

## Exercise 40

In an elementary chemical reaction, single molecules of two reactants A and B form a molecule of the product C:  $A + B \longrightarrow C$ . The law of mass action states that the rate of reaction is proportional to the product of the concentrations of A and B:

$$\frac{d[C]}{dt} = k[A][B]$$

(See Example 3.7.4.) Thus, if the initial concentrations are  $[A] = a$  moles/L and we write  $x = [C]$ , then we have

$$\frac{dx}{dt} = k(a - x)(b - x)$$

- (a) Assuming that  $a \neq b$ , find  $x$  as a function of  $t$ . Use the fact that the initial concentration of C is 0.
- (b) Find  $x(t)$  assuming that  $a = b$ . How does this expression for  $x(t)$  simplify if it is known that  $[C] = \frac{1}{2}a$  after 20 seconds?