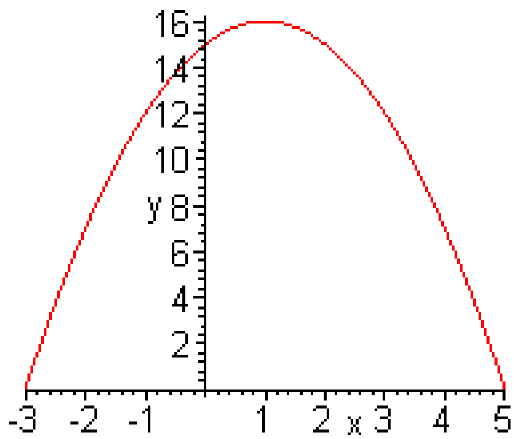
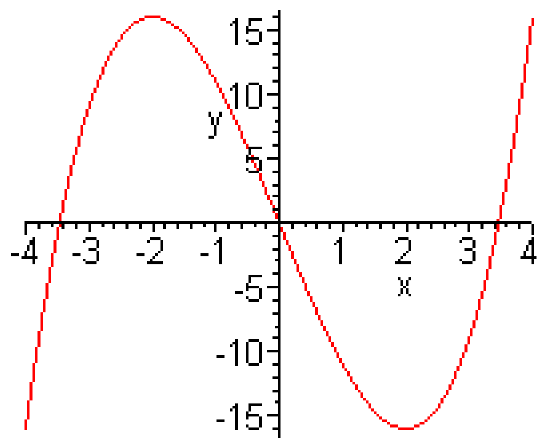
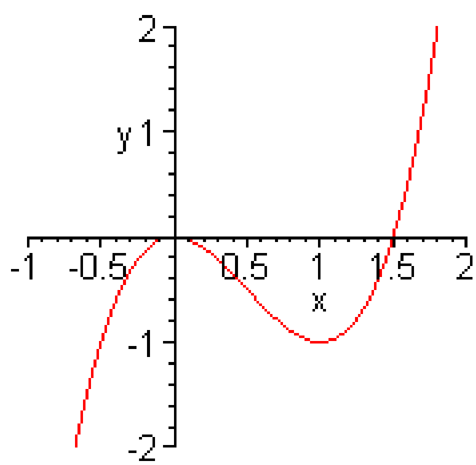
1. x-intercepts: $x = -3, 5$, y-intercept: $y = 15$, maximum at $(1, 16)$. Graph is below to the left.

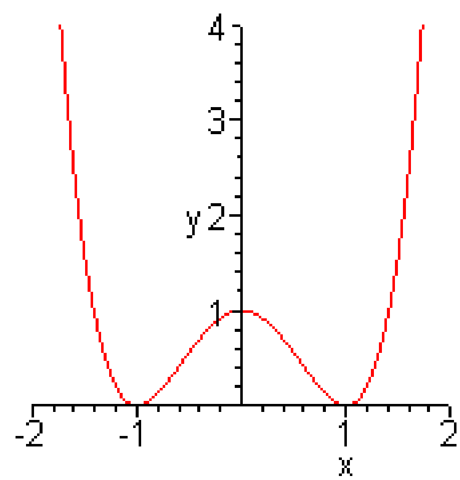




2. x-intercepts: $x = 0, \pm\sqrt{12}$, y-intercept: $y = 0$, maximum at $(-2, 16)$, minimum at $(2, -16)$, point of inflection at $(0, 0)$. Graph is above to the right.

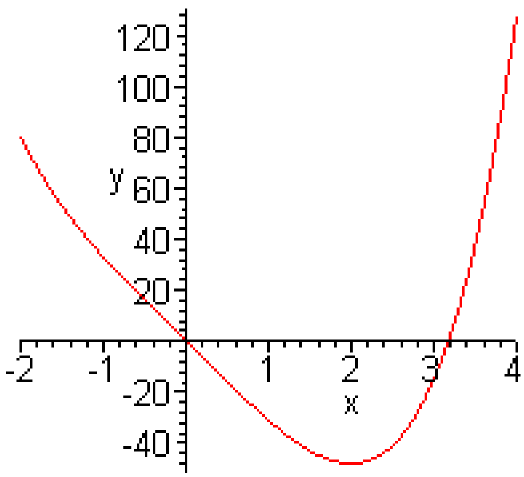
3. x-intercepts: $x = 0, \frac{3}{2}$, y-intercept: $y = 0$, maximum at $(0, 0)$, minimum at $(1, -1)$, point of inflection at $\left(\frac{1}{2}, -\frac{1}{2}\right)$. Graph is below to the left.

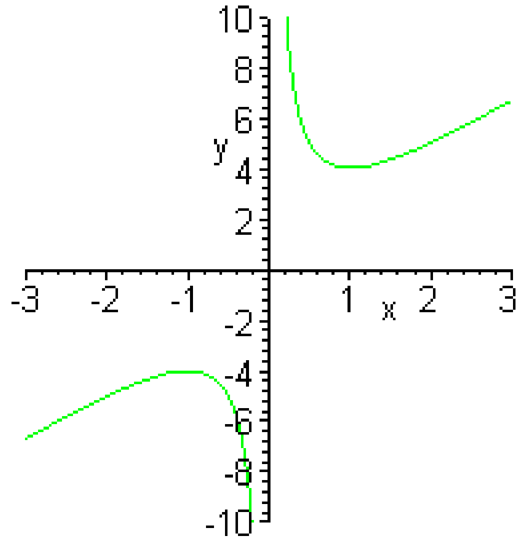




4. x-intercepts: $x = \pm 1$, y-intercept: $y = 1$, maximum at $(0, 1)$, minima at $(\pm 1, 0)$, points of inflection at $\left(\pm\frac{1}{\sqrt{3}}, \frac{4}{9}\right)$. Graph is above to the right.

5. x-intercepts: $x = 0, \sqrt[3]{32}$, y-intercept: $y = 0$, minimum at $(2, -48)$, $y'' = 0$ at $x = 0$, but no point of inflection. Graph is below to the left.





6. No x or y-intercepts, vertical asymptote at $x = 0$. maximum at $(-1, -4)$, minimum at $(1, 4)$. Graph is above to the right.

7. a. $c_0 = 0.1$, $c_1 = 0.0865$, and $c_2 = 0.075025$.

b. $c_e = 0.01$. $B'(c) = 0.85 < 1$, thus, the solution is stable and monotonically approaches the equilibrium.

8. a. $P_0 = 6000$, $P_1 = 6200$, and $P_2 = 6440$. Also, $P_0 = 3000$, $P_1 = 2600$, and $P_2 = 2120$.

b. $P_e = 5000$. $G'(P) = 1.2 > 1$, thus, the solution is unstable and monotonically grows away from the equilibrium.

c. The population goes to extinction.

9. a. $P_0 = 1000$, $P_1 = 1475$, and $P_2 = 2158$.

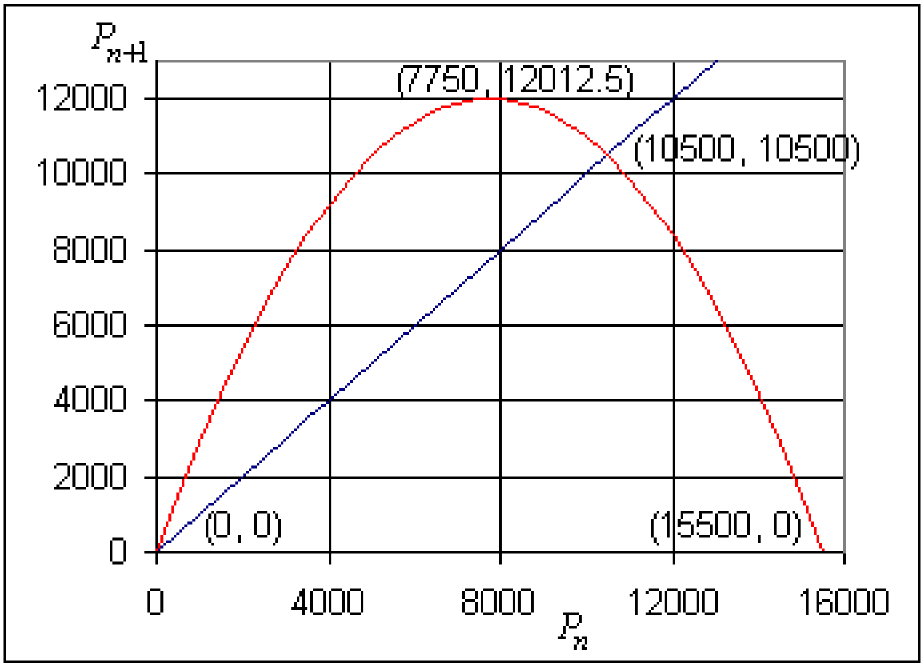
b. $P_e = 0, 20000$. $F'(P) = 1.5 - \frac{P}{20000}$, so $F'(0) = 1.5 > 1$, thus, the equilibrium $P_e = 0$ is unstable, and the solution monotonically grows away from the equilibrium. $F'(20000) = 0.5 < 1$, thus, the equilibrium $P_e = 20,000$ is stable, and the solution monotonically approaches this equilibrium.

c. For $r = 1.1$, $P_0 = 1000$, $P_1 = 2100$, and $P_2 = 4410$. $P_e = 0, 20000$. $F'(P) = 2.1 - \frac{2.2P}{20000}$, so $F'(0) = 2.1 > 1$, thus, the equilibrium $P_e = 0$ is unstable, and the solution monotonically grows away from this equilibrium. $F'(20000) = -0.1 < 0$, but $F'(20000) > -1$, thus, the equilibrium $P_e = 20,000$ is stable. The solution oscillates, but approaches this equilibrium.

10. a. $P_0 = 1000$, $P_1 = 2900$, $P_2 = 7308$, and $P_3 = 11,973$. Find the populations at the end of the first three generations P_1, P_2, and P_3.

b. $P_e = 0, 10500$. $F'(P) = 3.1 - 0.0004P$, so $F'(0) = 3.1 > 1$, thus, the equilibrium $P_e = 0$ is unstable, and the solution monotonically grows away from this equilibrium. $F'(10500) = -1.1 < -1$, thus, the equilibrium $P_e = 10,500$ is unstable. The solution oscillates about this equilibrium and moves way.

c. Below is the graph of the updating function and the identity function ($P_{n+1} = P_n$), showing the vertex of $F(P)$, the points of intersection, and the intercepts.



11. a. $v(t) = h'(t) = v_0 - 980t$.

b. $v(t) = 0$, when $t = \frac{v_0}{980}$. The initial velocity to clear the fence is $v_0 = 420\sqrt{2} \simeq 593.97$ cm/sec.

c. The hang time is $t = \frac{6}{7}\sqrt{2} \simeq 1.212$ sec.

12. a. $T'(t) = 0.006\,t^2 - 0.18\,t + 1.2$. At noon, $T'(12) = -0.096$ °C/hr.

b. The maximum temperature of the subject occurs at 10 AM with a temperature of 37 °C, while the minimum temperature of the subject occurs at 8 PM ($t = 20$) with a temperature of 36 °C.

13. a. $N_0 = 4$, $N_1 = 4.6$, and $N_2 = 5.407$ in thousands of birds.

b. The equilibria are $N_e = 0$, 2, and 10.

c. The derivative is $A'(N) = \frac{3}{4} + \frac{3}{10}N - \frac{3}{80}N^2$. At $N_e = 0$, $A'(0) = \frac{3}{4}$, so this equilibrium is a stable equilibrium with solutions monotonically approaching 0. At $N_e = 2$, $A'(2) = \frac{6}{5}$, so this equilibrium is an unstable equilibrium with solutions monotonically moving away from 2. At $N_e = 10$, $A'(10) = 0$, so this equilibrium is a stable equilibrium with solutions monotonically approaching 10.

d. Biologically, these results imply that if the population is below 2 thousand, then it will go to extinction ($N_e = 0$). If the population is above 2 thousand, then the population of birds will grow to a carrying capacity of $N_e = 10$ thousand.

14. a. The membrane potential is $V_0 = 3$, $V_1 = 4.68$, $V_2 = 7.477$, and $V_3 = 5.860$. (This solution cycles through a period 3 behavior of potentials $V = 3.52$, 5.68, and 8.14.)

b. The equilibria are $V_e = 0$, 1, and 7.

c. The derivative is $M'(V) = 0.51 + 1.12V - 0.21V^2$. At $V_e = 0$, $M'(0) = 0.51$, so this equilibrium is a stable equilibrium with solutions monotonically approaching 0. At $V_e = 1$, $M'(1) = 1.42$, so this equilibrium is an unstable equilibrium with solutions monotonically moving away from 1. At $V_e = 7$, $M'(7) = -1.94$, so this equilibrium is an unstable equilibrium with solutions oscillating about 7 and moving away. As stated above this is a period 3 behavior.

d. Biologically, these results imply that if the membrane potential is below 1, then it returns to a resting potential ($V_e = 0$). If the membrane potential is above 1, then the membrane potential rises in an oscillatory manner about the equilibrium $V_e = 7$. This results in a periodic spiking of action potentials.