

# Penny vs. Nitric Acid

In this classic demonstration, the experience Ira Remsen had with nitric acid can be reenacted.

Ira Remsen (1846-1927) was an influential chemist in America. He founded the chemistry department at Johns Hopkins and initiated the first center for chemical research in this country.

In this demonstration, he describes his experience with nitric acid.

## Chemicals and Equipment Needed

- d-H<sub>2</sub>O
  - squeeze bottle and 1 L bottle
- Concentrated HNO<sub>3</sub> – **K3**
- Penny – **M4**
  - **Must be pre-1983 - these are solid copper**
- 500 mL Erlenmeyer flask – **P1**
- 100 mL beaker – **Q3**
- 10 mL graduated cylinder – **Q3**
- Large Kimwipes – **A2**
- Foreceps – **U2**
- Cloth already treated with nitric acid – **U4**
  - We found that its best to singe the cloth with a lighter instead

## Hazards

- **This demo is subject to availability of a hood**
- Concentrated HNO<sub>3</sub> can cause serious chemical burns. The fumes from concentrated HNO<sub>3</sub> are very unpleasant. **Wear gloves**, goggles, and perform this demo near an in-bench fume hood. A lab coat is recommended.
- If skin exposure occurs, flush affected area with water and seek medical attention, if needed.

## Preparation

- Measure out 5 mL HNO<sub>3</sub> into a 10 mL graduated cylinder and stopper.
- On delivery, layer 2 large Kimwipes together and squirt water on them until quite damp. Fold into quarters.

## Presentation

- We suggest you read the script on the next page while doing the demonstration

## Discussion

- Nitric acid reacts with copper to produce the brown (and toxic) gas nitrogen dioxide:  
$$\text{Cu (s)} + 4 \text{HNO}_3 \text{ (aq)} \rightarrow \text{Cu(NO}_3)_2 \text{ (aq)} + 2 \text{NO}_2 \text{ (g)} + 2 \text{H}_2\text{O (l)}$$

## Clean-Up

- Dilute the contents of the flask with water, neutralize if needed, and flush down the sink.

**NOTES:** this was rewritten wholesale from Shkhashiri's *Chemical Demonstrations, Vol 2*. We should probably try to make it less plagiarizey. [Still pretty plagiarizey – AMM AU19]

## Presentation

- We suggest that you read his account as you perform this demonstration:

*While reading a textbook on chemistry, I came upon the statement “nitric acid acts upon copper.” I was getting tired of reading such absurd stuff and I determined to see what this meant. Copper was more or less familiar to me, for copper cents were then in use. I had seen a bottle marked “nitric acid” on a table in the doctor’s office where I was then “doing time!” I did not know its peculiarities but I was getting on and likely to learn. The spirit of adventure was upon me. Having nitric acid and copper, I had only to learn what the words “act upon” meant. Then, the statement, “nitric acid acts upon copper” would be something more than mere words.*

*All was still. In the interest of knowledge I was even willing to sacrifice one of the few copper cents then in my possession. I put one of them on the table; opened the bottle marked “nitric acid;” poured some of the liquid on the copper; and prepared to make an observation.*

- Place the penny in the flask, and carefully add the nitric acid.
- Place the damp Kaydry towels over the neck of the flask and invert the 100 mL beaker over the neck to secure the towels. Ira Remsen again:

*But what was this wonderful thing which I beheld? The cent was already changed, and it was no small change either. A greenish blue liquid foamed and fumed over the cent and over the table. The air in the neighborhood of the performance became dark red. A great colored cloud arose. This was disagreeable and suffocating – how should I stop this? I tried to get rid of the objectionable mess by picking it up and throwing it out of the window, which I had meanwhile opened. I learned another fact – nitric acid not only acts upon copper but it acts upon fingers. The pain led to another unpremeditated experiment. I drew my fingers across my trousers and another fact was discovered. Nitric acid also acts upon trousers.*

- Display to the class a large piece of cloth which has already been “treated” with nitric acid.
- Add water to the flask to stop the reaction.
- Use the forceps to remove the penny and show it (now much smaller) to the class.

*Taking everything into consideration, that was the most impressive experiment, and, relatively, probably the most costly experiment I have ever performed. I tell of it even now with interest. It was a revelation to me. It resulted in a desire on my part to learn more about that remarkable kind of action. Plainly the only way to learn about it was to see its results, to experiment, to work in the laboratory.*