



## Chemistry Comes Alive!

### Aqua Regia

Aqua Regia is a mixture of hydrochloric acid and nitric acid. It can dissolve gold, which single acids alone cannot do. Here we see that each of the acids separately has no effect on the gold but a mixture of the two dramatically reacts with the gold. To three samples of gold are added (1) concentrated hydrochloric acid (2) concentrated hydrochloric and concentrated nitric acids and (3) concentrated nitric acid. The gold reacts only with the concentrated acid mixture which is referred to as aqua regia (royal water).

(153)

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### Keywords

descriptive chemistry, halogens/halides/hydrohalic acids, nitrogen/nitrogen oxides/nitric acid, oxidizing acid, redox reaction, strong acid, strong oxidizing agent

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### Multimedia



[Play movie](#) (QuickTime 3.0 Sorenson, duration 78 seconds, size 5.1 MB)

Here are three samples of gold. We add concentrated hydrochloric acid on the left, concentrated nitric acid on the right, and a mixture of the two in the middle. The gold reacts with the concentrated acid mixture which is referred to as aqua regia, meaning "royal water".



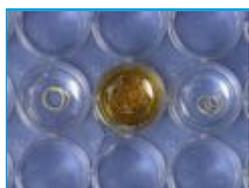
Concentrated hydrochloric acid.



Mixture of concentrated hydrochloric acid and concentrated nitric acid.



Concentrated nitric acid.



The gold reacts ... but not with the  
with the acids separately.  
concentrated acid  
mixture...

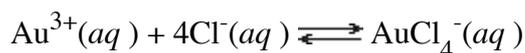
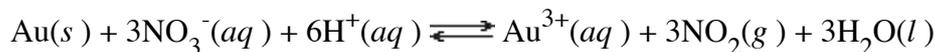
[Additional still images for this movie](#)

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## Discussion

Aqua regia can dissolve gold because each of its two component acids carries out a different function. The nitric acid is a good oxidizing agent. Chloride ions from the hydrochloric acid form coordination complexes with the gold ions, removing them from solution. Reducing the concentration of the  $\text{Au}^{3+}$  ions shifts the equilibrium towards the oxidized form.

Reaction equation:



[Demonstration Notes, Warnings, Safety Information, etc.](#)

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## Exam and Quiz Questions

1. What evidence indicates that there is a reaction between gold and aqua regia? What evidence indicates that neither concentrated nitric nor concentrated hydrochloric acid reacts with gold?
  2. In approximately what ratio were the two concentrated acids mixed to form aqua regia? Was there more of one acid than the other? If so, which?
  3. Use LeChatelier's principle to explain why gold can dissolve in a mixture of concentrated nitric acid and concentrated hydrochloric acid, even though it does not dissolve in either of the acids alone. Write balanced equations for the equilibria involved.
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