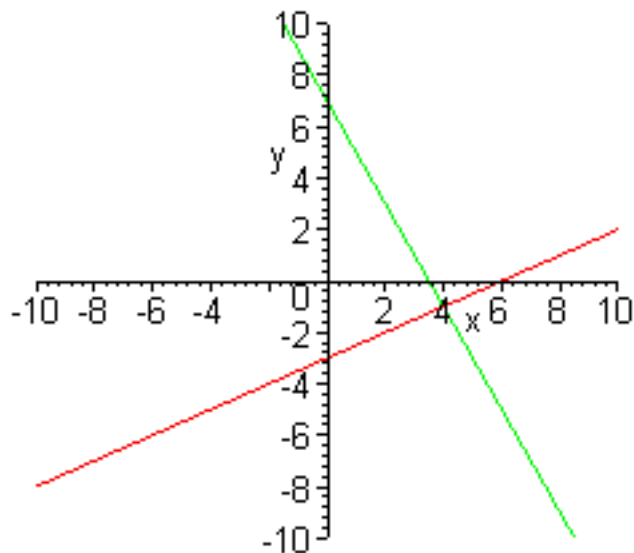
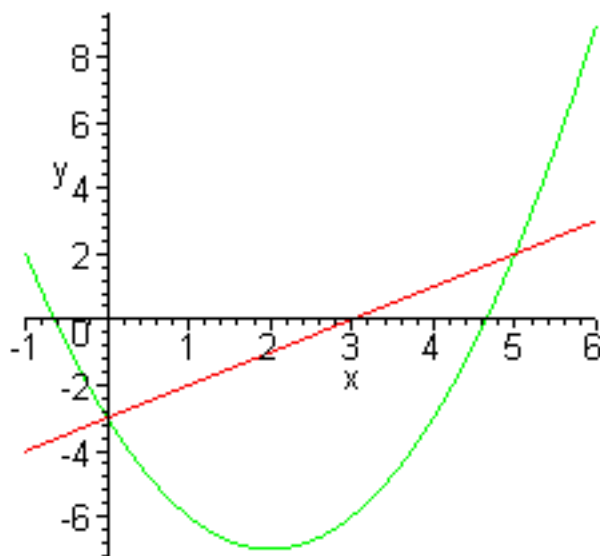
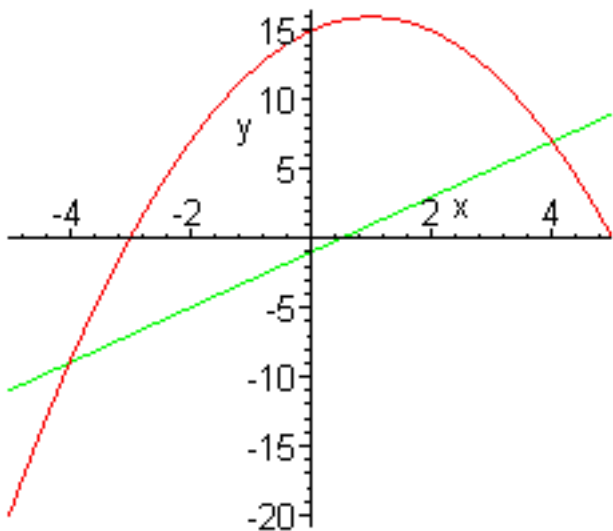


1. The first line is $y = \frac{x}{2} - 3$. The perpendicular line $y = -2x + 7$. The graph of these two lines is below.



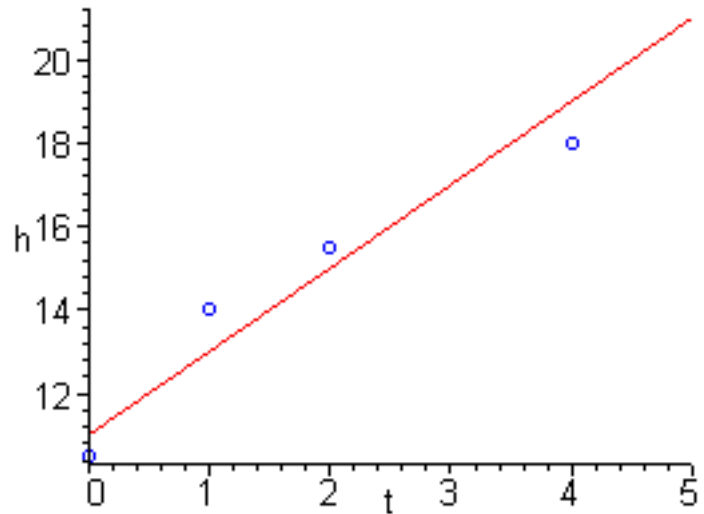
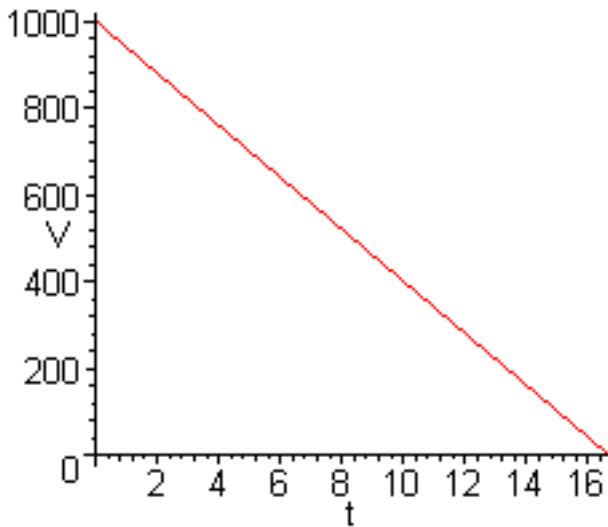
2. The weight of the dog is 19.5 kg, and its temperature 38.9°C.

3. For $f(x) = 2x - 1$, the x and y -intercepts are $(\frac{1}{2}, 0)$ and $(0, -1)$, respectively. The slope is $m = 2$. For $g(x) = 15 + 2x - x^2$, the x -intercepts are $x = 5, -3$, and the y -intercept is $(0, 15)$. The vertex is $(1, 16)$. The curves intersect at $(-4, -9)$ and $(4, 7)$. The graph of the line and the parabola are below to the left.



4. For $f(x) = x - 3$, the x and y -intercepts are $(3, 0)$ and $(0, -3)$, respectively. The slope is $m = 1$. For $g(x) = x^2 - 4x - 3$, the x -intercepts are $x = 2 \pm \sqrt{7}$, and the y -intercept is $(0, -3)$. The vertex is $(2, -7)$. The curves intersect at $(0, -3)$ and $(5, 2)$. The graph of the line and the parabola are above to the right.

5. The linear model satisfies $V(t) = 1000 - 60t$. The water is lost at time $t = \frac{1000}{60} \approx 16.7$ weeks. Note that this model is only valid for $0 \leq t \leq \frac{100}{6}$. The graph of the water evaporating is shown below to the left.



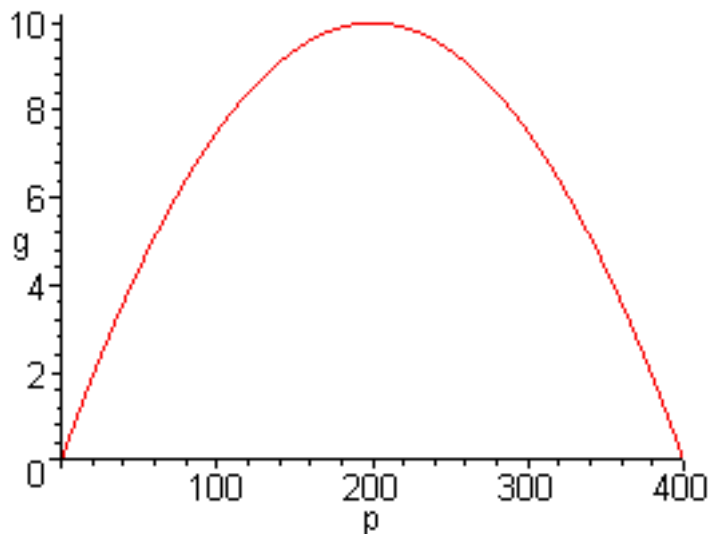
6. a. The sum of the squared error is given by $J = 2.5$. The graph of the model with the data points is above to the right. Over the given domain the model is reasonable. However, this model predicts that the plant will keep growing at a constant rate, which is not commonly observed.

b. The model predicts the height of the plant at 3 and 5 weeks to be $h(3) = 17$ cm and $h(5) = 21$ cm.

7. a. The equilibrium populations are $P_e = 0$ and 400.

b. The growth function $g(p)$ has maximum growth rate at the population $P = 200$ with $g(200) = 10$ individuals per generation.

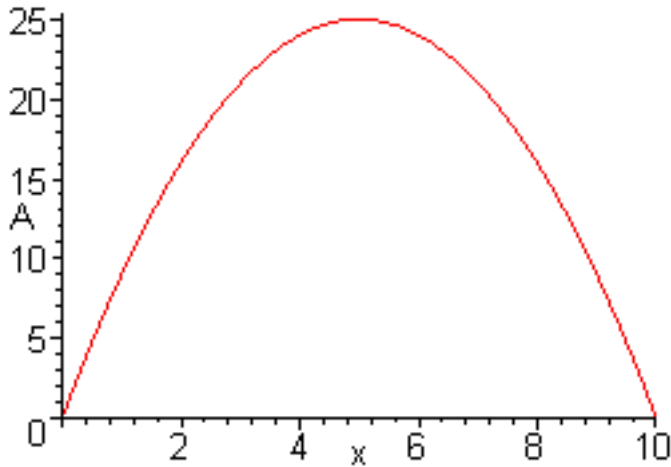
c. The graph $g(P) = 0.1P(1 - \frac{P}{400})$ is shown below.



8. a. A rectangle with length x , width y , and a perimeter of 20 cm, has its width satisfy $y = 10 - x$.

b. The area of a rectangle is $A(x) = x(10 - x) = 10x - x^2$. The domain is given by $0 \leq x \leq 10$.

c. $A(x)$ is a parabola, and its graph is shown below. The vertex occurs at $x = 5$ with $A(5) = 25 \text{ cm}^2$. Thus, the particular rectangle with the largest area is a square that measures 5 cm on a side.



9. a. For $y = x^3 - x^2 - 12x$

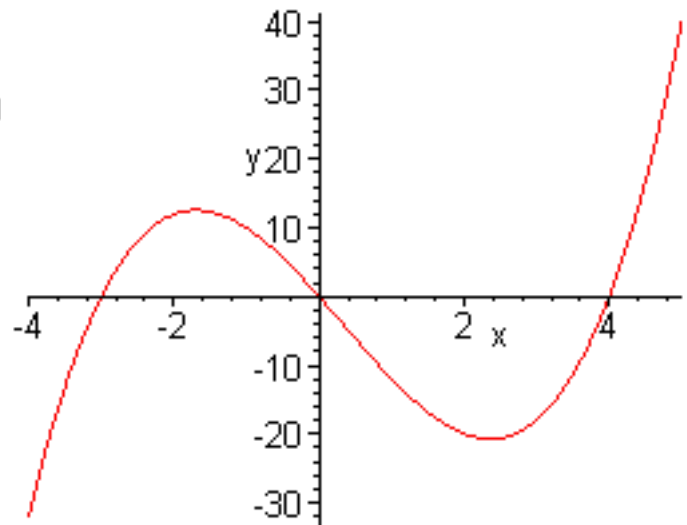
Domain: All x

x -intercept: $x = -3, 0, 4$

y -intercept: $y = 0$

Vertical asymptote: None

Horizontal asymptote: None



9. b. For $y = \frac{50}{25 - x^2}$

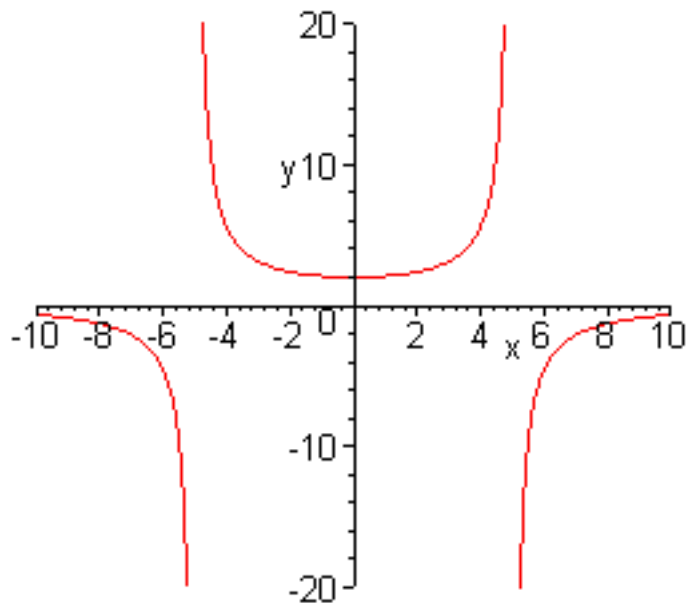
Domain: $x \neq \pm 5$

x -intercept: None

y -intercept: $y = 2$

Vertical asymptote: $x = \pm 5$

Horizontal asymptote: $y = 0$



9. c. For $y = \frac{6x}{x+2}$

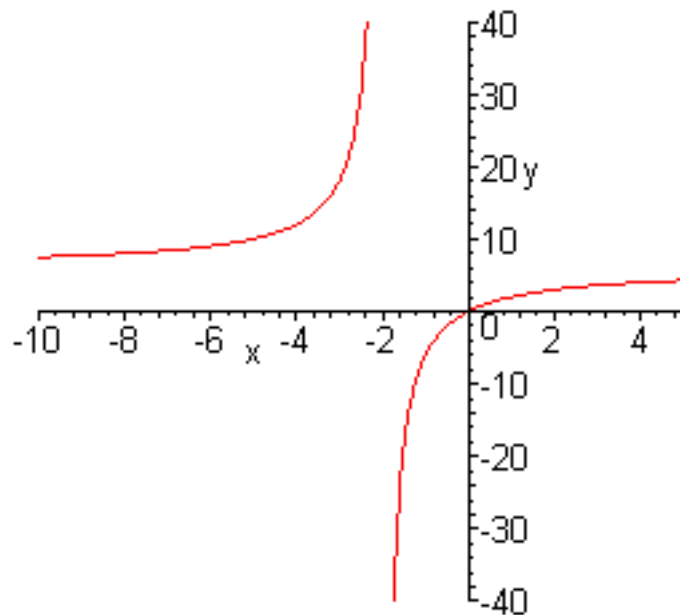
Domain: $x \neq -2$

x -intercept: $x = 0$

y -intercept: $y = 0$

Vertical asymptote: $x = -2$

Horizontal asymptote: $y = 6$



9. d. For $y = \sqrt{16 - 2x}$

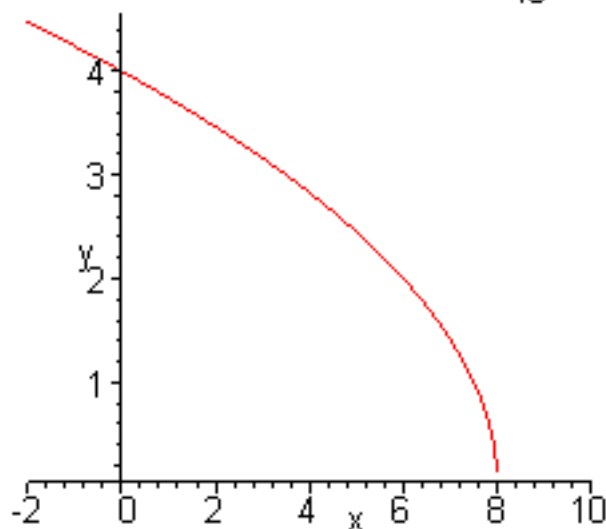
Domain: $x \leq 8$

x -intercept: $x = 8$

y -intercept: $y = 4$

Vertical asymptote: None

Horizontal asymptote: None



10. a. If $e^a = 2.2$ and $e^b = 0.7$, then

$$\frac{e^{a+b}}{(e^b + e^0)^2} = \frac{154}{289} \approx 0.5329.$$

10. b. If $e^a = 2.2$ and $e^b = 0.7$, then

$$\frac{(e^a)^2(e^0 - e^b)}{e^{2a+b}} = \frac{3}{7} \approx 0.429.$$

10. c. If $\ln(c) = 1.3$ and $\ln(d) = -0.5$, then

$$\frac{\ln(c^3) - \ln(c) + \ln(1)}{(\ln(c) + \ln(e))} = \frac{26}{23} \approx 1.13.$$

10. d. If $\ln(c) = 1.3$ and $\ln(d) = -0.5$, then

$$\frac{\ln(c^2d) - \ln(1)}{(\ln(c/d) - \ln(e))} = \frac{21}{8} \approx 2.625.$$

11. a. The linear model is given by $F = 0.4184W + 155.7$ with constants $m = 0.4184$ and $b = 155.7$.

b. The allometric model is given by $F = 3.329W^{0.7528}$ with constants $k = 3.329$ and $a = 0.7528$.

c. For a 1000 g chicken, the linear model says that the chicken consumes $F(1000) = 574.1$ g of feed per week. The allometric model says that this chicken consumes $F(1000) = 603.4$ g of feed per week.

If a chicken consumes 500 g of food, then the linear model suggests that the chicken weighs 822.9 g, while the allometric model suggests that the chicken weighs 779.0 g. The allometric model is superior as the linear model would suggest that a non-existent chicken ($W = 0$ g) would still eat 155.7 g of feed.

12. a. Sum of squares of the errors is $J = 207.9$. The beagle is furthest from the model.

b. The length of a Borzoi is predicted to be $L(81) = 148$ cm. The model suggests that the Border Collie will have a height of 44 cm.

c. The Border Collie is probably a better prediction because the data point lies within other data. If one were to use an allometric model, then the best power law model should be $L = a_1H$, since both length and height are one-dimensional (with L expanding directly in proportion to H).

13. a. The linear model is $T = 5v + 1.75$ with constants $m = 5$ and $b = 1.75$. A 2 mm tissue sample gives a voltage drop of $v = 0.05$ V. If the experiment reveals a 0.6 V drop, then the tissue thickness is $T(0.6) = 4.75$ mm.

b. The allometric model is $T = 5.913V^{0.4894}$ with constants $k = 5.913$ and $a = 0.4894$. If the thickness is 2 mm, then the voltage drop is $v = 0.1092$ V. If the voltage drop is 0.6 V, then the thickness of the unknown tissue is $T(0.6) = 4.605$ mm.

c. The allometric model is superior because the voltage drop goes to zero when the thickness goes to zero.

14. a. The sum of squares of error for the model $A = mc$ and data is given by $J(m) = 46m^2 - 49.6m + 13.38$. The m -value of the vertex is given by $m = 0.5391$, and the least sum of squares function satisfies $J(0.5391) = 0.011$.

b. Using the best slope in the model, $A = 0.5391c$ gives the concentration of the unknown urea sample as $c = 4.08$ mM.

15. a. The sum of squares error satisfies for the model $d = kp$ and the data is given by $J(k) = 57.21k^2 - 68.72k + 20.65$. The k -value of the vertex is given by $k = 0.6006$, and the least sum of squares function satisfies $J(0.6006) = 0.0136$.

b. Using the best slope in the model, $d = 0.6006p$, the leopard shark would measure $d = 1.32$ m. A 2 m shark would appear on the photograph as $p = 3.3$ cm.