Requirement 1

$$\frac{dS}{dt} = -a\,S(t)\,I(t)$$

$$\frac{dI}{dt} = -b\,S(t)\,I(t)$$

with initial conditions $S(0) = S_0$ & $I(0) = I_0$, the formula for the S forces is:

EQ(1) $$S(t) = S_0\left(\frac{bS_0 - aI_0}{bS_0 - aI_0 e^{-(aI_0 - bS_0)t}}\right) \quad \text{for } bS_0 \neq aS_0$$

or

EQ (2) $$S(t) = \frac{S_0}{1 + bS_0 t} \quad \text{if } bS_0 = aS_0$$

The formula for the I forces is:

EQ(3) $$I(t) = I_0\left(\frac{aI_0 - bS_0}{aI_0 - bS_0 e^{-(aI_0 - bS_0)t}}\right) \quad \text{for } bI_0 \neq aI_0$$

or

EQ(4) $$I(t) = \frac{I_0}{1 + aI_0 t} \quad \text{if } aI_0 = bI_0$$

since a is known to be 0 and 7000 Incas were killed, EQ(1) & EQ(3) are to be used

so, $$S(t) = S_0\left(\frac{bS_0}{bS_0}\right) = S_0 = 168$$

$$I(t) = I_0\left(\frac{-bS_0}{-bS_0 e^{-(-bS_0)t}}\right) = I_0\left(\frac{1}{e^{bS_0 t}}\right)$$

Rearrange $$e^{bS_0 t} = \frac{I_0}{I(t)} \rightsquigarrow bS_0 t = \ln\left(\frac{I_0}{I(t)}\right)$$

$$b = (\ln(I_0/I(t)))/S_0 t$$

$I(480) = 73000$, $S_0 = 168$

$$b = \frac{\ln\left(\frac{80000}{73000}\right)}{168(480)} = 1.136 \times 10^{-6} = b$$