**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Period\_\_\_\_\_\_\_**

**Logan’s Dilemma**

The City of Logan has a decision to make. Logan has watched many factories close down over the years, due to changing market interests and other economic factors. Now, because of improvements in the transportation infrastructure of the area, the city has caught the attention of Chemex, a multinational corporation; the company has offered to buy several of these factories, with the intention of starting up three new operations: a metal-refining center, a paper mill, and a fine chemicals synthesis unit.

The problem is that the original design of the factories calls for the emission of waste streams directly into the Logan and Bear Rivers; any major retrofitting of the factories looks, at first glance, to be prohibitively expensive. Chemex has offered the following projection for expected emissions from each plant:

|  |  |
| --- | --- |
| paper mill: | 2.5 g of NaOH produced per L of waste |
| synthesis unit: | 1.1 g of nitric acid or 1.5 g of phosphoric acid per L of waste (product depends on process being run) |
| metal refinery: | 2.0 g of H2SO4 produced per L of waste  The Metal refinery also burns coal and puts out high amounts  of Sulfur Dioxide. |

The city council has to decide whether to approve the sale of these factories for this intended use; while eager for the chance to revitalize Logan, they are also very concerned about the potential environmental impact of these industries.

You have been hired to help prepare a one page report on the latter. Your first concern is with the effect of these waste streams on the health of the rivers. The city has mandated that each plant effluent have a pH within the range of 6.5 - 7.2 before the stream is allowed to be discharged into the river.

You need to look into the feasibility of diluting and/or neutralizing and/or combining the waste streams, in order to meet the target pH range of 6.5 - 7.2. Your task is to decide how much of the appropriate agent it would require to neutralize/dilute each of the waste streams in question, and whether this pretreatment will, in fact, bring the pH of each waste stream into the range needed for compliance with the town council's mandate.



In your report, you should address several issues for the City Council:

1. What will the pH of each waste stream be, based on the company's projected emission data?
2. One way to reach the target pH is through dilution of the waste stream. What level of dilution will be required for each, in order to reach an acceptable pH value? Will dilution be able to deal with the problem at hand?
3. What is meant by the term "neutralization"?
4. What equation describes this process for each case?
5. What type and quantity of acids or bases are needed to carry out each reaction?
6. What will the pH of the solution be after the reaction has been carried out?
7. Which of the wastes could, in principle, be combined to accomplish this goal?
8. If this process is feasible, in what proportions would the waste streams need to be combined, in order to achieve the desired pH?
9. What assumptions have you made in the course of this analysis?
10. Are there any other factors or considerations that you feel should be mentioned?
11. What are your recommendations to Logan City Council?