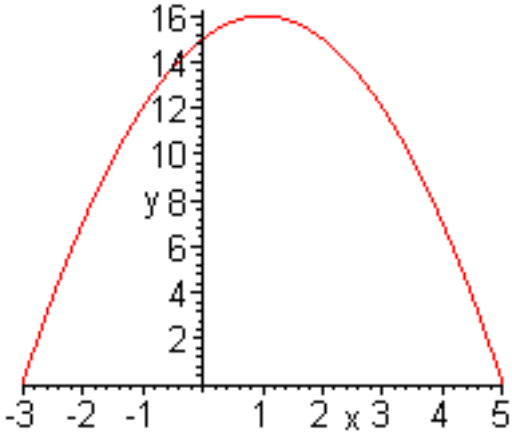
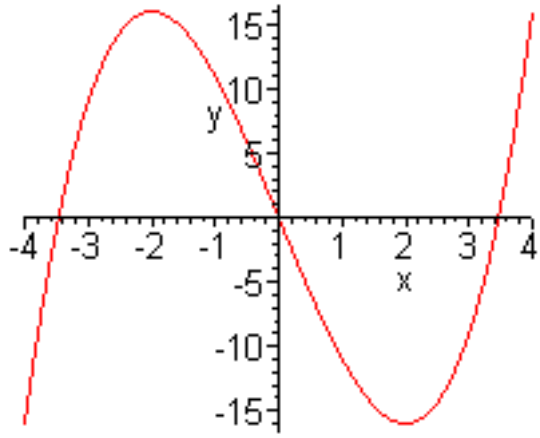
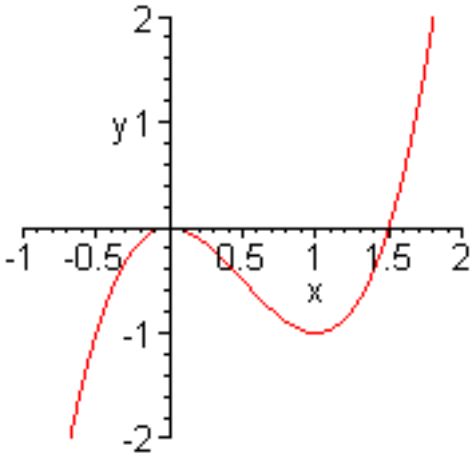
1. x-intercepts: $x = -3, 5$, y-intercept: $y = 15$, maximum at $(1, 16)$. Graph is below to the left.

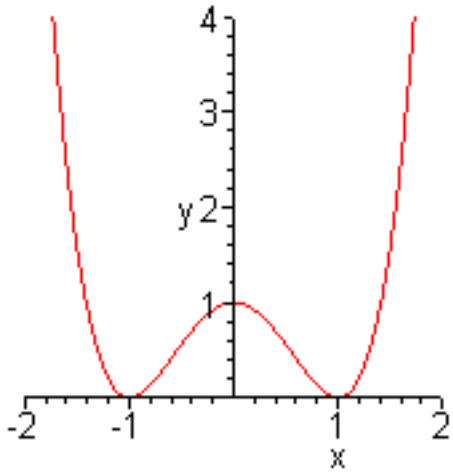




2. x-intercepts: $x = 0, \pm\sqrt{12}$, y-intercept: $y = 0$, maximum at $(-2, 16)$, minimum at $(2, -16)$, point of inflection at $(0, 0)$. Graph is above to the right.

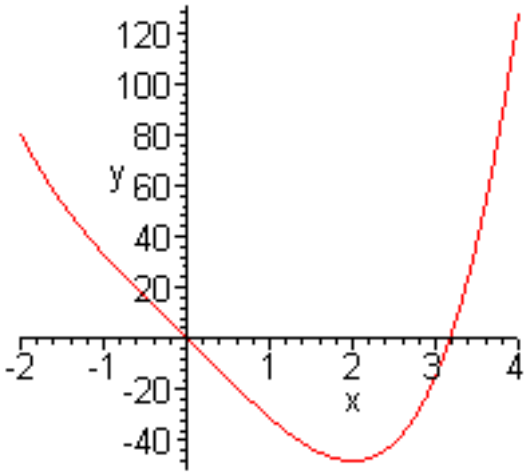
3. x-intercepts: $x = 0, \frac{3}{2}$, y-intercept: $y = 0$, maximum at $(0, 0)$, minimum at $(1, -1)$, point of inflection at $\left(\frac{1}{2}, -\frac{1}{2}\right)$. Graph is below to the left.

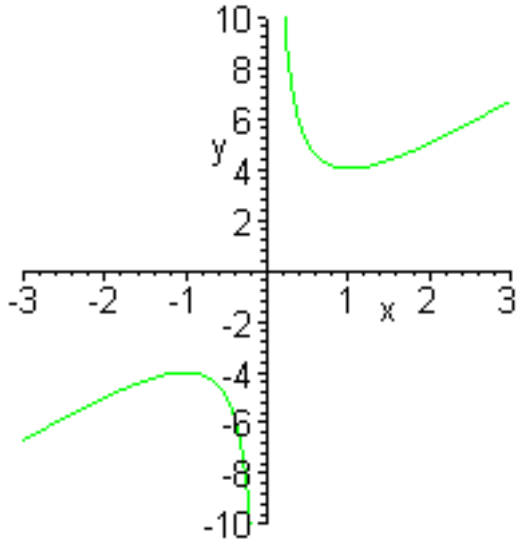




4. x-intercepts: $x = \pm 1$, y-intercept: $y = 1$, maximum at $(0, 1)$, minima at $(\pm 1, 0)$, points of inflection at $\left(\pm\frac{1}{\sqrt{3}}, \frac{4}{9}\right)$. Graph is above to the right.

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.

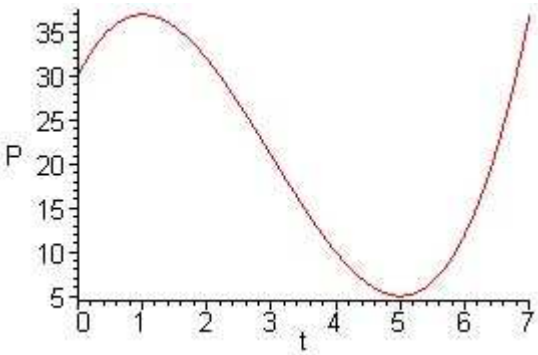
7. a. $T'(t) = 0.006\,t^2 - 0.18\,t + 1.2$. At noon, $T'(12) = -0.096$ °C/hr.

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.

8. a. $P'(t) = 3t^2 - 18t + 15$. $P'(2) = -9$ thousand algae/cc/day.

b. There is a maximum at $t = 1$ with $P(1) = 37$. There is a minimum at $t = 5$ with $P(5) = 5$. The population is increasing for $t \in (0, 1)$ and $t \in (5, 7)$. It is decreasing for $t \in (1, 5)$

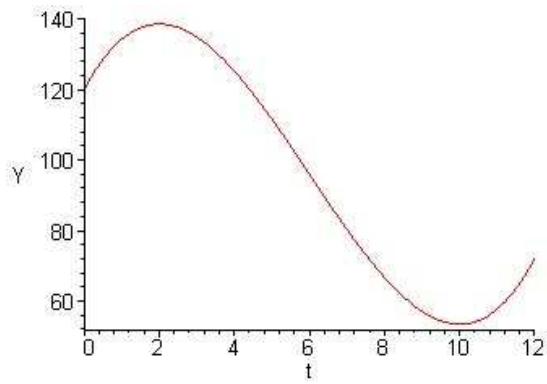
c. The population at the beginning and end are $P(0) = 30$ and $P(7) = 37$. Below is the graph.



9. a. $Y'(t) = t^2 - 12t + 20$. $Y'(6) = -16$ μl/hr/hr.

b. There is a maximum at $t = 2$ with $Y(2) = \frac{416}{3}$. There is a minimum at $t = 10$ with $Y(10) = \frac{160}{3}$.

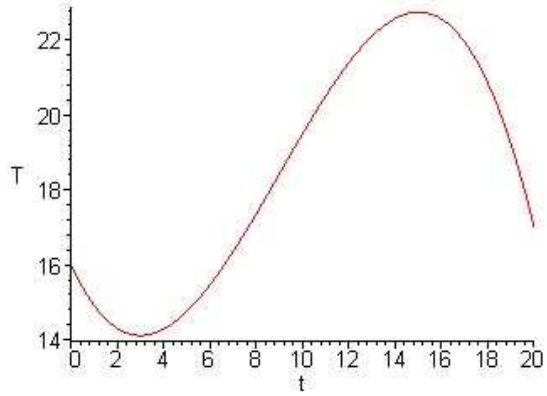
c. The O_2 consumption at the beginning and end are $Y(0) = 120$ and $Y(12) = 72$. Below is the graph.



10. a. $T'(t) = 0.01(-135 + 54t - 3t^2)$. $T'(3) = 0$.

b. There is a minimum at $t = 3$ with $T(3) = 14.11$. There is a maximum at $t = 15$ with $T(15) = 22.75$.

c. The temperature at the beginning and end are $T(0) = 16$ and $T(20) = 17$. Below is the graph.



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.