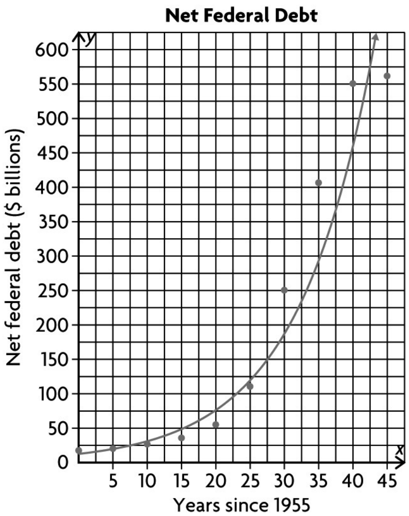
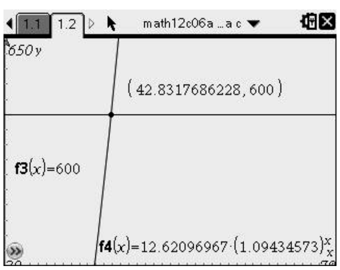
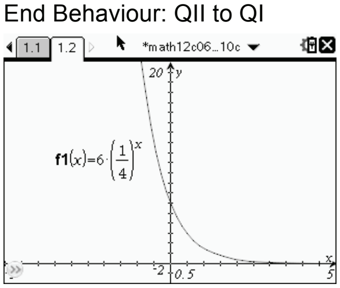
2. a) The exponential regression function is $y = 12.620…(1.094…)^x$, where y is the debt in billions of dollars and x is the number of years after 1955.



b) 1988 – 1955 = 33
$y = 12.620…(1.094…)^{33}$
$y = 12.620…(19.592…)$
$y = \$247.282…$ billion
The net federal debt was $247.28 billion.
c) Assuming the same growth rate and that these figures were taken at the end of the year, the net federal debt should have reached $600 billion in 1998.



3. Number of x-intercepts: 0
y-intercept: $y = 6$
Domain: $\{x \mid x \in R\}$
Range: $\{y \mid y > 0, y \in R\}$
End Behaviour: QII to QI



4. x-intercept: 1
y-intercept: none
End behaviour: QI to QIV
Domain: $\{x \mid x > 0, x \in R\}$
Range: $\{y \mid y \in R\}$
Function: decreasing

5. a) Let x represent the energy released. Let y represent the magnitude of the earthquake.
The regression equation is
$y = –1.199… + 0.289…\ln x$.
b) $x = 1.1 \cdot 10^{16}$
$y = –1.199… + 0.289…\ln x$
$y = –1.199… + 0.289…\ln (1.1 \cdot 10^{16})$
$y = 9.493…$
The Valdivia earthquake had a magnitude of about 9.5.

Chapter Review, page 504

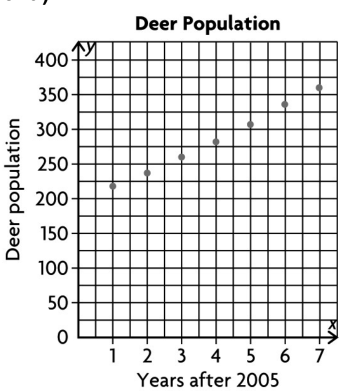
1. a) e.g., The end behaviours of exponential functions extend from QII to QI. Polynomials have varying end behaviours.
b) e.g., The domain is always $\{x \mid x \in R\}$, the range is always $\{y \mid y > 0, y \in R\}$, and they all extend from QII to QI. a is the y-intercept.

2. a) domain: $\{x \mid x \in R\}$; range: $\{y \mid y > 0, y \in R\}$
y-intercept: $y = 9$; end behaviour: QII to QI
This is a decreasing function.
b) To make the function into an increasing exponential function, the b should be changed so Its value is greater than 1.
3. a) i) number of x-intercepts: 0
ii) y-intercept: 125
iii) end behaviour: QII to QI
iv) domain: $\{x \mid x \in R\}$; range: $\{y \mid y > 0, y \in R\}$
v) The function decreases.
b) i) number of x-intercepts: 0
ii) y-intercept: 0.12
iii) end behaviour: QII to QI
iv) domain: $\{x \mid x \in R\}$; range: $\{y \mid y > 0, y \in R\}$
v) The function decreases.
c) i) number of x-intercepts: 0
ii) y-intercept: 1
iii) end behaviour: QII to QI
iv) domain: $\{x \mid x \in R\}$; range: $\{y \mid y > 0, y \in R\}$
v) The function increases.
d) i) number of x-intercepts: 0
ii) y-intercept: 0.85
iii) end behaviour: QII to QI
iv) domain: $\{x \mid x \in R\}$; range: $\{y \mid y > 0, y \in R\}$
v) The function increases.

4. To match the functions with the graphs, look at the y-intercepts of the functions and of the graphs. This is because each function and each graph has a unique y-intercept.
a) It is an increasing exponential function with y-intercept of 5, so it must match with i.
b) It is a decreasing exponential function with y-intercept of 2 so it must match with ii.

5. a) Let *x* be the number of months since April 1, 1896.
Let *y* be the population of Dawson City.
a = 1000
b = 3
Tripling time: 3 months
An exponential equation that models the population growth is $y = 1000(3)^x$, where *y* is the population and *x* is the number of quarters after April 1, 1896.
b) Domain: $\{x \mid 0 \le x \le 3, x \in \mathbb{N}\}$ (quarters)
Range: $\{y \mid 1000 \le y \le 27\ 000, y \in \mathbb{N}\}$ (population)
c) The population of Dawson City in mid-May of 1896 was 1732, and the population of Dawson City in mid-August of 1896 was 5196. To determine the answer for mid-May, I substituted in 1.5 for *x* for my equation. To determine the answer for mid-August, I substituted in 4.5 for *x* for my equation. These two points are midpoints of the first two quarters, and so correspond to x = 0.5 and *x* = 1.5.

6. a)



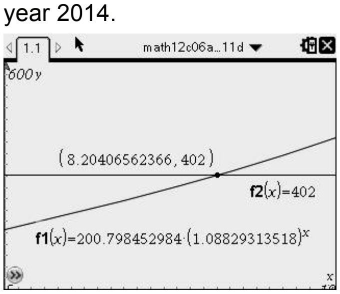
b) Using the graphing calculator, the exponential regression function is $y = 200.798\ldots(1.088\ldots)^x$.

c) $y = 400.798...(1.088...)^{10}$

$y = 400.798...(2.330...)$

$y = 467.971...$

The deer population 10 years after 2005 will be 468.
d) 200.798…(2) = 402 (rounded)
Assuming the deer population numbers were recorded at the beginning of the year, I would expect the deer population to have doubled in the year 2014.



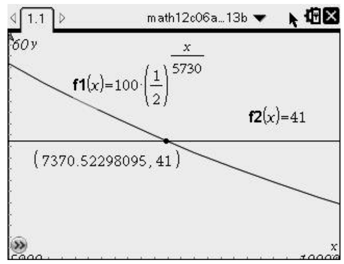
7. a) $A(8000) = 100\left(\frac{1}{2}\right)^{\frac{8000}{5730}}$

$A(8000) = 100\left(\frac{1}{2}\right)^{1.396...}$

$A(8000) = 100(0.379...)$

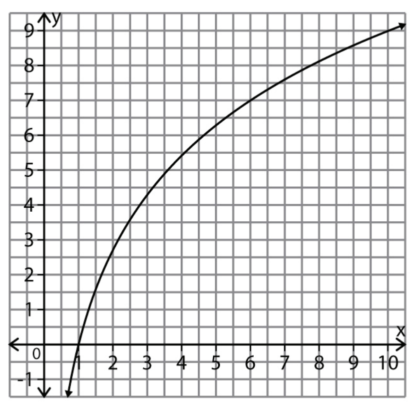
$A(8000) = 39.993...\%$

38% of the initial carbon-14 would be present in the tools.
b) The age of the tools were 7400 years old.

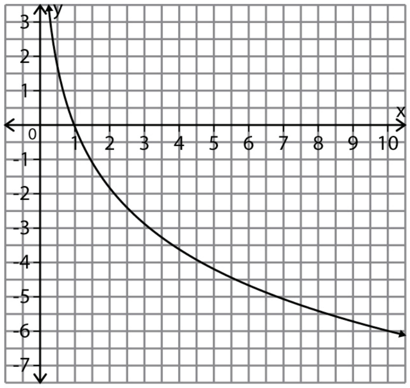


8. *x*-intercept: 1
Number of *y*-intercepts: none
End Behaviour: QIV to QI
Domain: $\{x \mid x > 0, x \in \mathbb{R}\}$
Range: $\{y \mid y \in \mathbb{R}\}$

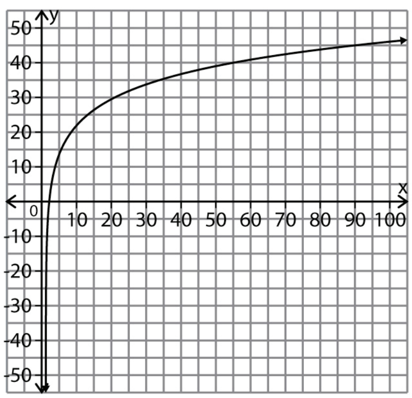
9. a) *x*-intercept: 1
Number of *y*-intercepts: none
End Behaviour: QIV to QI
Domain: $\{x \mid x > 0, x \in \mathbb{R}\}$
Range: $\{y \mid y \in \mathbb{R}\}$



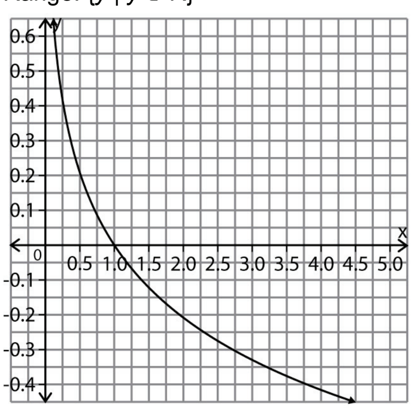
b) *x*-intercept: 1
Number of *y*-intercepts: none
End Behaviour: QI to QIV
Domain: $\{x \mid x > 0, x \in \mathbb{R}\}$
Range: $\{y \mid y \in \mathbb{R}\}$



c) *x*-intercept: 1
Number of *y*-intercepts: none
End Behaviour: QIV to QI
Domain: $\{x \mid x > 0, x \in R\}$
Range: $\{y \mid y \in R\}$



d) *x*-intercept: 1
Number of *y*-intercepts: none
End Behaviour: QI to QIV
Domain: $\{x \mid x > 0, x \in R\}$
Range: $\{y \mid y \in R\}$



10. i) d, e.g., *x*-intercept of 1, no *y*-intercept, QI to QIV. Thus, the function is logarithmic so a and d are the only possible choices. The function has a negative leading coefficient, which means that the function is a decreasing function and therefore the correct choice is d.

ii) b, e.g., no *x*-intercept, *y*-intercept of 1, increasing. Thus. the function is exponential so b and c are the only possible choices. Since $b > 1$, the function is increasing and therefore the correct choice is b.
iii) a, e.g., *x*-intercept of 1, no *y*-intercept, QIV to QI. Thus, the function is logarithmic so a and d are the only possible choices. The function has a positive leading coefficient which means that the function is an increasing function and therefore the correct choice is a.
iv) c, e.g., no *x*-intercept, *y*-intercept of 6, decreasing. Thus, the function is exponential so b and c are the only possible choices. Since $b < 1$, the function is decreasing and therefore the correct choice is c.

11. The logarithmic regression equation of this data is $y = 151.211\ldots - 32.836\ldots(\ln x)$.

$$\begin{aligned} y &= 151.211\ldots - 32.836\ldots(\ln x) \\ 200 &= 151.211\ldots - 32.836\ldots(\ln x) \\ 48.788\ldots &= -32.836\ldots(\ln x) \\ -1.485\ldots &= \ln x \\ x &= e^{-1.485\ldots} \\ x &= 0.226\ldots \end{aligned}$$

Therefore about 0.23% of the sunlight penetrates water to a depth of 200 m.

Chapter Task, page 507

A. I found that the amount of caffeine in one espresso is about 100 mg. So, a triple espresso will have 300 mg of caffeine.

B. I should use time as the independent variable because it is the change in time that causes the change in the amount of caffeine.
If time is the independent variable, then the function is an exponential function.

C. I chose to use 6 h as my estimate because that is the maximum possible time to reduce the amount of caffeine to a half.

Time (h)	Caffeine (mg)
0	300
6	150
12	75
18	37.5

D. Using a graphing calculator, the exponential regression function for the data is $y = 300(0.890\ldots)^x$.