Supplemental Problems

(#1) (Gnostics)

a) Production rate depends on the number of gospels they already have because gospels must be copied.

   More gospels $\longrightarrow$ more copies can be made

b) $\dfrac{dG(t)}{dt} = \underbrace{0.15\,G}_{\text{growth}} - \underbrace{75}_{\text{loss}}$ t in months

c) $\dfrac{dG}{dt} = 0.15\,G - 75$

   $\dfrac{dG}{dt} = 0.15\,(G - 500)$ (substitute $P = G - 500$)

   $\dfrac{dG}{dt} = \dfrac{dP}{dt} = 0.15\,P$

   $P = C\,e^{0.15t}$

   $G - 500 = C\,e^{0.15t}$

   $\underline{G = C\,e^{0.15t} + 500}$

   we know $G(0) = G_0$

   $\therefore\ G_0 = C\,e^{0.15(0)} + 500$

   $G_0 = C + 500\ \implies\ C = G_0 - 500$

   so, $\boxed{G(t) = (G_0 - 500)\,e^{0.15t} + 500}$

d) if sect survives indefinitely, we know $\dfrac{dG}{dt} = 0$ (no net change)

   $\dfrac{dG}{dt} = 0.15\,G - 75$

   @ $t = 0$, $G = G_0$

   $0 = 0.15\,G_0 - 75$

   $75 = 0.15\,G_0\ \implies\ \boxed{G_0 = 500}$