1.1 5, 6, 15

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5. P = population

$$\frac{dP}{dt} = \alpha P, \quad P(0) = 10{,}000$$

$$P(t) = 10{,}000 e^{\alpha t}$$

$$25{,}000 = P(10) = 10{,}000 e^{\alpha \cdot 10}$$

$$\ln e^{10\alpha} = \ln(2.5)$$

$$\alpha = \frac{1}{10}\ln(2.5) \approx 0.0916$$

$$P(20) = 10{,}000 e^{0.0916(20)} \approx 6{,}2464 \text{ individuals}$$

$$P(30) \approx 15{,}6113 \text{ individuals.}$$

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6. $\alpha = \frac{1}{10}\ln\left(\frac{\cancel{25}6{,}000}{10{,}000}\right)$

$$\approx -0.0511$$

$$P(20) = 10{,}000 e^{-0.0511(20)} \approx 3599 \text{ individuals}$$

$$P(30) \approx 2159 \text{ individuals}$$

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15. $\frac{dA}{dt} = -1.5\times 10^{-7} A$

$$\Rightarrow A(t) = A(0) e^{-1.5\times10^{-7} t}$$

$$\frac{1}{2}\cancel{A(0)} = \cancel{A(0)} e^{-1.5\times10^{-7} t}$$

$$t = \frac{-1}{1.5\times10^{-7}}\ln\left(\frac{1}{2}\right)$$

$$= 4620981.2 \text{ years}$$

23.

$$\frac{dP}{da} = \beta P$$

$$P(t) = 1013.25 e^{\beta a}$$

$$845.6 = P(1500) = 1013.25 e^{\beta 1500}$$

$$\beta = \frac{1}{1500}\ln\left(\frac{845.6}{1013.25}\right)$$

$$\approx -0.0001206$$

$P(8848)$

$$= 1013.25 e^{-0.0001206 \cdot 8848}$$

$$= 348.6 \text{ mbar}$$