

Name: _____

Quiz 5, Section 3.2, due on _____

(10 pts) A pond has volume 1000 cubic meters. Initially, there are 10 kilograms of gunk in the pond. A stream flows into the pond with flow rate 3 cubic meters per min; the stream contains gunk with a concentration of 0.4 kilograms per cubic meter. The gunk is well-mixed in the pond before exiting via an outflow stream with the same flow rate. Find the mass of gunk $G(t)$ in the pond.

Let $G(t)$ be the mass of gunk (kg)

$$\frac{dG}{dt} = I(t) - O(t) = rG_{in} - r\left(\frac{G(t)}{V}\right)$$

$$r = 3 \text{ m}^3/\text{min} \quad G_{in} = 0.4 \text{ kg}/\text{m}^3 \quad V = 1000 \text{ m}^3$$

$$\frac{dG}{dt} = 1.2 - \frac{3}{1000} G \quad G(0) = 10$$

$$\frac{dG}{dt} + 0.003G = 1.2$$

$$L P = .003 \quad k = e^{.003t}$$

$$\frac{d}{dt} \left(e^{.003t} G \right) = 1.2 e^{.003t}$$

$$e^{.003t} G = \frac{1.2}{.003} e^{.003t} + c = 400 e^{.003t} + c$$

$$G = 400 + c e^{-.003t}$$

$$10 = G(0) = 400 + c \quad c = -390$$

$$G = 400 - 390 e^{-.003t}$$