

## STUDENT VERSION

### Airshed Sulfur

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#### STATEMENT

Temperature inversions and low wind speeds can trap air pollutants in a mountain valley for an extended period of time. Gaseous sulfur compounds are often a significant air pollution problem, but their study is complicated by their rapid oxidation. Hydrogen sulfide,  $H_2S$ , oxidizes into sulfur dioxide,  $SO_2$ , which turns into a sulfate. The following model has been proposed for determining the concentration  $x(t)$  and  $y(t)$  of  $H_2S$  and  $SO_2$ , respectively, in a fixed air shed.

Let

$$\begin{aligned}x'(t) &= -\alpha x + \gamma \\y'(t) &= \alpha x - \beta y + \delta.\end{aligned}$$

where the constants  $\alpha$  and  $\beta$  are the conversion rates of  $H_2S$  into  $SO_2$  and  $SO_2$  into sulfate, respectively, and  $\gamma$  and  $\delta$  are the production rates of  $H_2S$  into  $SO_2$  and  $SO_2$  into sulfate, respectively.

- Solve the equations and estimate the concentration levels that could be reached under prolonged air pollution.
- What effect does this model show if we were to reduce,  $\delta$ , the production rate of  $SO_2$ ?
- Does the original amount of either compound effect the long-term amount of the respective compound?
- Suppose we stopped producing  $SO_2$  altogether. How would the resulting long-term level of  $SO_2$  compare to the original long-term level of  $SO_2$ . say if we assumed  $\gamma = 0.5$  and  $\delta = 0.4$ ?