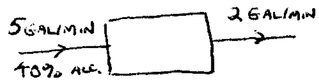
① 

$$\boxed{\frac{dA}{dt} = 5(.40) - 2\left(\frac{A}{20+3t}\right)\ ;\ A(0)=3} \longleftarrow A(0) = .15(20)$$

② 

$$\boxed{\frac{dS}{dt} = 4(5) - 6\left(\frac{S}{600-2t}\right)\ ;\ S(0)=80}$$

③ $N(t) = \dfrac{K}{1+ae^{-rt}} = \dfrac{1200}{1+ae^{-rt}}$

i) WHEN $t=0$, $N=200$; SO $\dfrac{1200}{1+a\cdot 1} = 200$, $\dfrac{1200}{200} = 1+a$, $6 = 1+a$, $\underline{a=5}$:

$\underline{N = \dfrac{1200}{1+5e^{-rt}}}$

ii) WHEN $t=8$, $N=300$; SO $\dfrac{1200}{1+5e^{-8r}} = 300$, $\dfrac{1200}{300} = 1+5e^{-8r}$, $4 = 1+5e^{-8r}$, $3 = 5e^{-8r}$,

$e^{-8r} = \frac{3}{5}$, $\underline{e^{-r} = \left(\frac{3}{5}\right)^{1/8}}$ SO $\underline{N} = \dfrac{1200}{1+5e^{-rt}} = \dfrac{1200}{1+5(e^{-r})^t} = \dfrac{1200}{1+5\left(\left(\frac{3}{5}\right)^{1/8}\right)^t} = \underline{\dfrac{1200}{1+5\left(\frac{3}{5}\right)^{t/8}}}$

iii) WHEN $N=600$, $\dfrac{1200}{1+5\left(\frac{3}{5}\right)^{t/8}} = 600$, $\dfrac{1200}{600} = 1+5\left(\frac{3}{5}\right)^{t/8}$, $2 = 1+5\left(\frac{3}{5}\right)^{t/8}$, $1 = 5\left(\frac{3}{5}\right)^{t/8}$,

$\left(\frac{3}{5}\right)^{t/8} = \frac{1}{5}$, $\frac{t}{8}\ln\frac{3}{5} = \ln\frac{1}{5}$, $t = \boxed{\dfrac{8\ln\frac{1}{5}}{\ln\frac{3}{5}} \text{ MONTHS}}$ ≈ 25.2 MONTHS

④ $N(t) = \dfrac{K}{1+ae^{-rt}} = \dfrac{300}{1+ae^{-rt}}$

i) WHEN $t=0$, $N=60$; SO $\dfrac{300}{1+a\cdot 1} = 60$, $\dfrac{300}{60} = 1+a$, $5 = 1+a$, $\underline{a=4}$:

$\underline{N = \dfrac{300}{1+4e^{-rt}}}$

ii) WHEN $t=7$, $N=100$; SO $\dfrac{300}{1+4e^{-7r}} = 100$, $\dfrac{300}{100} = 1+4e^{-7r}$, $3 = 1+4e^{-7r}$, $2 = 4e^{-7r}$,

$e^{-7r} = \frac{1}{2}$, $\underline{e^{-r} = \left(\frac{1}{2}\right)^{1/7}}$ SO $\underline{N} = \dfrac{300}{1+4e^{-rt}} = \dfrac{300}{1+4(e^{-r})^t} = \dfrac{300}{1+4\left(\left(\frac{1}{2}\right)^{1/7}\right)^t} = \underline{\dfrac{300}{1+4\left(\frac{1}{2}\right)^{t/7}}}$

iii) WHEN $t=21$,

$$N = \frac{300}{1+4\left(\frac{1}{2}\right)^3} = \frac{300}{1+4\cdot\frac{1}{8}} = \frac{300}{1+\frac{1}{2}} = \frac{300}{3/2} = 300\left(\frac{2}{3}\right) = \boxed{200 \text{ FOXES}}$$

(5) $\frac{dV}{dT} = KS$ AND $\sqrt{S} = \ell \sqrt[3]{V}$, SO $S = \ell^2 V^{2/3}$ AND

$\frac{dV}{dT} = K(\ell^2 V^{2/3}) = bV^{2/3}$ (WHERE $b = K\ell^2$). SOLVING GIVES

$\int \frac{1}{V^{2/3}}\, dV = \int b\, dT$, $\int V^{-2/3}\, dV = bT + C$, $3V^{1/3} = bT + C$,

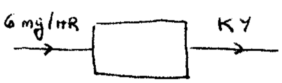
$V^{1/3} = aT + d$, $V = (aT + d)^3$

i) WHEN $T=0$, $V=8$; SO $\sqrt[3]{8} = 0 + d$ GIVES $d = 2$

ii) WHEN $T=5$, $V=27$; SO $\sqrt[3]{27} = 5a + d$ GIVES $3 = 5a + 2$, $1 = 5a$, $a = 1/5$

THEREFORE $\boxed{V = \left(\frac{1}{5}T + 2\right)^3}$

(6) LET $Y(T)$ BE THE AMOUNT OF DRUG IN THE PATIENT'S BLOOD AFTER T HOURS.



$\frac{dY}{dT} = 6 - KY$; $Y(0) = 0$ $u = 6 - KY$, $du = -K\,dY$

$\int \frac{1}{6-KY}\, dY = \int dT$, $\left(-\frac{1}{K}\right) \int \frac{(-K)}{6-KY}\, dY = T + C$, $-\frac{1}{K} \ln(6 - KY) = T + C$

$\ln(6 - KY) = -KT + D$, $6 - KY = e^{-KT+D} = e^D e^{-KT} = Ae^{-KT}$,

$6 - Ae^{-KT} = KY$, $Y = \frac{6}{K} - be^{-KT}$

a) WHEN $T=0$, $Y=0$; SO $0 = \frac{6}{K} - b \cdot 1$ SO $b = \frac{6}{K}$ AND $Y = \frac{6}{K} - \frac{6}{K} e^{-KT}$

OR $Y = \frac{6}{K}(1 - e^{-KT})$.

b) $\lim_{T \to \infty} Y = \lim_{T \to \infty} \frac{6}{K}\left(1 - \frac{1}{e^{KT}}\right) = \frac{6}{K}(1 - 0) = \frac{6}{K} = 3$, SO $K = 2$ AND

$Y = 3(1 - e^{-2T})$

c) WHEN $T = 4$, $Y = \boxed{3(1 - e^{-8})\text{ mg}} \approx 2.999$ mg