

## Problem 19

Your swimming pool containing 60,000 gal of water has been contaminated by 5 kg of a nontoxic dye that leaves a swimmer's skin an unattractive green. The pool's filtering system can take water from the pool, remove the dye, and return the water to the pool at a flow rate of 200 gal/min.

- (a) Write down the initial value problem for the filtering process; let  $q(t)$  be the amount of dye in the pool at any time  $t$ .
- (b) Solve the problem in part (a).
- (c) You have invited several dozen friends to a pool party that is scheduled to begin in 4 h. You have also determined that the effect of the dye is imperceptible if its concentration is less than 0.02 g/gal. Is your filtering system capable of reducing the dye concentration to this level within 4 h?
- (d) Find the time  $T$  at which the concentration of dye first reaches the value 0.02 g/gal.
- (e) Find the flow rate that is sufficient to achieve the concentration 0.02 g/gal within 4 h.