Part I Problems

For each of the next three problems, solve the given linear DE. Give the general solution, and also the specific solution satisfying the initial condition.

Problem 1:

$$\frac{dy}{dx} + y = 2 \qquad\qquad y(0) = 0$$

Problem 2: $xy' - y = x$ and $x(1) = 7$

Problem 3: $y' = 1 + x + y + xy, \qquad y(0) = 0$

Problem 4: Water flows into and out of a 100,000 liter (ℓ) reservoir at a constant rate of 10 ℓ/min. The reservoir initially contains pure water, but then the water coming in has a concentration of 10 grams/liter of a certain pollutant. The reservoir is well-stirred so that the concentration of pollutant in it is uniform at all times.

a) Set up the DE for the concentration $c = c(t)$ of salt in the reservoir at time t. Specify units.

b) Solve for $c(t)$ with the given initial condition, and graph the solution c vs. t.

c) How long will it take for the concentration of salt to be 5 $\frac{\text{g}}{\ell}$?

d) What happens in the long run?

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18.03SC Differential Equations
Fall 2011

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