1. $f(x)$ is the age of Antarctic ice (in hundreds of years) at a depth of $x$ meters below the surface.
   (a) In words, what is the practical meaning of $f(10)$?
   $f(10)$ is the age of the ice, 10 meters below the surface.
   (b) Is $f$ increasing or decreasing, and why?
   You would expect $f$ to be increasing, because the deeper you go, the older the ice.

2. From the following table

**Table 1.1.1**

| $x$ | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| $f(x)$ | 2 | 3 | 7 | 6 | 4 | 2 |

   (a) Find $f(3)$. $f(3) = 7$
   (b) Find the value(s) of $x$ that give $f(x) = 2$. $f(x) = 2$ when $x = 1$ or when $x = 6$

3. An object is put outside on a cold day and its temperature, $H$, in degrees Celsius, is a function of the time, $t$, in minutes since it was put outside.
   (a) What does the statement $H(30) = 10$ mean? Use words and remember to include units in your answer.
   30 minutes after the object is put outside, its temperature is 10 degrees Celsius

   (b) The graph of $H$ versus $t$ is shown below. Explain in terms of temperature of the object and the time outside, what each of the following mean.

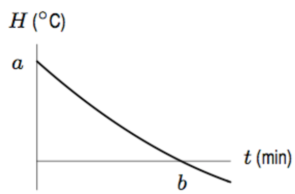



**Figure 1.1.3**

   *i.* vertical intercept $a$
   The vertical intercept $a$ is the temperature when the object is first placed outside.
   *ii.* horizontal intercept $b$
   The horizontal intercept $b$ is the time it takes for the object to reach 0 degrees Celsius.

4. Suppose $g(x)$ is an exponential function. Complete the table of values for the function $g$ below.

| $x$ | 0 | 5 | 10 | 15 | 20 |
|---|---|---|---|---|---|
| $g(x)$ | 10 | 20 | ? | ? | ? |

Now find a formula for $g(x)$. Various equations (all equivalent) are possible - One simple one is $g(x) = 10(2)^{x/5}$

5. Values for $g(x)$ are given in the table below. Is $g(x)$ concave up, concave down, or neither?

**Table 1.3.9**

| $x$ | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| $g(x)$ | 100 | 90 | 81 | 73 | 66 | 60 |

6. Sketch a graph of a function that is decreasing at an increasing rate.
[I've decided this is an ambiguous question. Instead:]
Sketch a function that is increasing at an increasing rate: It's concave up:

7. A population is growing according to the function $P = 250(1.065)^t$, where $P$ is the population at time $t$.
   (a) What is the initial population? 250
   (b) What is the annual growth rate? 6.5%
   (c) What is the population in year 10? Compute $250(1.065)^{10}$
   (d) How many years will it take for the population to reach 1000? Solve for $t$. $1000=250(1.065)^t$. So $4= (1.065)^t$. Take natural log of both sides: $\ln(4)=t \ln(1.065)$. Therefore $t = \ln(4)/\ln(1.065)$. So about 22 years.

8. An exponentially decaying substance was weighed every hour and the results are given below. If the formula $Q = Q_0 e^{-kt}$ gives the weight of the substance, $Q$, at time $t$ in hours since 9 am, then $Q_0$ =_____14__________ and $k$ =______0.11_________. Round $k$ to 2 decimal points.

| Time | Weight (in grams) |
|---|---|
| 9 am | 14 |
| 10 am | 12.542 |
| 11 am | 11.235 |
| 12 noon | 10.065 |
| 1 pm | 9.017 |

9. A bakery has 200 lbs of flour. If they use 5% of the available flour each day, how much do they have after 10 days? How much do they have left after $n$ days?
After 10 days they have about 119.7 lbs
The formula is $A = 200*(0.95)^n$ where $A$ is the amount of flour after $n$ days.

10. If $8 \cdot (2.5^x) = a \cdot e^{kx}$ find $a$ and $k$.
$a = 8$ and $e^k = 2.5$ so $k = \ln(2.5)=0.916$

11. If the size of a bacteria colony doubles in 8 hours, how long will it take for the number of bacteria to be 5 times the original amount?
If the size doubles in 8 hours, we can write this as $N = N_0\,(2)^{t/8}$. Solve $5\,N_0 = N_0\,(2)^{t/8}$.
Or ln(5)=$t$/8*ln(2). So $t$ = 8*ln(5)/ln(2) = 18.57 hours - so a little over 18 and a half hours.

12. A cigarette contains about 0.4 mg of nicotine. The half-life of nicotine in the body is about 2 hours. How long does it take after smoking a cigarette, for the level of nicotine in a smoker's body to be reduced to 0.08 mg?
If the half life is 2 hours we can write this as $A = 0.4\,(1/2)^{t/2}$. Solve $0.08 = 0.4\,(0.5)^{t/2}$.
Or ln(0.08/0.4)=$t$/2*ln(0.5). So $t$ = 2*ln(0.08/0.4)/ln(0.5) = 4.64 hours - so about 4 hours and 40 minutes.

13. Use the table below.

**Table 1.8.19**

| $x$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $f(x)$ | 2 | 4 | 6 | 3 | 5 |
| $g(x)$ | 5 | 3 | 2 | 1 | 0 |

Find $f(g(1))$ = 3 $g(f(1))$ = 0 $f(g(3))$ = 4 $g(f(3))$ = 1

14. The graph of $y = f(x)$ is shown below.

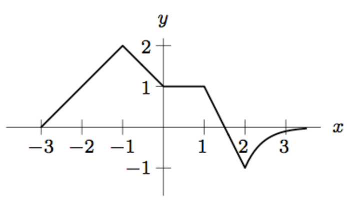
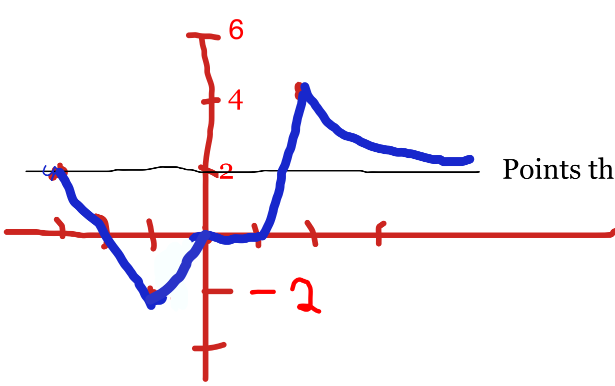



**Figure 1.8.23**

Sketch the graph of $y = 2 - 2f(x)$. Stretch by 2 vertically, flip it over the horizontal axis, Shift up by 2




Points that were at y=0 are now at y=2

15. The number of species $S$ on an island is proportional to the square root of the area $A$ of the island. An island with an area of 4 square miles contains 20 species.

(a) Find a formula for $S$ as a function of $A$.
$S = k$*sqrt($A$). Since we know that when $A = 4$ that $S = 20$, we can solve for $k$. Set up 20=$k$*sqrt(4). So 20=2$k$, $k = 10$. So our equation is $S = 10$*sqrt($A$)

(b) If an island is 9 square miles in area, determine the number of species expected on the island.
Compute $S = 10$*sqrt(9) = 10*3=30

16. Consider the function given in the table below.

**Table 1.10.22**

| $x$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| $f(x)$ | -2 | 0 | -2 | -4 | -2 | 0 | -2 | -4 | -2 |

(a) Explain why the function represented in the following table appears to be periodic.

The numbers in the *f(x)* column start to repeat.

(b) Approximate the period and the amplitude of the function.
period 4, amplitude 2

(c) Assuming the function is periodic, estimate $f(10)$ and $f(15)$.
So $f$ (10) would be the same as $f$ (6) and $f$ (15) would be the same as $f$ (11) which is the same as $f$ (7).

17. Find an equation which defines the function shown below. Period 8π and amplitude is 2. The midline of the function is at $y$=2. The equation would be
$y$ = 2*sin[(2π/8π )$x$)]+2    =2*sin[ (1/4)*x] + 2

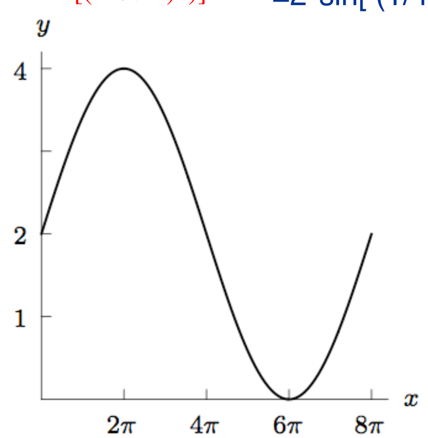



**Figure 1.10.31**