1. a. $\frac{40}{3}$, b. $\frac{97}{3} + e^{-4}$,

   c. $\frac{206}{15}$, d. -2,

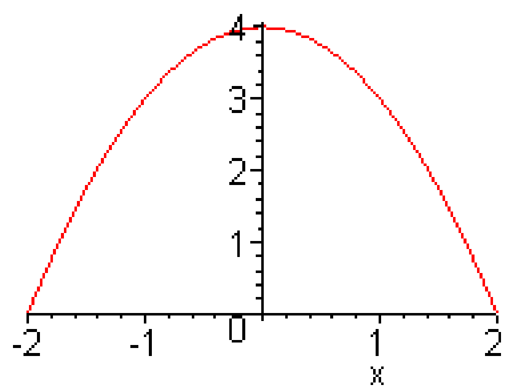
   e. 2, f. $12 + \ln(5)$,

   g. $2\pi^2$, h. $\ln(2)$,

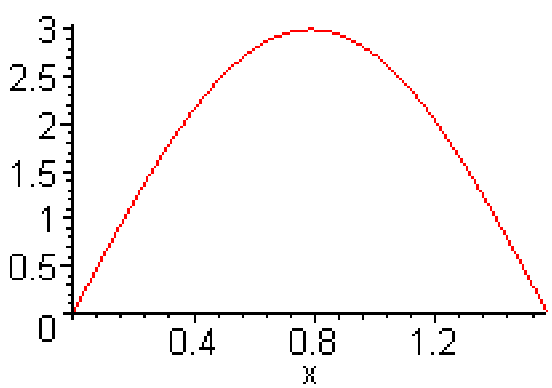
   i. 2, j. π^3,

   k. $\ln(5) + \frac{1}{2}e^4 - \frac{1}{2}e^{-4}$, l. 7.

2. Area $= \int_{-2}^{2} \left(4 - x^2\right) dx = \frac{32}{3}$. The graph is shown below.



3. Area $= \int_0^{\pi/2} 3\sin(2x)dx = 3$. The graph is shown below.

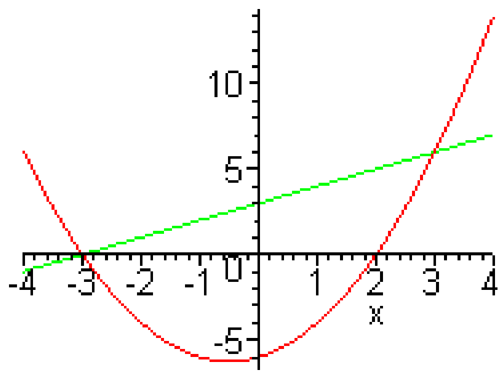


4. a. For the line $y = x + 3$, the x and y-intercepts are $(-3, 0)$ and $(0, 3)$, respectively. For the quadratic $y = x^2 + x - 6$, the x-intercepts are $(-3, 0)$ and $(2, 0)$, and y-intercept is $(0, -6)$. The vertex occurs at $(-\frac{1}{2}, -6\frac{1}{4})$. The graph is shown below.

b. The points of intersection are $(-3, 0)$ and $(3, 6)$.

c. The area is

$$\int_{-3}^{3} \big((x + 3) - (x^2 + x - 6)\big)\, dx = 36.$$

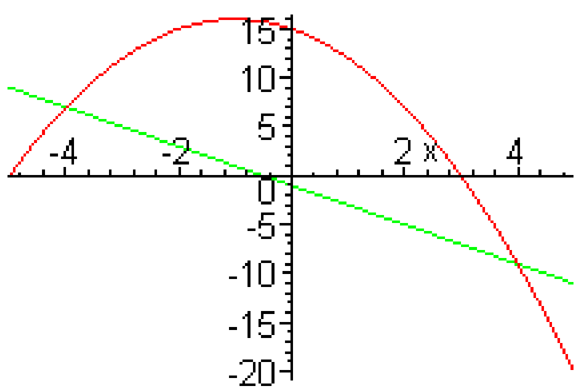


5. a. For the line $y = -2x - 1$, the x and y-intercepts are $(-\frac{1}{2}, 0)$ and $(0, -1)$, respectively. For the quadratic $y = 15 - 2x - x^2$, the x-intercepts are $(-5, 0)$ and $(3, 0)$, and y-intercept is $(0, 15)$. The vertex occurs at $(-1, 16)$. The graph is shown below.

b. The points of intersection are $(-4, 7)$ and $(4, -9)$.

c. The area is

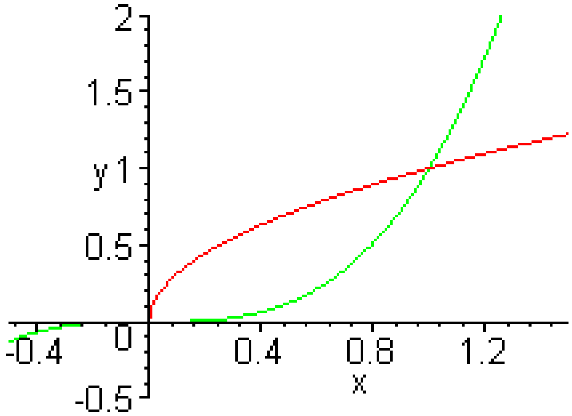
$$\int_{-4}^{4} \big((15 - 2x - x^2) - (-2x - 1)\big)\, dx = \frac{256}{3}.$$



6. a. The points of intersection are $(0, 0)$ and $(1, 1)$. The graph is shown below.

   b. The area is

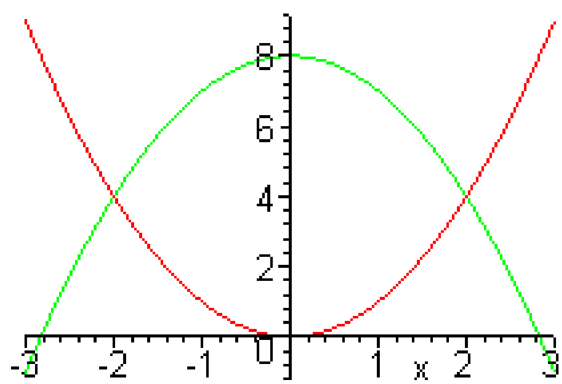
$$\int_0^1 \left(\sqrt{x} - x^3\right) dx = \frac{5}{12}.$$



7. a. The points of intersection are $(-2, 4)$ and $(2, 4)$. The graph is shown below.

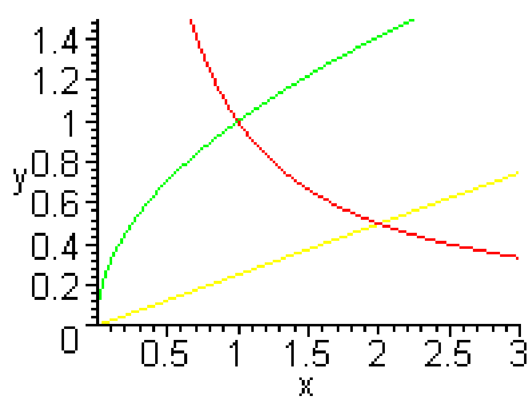
   b. The area is

$$\int_0^1 \left((8 - x^2) - x^2\right) dx = \frac{64}{3}.$$



8. The points of intersection are $(0, 0)$, $(1, 1)$, and $(2, \frac{1}{2})$. The graph is shown below. The area is

$$\int_0^1 \left(\sqrt{x} - \frac{x}{4}\right) dx + \int_1^2 \left(\frac{1}{x} - \frac{x}{4}\right) dx = \frac{1}{6} + \ln(2).$$



9. a. There are two minima at $(0, 12)$ and $(6, 12)$ and one maximum at $(3, 32\frac{1}{4})$.

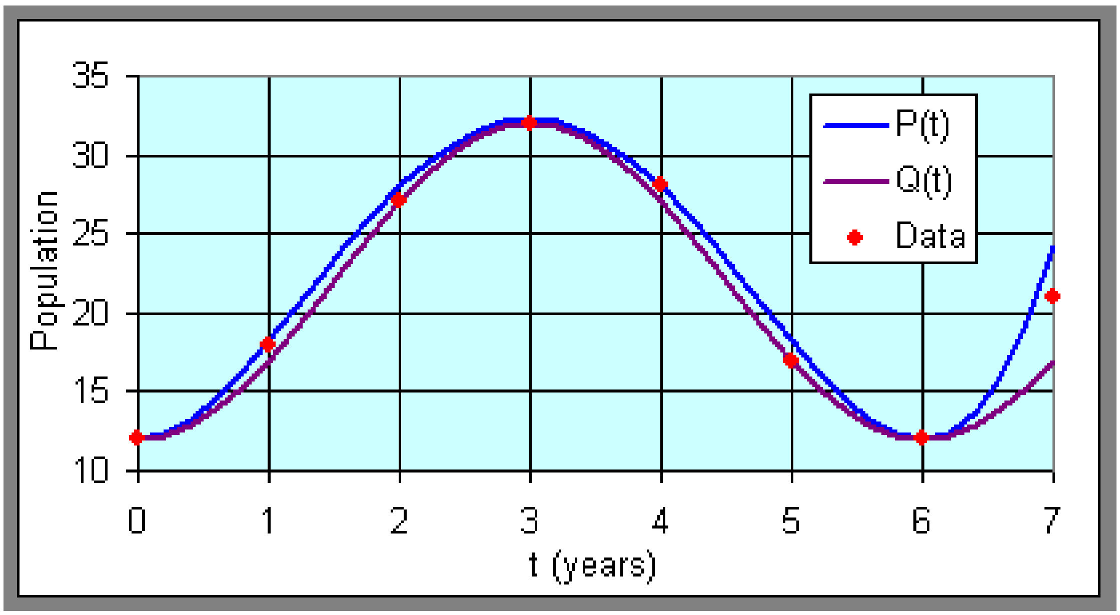
b. The average population is given by

$$P_{ave} = \frac{1}{7}\int_0^7 P(t)dt = 21.8$$

c. There are two minima at $(0, 12)$ and $(6, 12)$ and one maximum at $(3, 32)$. Below is a graph of both $P(t)$ and $Q(t)$ with the data.

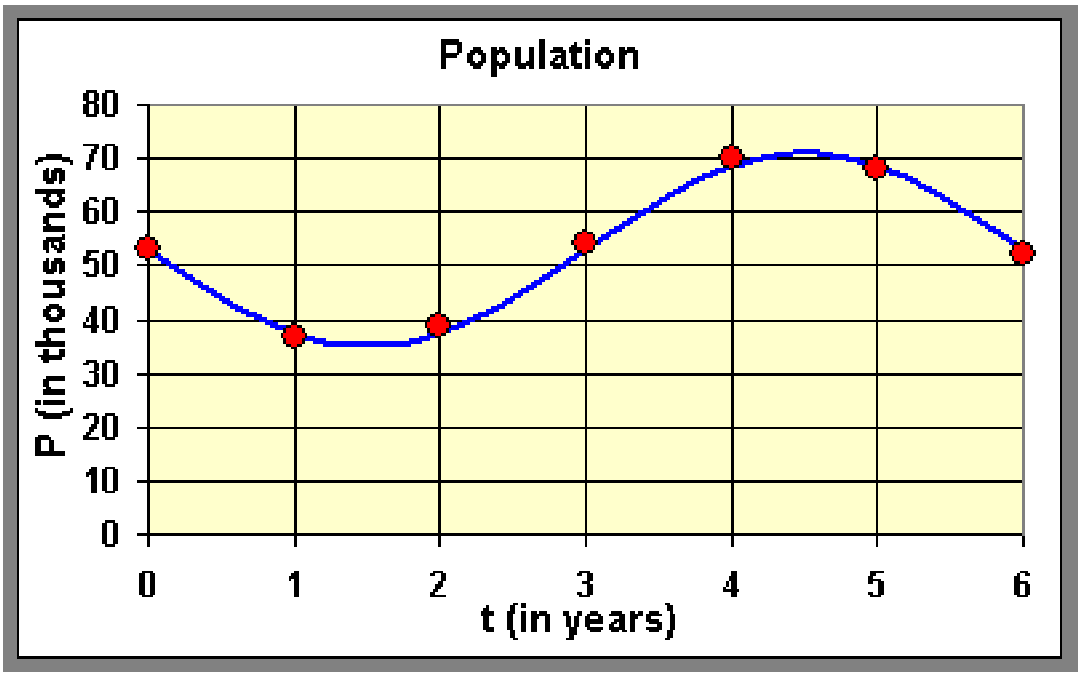
d. The average population is given by

$$Q_{ave} = \frac{1}{7}\int_0^7 Q(t)dt = 22 - \frac{15\sqrt{3}}{7\pi} \simeq 20.82.$$



10. a. The maximum occurs when $t = \frac{9}{2}$ with a population of $P(9/2) = 71$, while the minimum occurs when $t = \frac{3}{2}$ with a population of $P(3/2) = 35$. The graph of the function and the data can be seen below.

b. The average population is 53.



11. a. The solution is $R(t) = 50\,e^{-0.1t}$ and has a half-life $t = 10\ \ln(2) \simeq 6.9$ days.

b. The total exposure is $50(1 - e^{-1}) = 31.6$ mCi.

c. For exposure less than 10 mCi, time must be $t \leq 10\ \ln(5/4) \simeq 2.23$ days.

12. a. The population is given by $P(t) = 100\,e^{kt}$, where $k = \ln(2.5) = 0.9163$. The doubling time for this pest is $t = \frac{\ln(2)}{\ln(2.5)} \simeq 0.756$ weeks (a little more than 5 days.

b. The average population is 1038.5 (with the population being 3906 at the end of 4 weeks).

13. The expected value of x for $\sigma = 1$ and $x \in [0, 2]$ is $x_m = (1 - e^{-2})/\sqrt{2\pi} \simeq 0.345$.