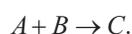


Chapter 8 Conceptual Project: Creating a New Element

Recall from Section 3.7 our discussion of a chemical reaction where reactants A and B produce a new product substance C , a process represented by



In this project, we will derive and use a differential equation that describes such a process.

1. Suppose that in the above reaction for each gram of reactant A , b grams of B are used to form C . If we start with initial amounts A_0 and B_0 , respectively, and $X(t)$ denotes in grams the amount of substance C already formed at time t , find the remaining amounts of reactants A and B at any time during the process.
2. Given that the rate of formation of substance C at any time is proportional to the product of the remaining amounts of reactants A and B , respectively, find a differential equation in terms of $X(t)$ that describes the process.

(As in Question 1, let A_0 and B_0 stand for the initial amounts.)
3. Suppose a product substance C is being formed from reactant substances A and B and that for each gram of substance A , 3 grams of B are used to form C . As in Question 1, let $X(t)$ denote the amount of C formed at time t , and assume that the initial amounts of reactants A and B are $A_0 = 60$ grams and $B_0 = 40$ grams, respectively. Find the initial value problem describing this reaction. (**Hint:** Use your answer to Question 2.)
4. If 20 grams of the product compound form during the first 5 minutes, use the model you obtained in Question 3 to predict how much of the product compound C is present 10 minutes into the process.
5. Use your model from Question 3 to predict what happens as $t \rightarrow \infty$. Interpret your answer.