1/1

4) $B(t) = 0.4P$ ($B(t)$ is constant) B is ?

$P = 2000$, $D(t) = 0.2P$ D is ?

$P = 3000$, $D(t) = 0.25P$

So for $\Delta P = 1000$, $\Delta D(t) = 0.05P$

Assuming linearity $D(t) = 0.2P + mP$

$$m = \frac{\Delta D(t)}{\Delta P} = \frac{0.05P}{1000} = \frac{P}{2E4}$$

Hence $D(t) = \frac{P(t)}{5} + \frac{P(t)}{2E4}(P(t) - 2000)$ your calculator may use this – we usually prefer 2×10^4

Dropping the t's.

$B = 0.4P$, $D = \frac{P}{5} + \frac{P}{2E4}(P - 2000)$ 4/4

$$\frac{dP}{dt} = 0.4P - \left(\frac{P}{5} + \frac{P(P-2000)}{2E4}\right)$$

$$= 0.4P - 0.2P - \frac{P(P-2000)}{2E4}$$

starting to miss the division sign again!

$$= 0.2P - \frac{P^2}{2E4} + 0.1P$$

$$= 0.3P - \frac{P^2}{2E4} = P\left(0.3 - \frac{P}{2E4}\right)$$ 4/4

$\frac{dP}{dt} = P\left(0.3 - \frac{P}{2E4}\right)$ is the equation satisfied by the population of the colony during it's growth.

The stable population is given by $\frac{dP}{dt} = 0$

as below we prefer in the logistic form $0.3P\left(1 - \frac{P}{6000}\right)$

ie $0 = P\left(0.3 - \frac{P}{2E4}\right)$

either $P = 0$ or $0.3 - \frac{P}{2E4} = 0$ ie $P = 0.3 \times 2E4$

$P = 6000$

(since we are not interested in $P = 0$). 2/2

ii) $\frac{dP}{dt} = P\left(0.3 - \frac{P}{2E4}\right) - M$

$$= P\left(0.3 - \frac{P}{2E4}\right) - \frac{P}{10} \quad (M = P/10)$$