS	S
<u>HCl</u>	NS	NS	S	NS
<u>HI</u>	S	S	S	NS

## **APPENDIX NT27: Chemical Information**

### **NT27.1: Bases**

<b><u>Name</u></b>	<b><u>Chemical Formula</u></b>	<b><u>Cation</u></b>	<b><u>Chemical Symbol</u></b>	<b><u>Atomic Number</u></b>
Ammonia	NH <sub>3</sub>	Hydrogen	H	1
Lithium hydroxide	LiOH	Lithium	Li	3
Sodium hydroxide	NaOH	Sodium	Na	11
Potassium hydroxide	KOH	Potassium	K	19

### **NT27.2: Acids**

<b><u>Name</u></b>	<b><u>Chemical Formula</u></b>	<b><u>Anion</u></b>	<b><u>Chemical Symbol</u></b>	<b><u>Atomic Number</u></b>
Hydrofluoric acid	HF	Fluorine	F	9
Hydrochloric acid	HCl	Chlorine	Cl	17
Hydrobromic acid	HBr	Bromine	Br	35
Hydroiodic acid	HI	Iodine	I	53