# 6.2 Growth and Decay

Pg 412 #'s 3, 5, 15, 19, 20, 51, 52, 56, 65

3) $\frac{dy}{dx} = y+3$

$\int \frac{1}{y+3}\,dy = \int dx$

$\ln|y+3| = x + C$

$e^{\ln|y+3|} = e^{x+C}$

$y+3 = Ce^x$

$\boxed{y = Ce^x - 3}$

5) $y' = \frac{5x}{y}$

$\int y\,dy = \int 5x\,dx$

$\frac{1}{2}y^2 = \frac{5}{2}x^2 + C$

$\boxed{y^2 = 5x^2 + C}$

15) $\frac{dy}{dt} = \frac{1}{2}t$

$\int dy = \int \frac{1}{2}t\,dt$

$y = \frac{1}{4}t^2 + C$

$10 = \frac{1}{4}(0)^2 + C$

$10 = C$

$\boxed{y = \frac{1}{4}t^2 + 10}$

19) $\frac{dN}{dt} = kN$

$\int \frac{1}{N}dN = \int k\,dt$

$\ln|N| = kt + C$

$e^{\ln|N|} = e^{kt+C}$

$N = Ce^{kt}$

$250 = Ce^{k(0)}$

$250 = C$

$N = 250e^{kt}$

$400 = 250e^{k(4)}$

$\frac{400}{250} = e^{k}$

$\ln\left(\frac{400}{250}\right) = k$

$N = 250e^{\ln\left(\frac{40}{25}\right)t}$

$N = 250e^{\ln\left(\frac{40}{25}\right)\cdot 4}$

$\boxed{N = 1638.4}$

20) $\frac{dP}{dt} = kP$

$\int \frac{1}{P}dP = \int k\,dt$

$\ln|P| = kt + C$

$e^{\ln|P|} = e^{kt+C}$

$P = Ce^{kt}$

$5000 = Ce^{k(0)}$

$5000 = C$

$P = 5000e^{kt}$

$4750 = 5000e^{k(1)}$

$\frac{4750}{5000} = e^{k}$

$\ln\left(\frac{4750}{5000}\right) = k$

$P = 5000e^{\ln\left(\frac{4750}{5000}\right)t}$

$P = 5000e^{\ln\left(\frac{4750}{5000}\right)\cdot 5}$

$\boxed{P = 3868.905}$

51) $P = Ce^{kt}$

$2.2 = Ce^{-.006(1)}$

$C = \frac{2.2}{e^{-.006}}$

$C = 2.213239$

a) $P = 2.213e^{-.006t}$

b) $P = 2.213e^{-.006(10)}$

$P = 2.084$ million

c) Negative k means population is decreasing

52) $P = Ce^{kt}$

$82.1 = Ce^{.020(1)}$

$C = \frac{82.1}{e^{.020}}$

$C = 80.474311$

a) $P = 80.474e^{.02t}$

b) $P = 80.474e^{.02(10)}$

$P = 98.291$

c) Positive k indicates pop. growth

56) $P = Ce^{kt}$

$125 = Ce^{2k}$ $350 = Ce^{4k}$

$C = \frac{125}{e^{2k}}$

$350 = \frac{125}{e^{2k}} e^{4k}$

$350 = 125e^{2k}$

$\frac{350}{125} = e^{2k}$

$\ln\left(\frac{350}{125}\right) = 2k$

$k = \frac{1}{2}\ln\left(\frac{350}{125}\right)$

$C = \frac{125}{e^{2\left(\frac{1}{2}\ln\left(\frac{350}{125}\right)\right)}}$

$C = 44.64$

a) $\boxed{C = 45}$

b) $\boxed{P = 45e^{\frac{1}{2}\ln\left(\frac{350}{125}\right)t}}$

c) $P = 45e^{\frac{1}{2}\ln\left(\frac{350}{125}\right)(8)}$

$\boxed{P = 2766}$

d) $25000 = 45e^{\frac{1}{2}\ln\left(\frac{350}{125}\right)t}$

$\frac{25000}{45} = e^{\frac{1}{2}\ln\left(\frac{350}{125}\right)t}$

$\ln\left(\frac{25000}{45}\right) = \frac{1}{2}\ln\left(\frac{350}{125}\right)t$

$t = \frac{\ln\left(\frac{25000}{45}\right)}{\frac{1}{2}\ln\left(\frac{350}{125}\right)}$

$\boxed{t = 12.276 \text{ hrs}}$

65) $\frac{dT}{dt} = k(T-M)$

$\frac{1}{T-M}dT = kdt$

$\int \frac{1}{T-80}\,dT = \int k\,dt$

$\ln|T-80| = kt + C$

$T - 80 = Ce^{kt}$

$T = 80 + Ce^{kt}$

$1500 = 80 + Ce^{k(0)}$

$1420 = C$

$T = 80 + 1420e^{kt}$

$1120 = 80 + 1420e^{k(1)}$

$1040 = 1420e^{k}$

$\ln\left(\frac{1040}{1420}\right) = k$

$T = 80 + 1420e^{\ln\left(\frac{1040}{1420}\right)t}$ @ $t = 5 \rightarrow \boxed{T = 379.236°F}$