1. Solutions for the integrals:

a. $-\dfrac{(2-x)^3}{3}+C,$

b. $\dfrac{(2x^2-3)^{\frac{3}{2}}}{6}+C,$

c. $2\ln|2x-6|+C,$

d. $-\dfrac{1}{4(x^2+4x-5)^2}+C,$

e. $-\dfrac{1}{2}e^{1-x^2}+C,$

f. $-\dfrac{1}{2}e^{-x^2+2x}+C,$

g. $-\dfrac{1}{2}\cos(x^2+4)+C,$

h. $-\dfrac{1}{2}\ln|\cos(2x)|+C,$

i. $2e^{\sqrt{x}}+C,$

j. $-\dfrac{1}{2}\sqrt{1-x^4},$

2. Solutions for the differential equations.

a. $y(t)=\dfrac{1}{3}\left(t^2+1\right)^{3/2}+\dfrac{14}{3},$

b. $y(t)=-1/2\,\cos(t^2-4)+\dfrac{7}{2},$

c. $y(t)=4\,e^{\sqrt{t^2-1}},$

d. $y(t)=\sqrt{\dfrac{1}{2(t^2-2t+2)^2}+\dfrac{1}{2}},$

e. $y(t)=\sqrt{\ln\left(\dfrac{2}{3}t^3+1\right)},$

f. $y(t)=4+6\,e^{-0.05\,t^2},$

g. $y(t)=\dfrac{1}{3}\,(\ln(t))^3-2,$

h. $y(t)=\dfrac{10}{1+4\,e^{-0.2\,t}}.$

3. The velocity is zero at the maximum height, and the solution of the velocity equation is given by

$$v(x)=\sqrt{\frac{2gR^2}{x+R}+V_0^2-2gR}=\sqrt{\frac{797,306}{x+6378}-100.0088}.$$

It follows that the maximum height achieved by the object is 1594 km.

4. The population of yeast is given by

$$P(t) = \frac{50,000}{1 + 49e^{-0.2t}}.$$

If t is in hours, then the culture doubles in 3.57 hr. Since the carrying capacity is 50,000, then it takes 19.46 hr to reach 25,000.

5. a. The population of game fish is given by

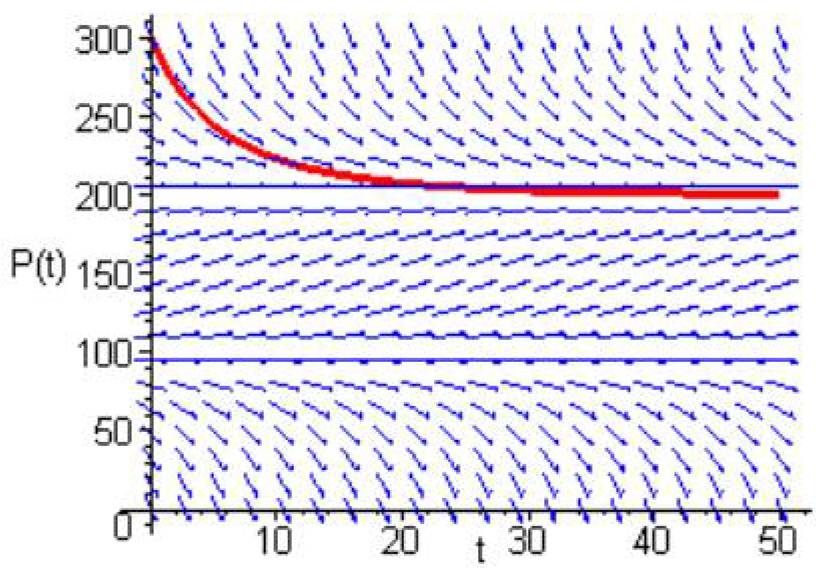
$$P(t) = \frac{300}{1 + 299e^{-0.3t}}.$$

The carrying capacity for the game fish is 300 (thousand), and it takes 26.3 yr to reach 90% of this carrying capacity.

b. The solution to the differential equation with harvesting is

$$P(t) = \frac{400 - 100e^{-0.1t}}{2 - e^{-0.1t}}.$$

c. The limiting population for this equation is 200 (thousand) game fish. A sketch a graph of the solution is below.



6. a. The differential equation describing the concentration of dioxin in the lake is given by

$$\frac{dc}{dt} = -0.0008(c-4), \qquad c(0) = 0.$$

The solution of this differential equation is given by

$$c(t) = 4 - 4\,e^{-0.0008t}.$$

b. The model with the variable flow is given by

$$\frac{dc}{dt} = -0.0008(1-\sin(0.0172t))(c-4), \qquad c(0) = 0.$$

The solution of this differential equation is given by

$$c(t) = 4 - 4\,\exp(-0.0008(t + 58.14\cos(0.0172t) - 58.14)).$$

c. In both models, the limiting concentration will be equal to the concentration in the entering river, so

$$\lim_{t\to\infty} c(t) = 4\ \mu\text{g/m}^3.$$

7. a. The maximum growth rate, $k(t)$, is 0.06, occurring at $t = 1$. Below is a graph of this function.

b. The solution to the differential equation is

$$V(t) = \left(1 + 0.02\ln(t^2+1)\right)^3.$$

c. It takes 664 min for the cell to double in volume.