

Worksheet 6.4

The Ostwald process

NAME:

CLASS:

INTRODUCTION

One of the limiting factors for chemists of old was the lack of any strong acids. The synthesis of sulfuric acid in the 14th century changed all that. Nitric acid, or *aqua fortis* as it was called, was soon produced from sulfuric acid. Nitric acid is a strong acid and an oxidant, and is a key component in the production of explosives ranging from TNT to nitroglycerine. It is also used in the production of many fertilisers. For these reasons, demand for it has always been high.

No.	Question	Answer
1	Nitric acid can be produced by the reaction of potassium nitrate and sulfuric acid. a Write an equation for this reaction. b What property of nitric acid allows the nitric and sulfuric acids to be separated relatively easily? c The production of nitric acid this way is relatively simple. Why is this method not used on a large scale?	
2	The first step in the Ostwald process is the burning of ammonia in air. Write the thermochemical equation for this reaction.	
3	Theoretically, what conditions would increase the <i>rate</i> of this process?	
4	Theoretically, what conditions would increase the <i>yield</i> of this process?	
5	This reaction is conducted at particular conditions of temperature, pressure and catalyst use. What are these conditions and why are they used?	

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6	<p>An undesirable side reaction is the decomposition of nitrogen monoxide to nitrogen and oxygen.</p> <p>a Write an equation for this reaction.</p> <p>b This reaction is reversible and endothermic. Is a low or high temperature better for limiting this reaction?</p>	
7	<p>The decomposition of ammonia to nitrogen and hydrogen is another problem reaction.</p> <p>a Write an equation for this reaction.</p> <p>b This reversible reaction is also endothermic. Is a low or high temperature better for limiting this reaction?</p>	
8	<p>The second step in the Ostwald process is the reaction of nitrogen monoxide and air.</p> <p>a Write a thermochemical equation for this reaction.</p> <p>b Explain why this reaction is conducted at a much lower temperature than the first reaction.</p>	
9	<p>a Write a balanced equation for the final step in which nitrogen dioxide absorbs water.</p> <p>b What happens to the nitrogen monoxide formed in this final step?</p>	
10	<p>The Ostwald process involves a number of oxidation reactions. State the oxidation number of nitrogen in each of the following compounds: NH_3, NO, NO_2, NO_3^-</p>	
11	On a separate page, draw a flowchart to summarise the Ostwald process for nitric acid production.	