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. $\pi^3$,  
k. $\ln(5) + \frac{1}{2}e^4 - \frac{1}{2}e^{-4}$,  
l. $7$.  

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

![Graph of $y = 4 - x^2$ from x = -2 to x = 2]

3. Area = $\int_{0}^{\pi/2} 3 \sin(2x) \, dx = 3$. The graph is shown below.

![Graph of $y = 3\sin(2x)$ from x = 0 to x = $\pi/2$]
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
\[
\int_{-3}^{3} \left((x + 3) - (x^2 + x - 6)\right) \, dx = 36.
\]

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
\[
\int_{-4}^{4} \left((15 - 2x - x^2) - (-2x - 1)\right) \, dx = \frac{256}{3}.
\]
6. a. The points of intersection are (0, 0) and (1, 1). The graph is shown below.

b. The area is

\[
\int_0^1 (\sqrt{x} - x^3) \, dx = \frac{5}{12}.
\]

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

b. The area is

\[
\int_0^1 (8 - x^2 - x^4) \, dx = \frac{64}{3}.
\]

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

\[ P_{\text{ave}} = \frac{1}{7} \int_0^7 P(t) \, dt = 21.8 \]

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

\[ Q_{\text{ave}} = \frac{1}{7} \int_0^7 Q(t) \, dt = 22 - \frac{15\sqrt{3}}{7\pi} \approx 20.82. \]
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.

![Population Graph](image)

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

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

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

12. a. The population is given by \( P(t) = 100e^{kt} \), where \( k = \ln(2.5) = 0.9163 \). The doubling time for this pest is \( t = \frac{\ln(2)}{\ln(2.5)} \approx 0.756 \) 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 \( x_m = (1 - e^{-2})/\sqrt{2\pi} \approx 0.345 \).