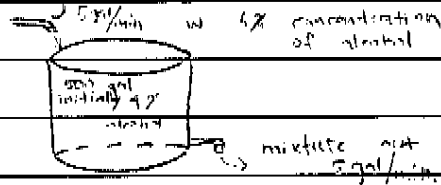


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Section 7.3 continue

Separable Equations

Mixing Problems:



contents always
perfectly mixed.

Question: How much alcohol is in the tank after 1 hr?

1st. need a function to talk about $c(t)$

$c(t)$ gives the ~~concentration~~ ^{amount} of alcohol after t minutes.
in the tank

2nd. set up a D.E.

$$\frac{dc}{dt} = (\text{rate in}) - (\text{rate out})$$

$5 \frac{\text{gal}}{\text{min}} \cdot (.04)$	$- 5 \frac{\text{gal}}{\text{min}} \left(\frac{c(t)}{500 \text{ gal}} \right)$	rate amount per time
$\frac{\text{alcohol in}}{\text{min}}$	$\frac{\text{alcohol out}}{\text{min}}$	\leftarrow total alcohol at time t \leftarrow total amount (gals)

3rd: Solve: $\frac{dc}{dt} = .3 - \frac{1}{100}c$

$$dc = (.3 - \frac{1}{100}c) dt$$

$$\int \frac{dc}{(.3 - \frac{1}{100}c)} = \int dt$$

let $u = .3 - \frac{1}{100}c$

$$du = -\frac{1}{100}dc$$

$$-100 \int \frac{du}{u} = t + C$$

$$-100 du = dc$$

$$-100 \ln|u| = t + C$$

$$\Rightarrow -100 \ln|.3 - \frac{1}{100}c| = t + C$$

solve for c .

$$\ln|.3 - \frac{1}{100}c| = \frac{t}{-100} + C$$

$$.3 - \frac{1}{100}c = \pm K e^{\frac{t}{-100}}$$

$$-\frac{1}{100}c = \pm K e^{\frac{t}{-100}} - .3$$

$$c = -100(\pm K e^{\frac{t}{-100}} - .3)$$

$$c = 30 \pm K e^{\frac{t}{-100}}$$

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4th Find the constant.

$$C(t) = \frac{.04(500)}{.70} \quad C(t) = 20.$$

$$\Rightarrow 20 = 50 \pm k e^t$$

$$\Rightarrow \frac{-10}{50} = \pm k \quad \text{choose } \pm \Rightarrow k = \frac{-10}{50}$$

$$C(t) = 50 + \frac{(-10)}{50} e^{-t/10}$$

5th Answer the question.

$$C(10) = \frac{1}{50} \cdot 50 - 10 e^{-\frac{10}{10}} = 21.5 \text{ gal}$$