Exercise 41

In contrast to the situation of Exercise 40, experiments show that the reaction $H_2 + Br_2 \longrightarrow 2\,HBr$ satisfies the rate law

$$\frac{d[\mathrm{HBr}]}{dt} = k[\mathrm{H_2}][\mathrm{Br_2}]^{1/2}$$

and so for this reaction the differential equation becomes

$$\frac{dx}{dt} = k(a-x)(b-x)^{1/2}$$

where $x = [\mathrm{HBr}]$ and a and b are the initial concentrations of hydrogen and bromine.

(a) Find x as a function of t in the case where $a = b$. Use the fact that $x(0) = 0$.

(b) If $a > b$, find t as a function of x. [*Hint:* In performing the integration, make the substitution $u = \sqrt{b-x}$.]