9: Exponential Functions -- Answers

1. \$33,554,432
2. The both have constant *rates.* Linear functions have a constant *rate of change* (the same number is added to outputs of successive inputs). Exponential functions have a constant *growth factor* (the same number is multiplied by outputs of successive inputs).
3.
   a) $a = 5$, $b = 1$
   b) $a = ½$, $b = 3$
   c) $a = 3$, $b = 2$
   d) $a = 6$, $b = 1$
4. If the population is decaying, $0 < a < 1$.
5.
   a) His 20th.
   b) \$134,217,728
6. Since $f(x) = a^x$ is increasing on the whole domain, $a > 1$.
7. $f(x) = 1.5(4)^x$
8. Since (0,1) is the y-intercept, $b = 1$.
9.
   a) Yes; this equation is equivalent to $y = ½\,(4^x)$.
   b) Yes; $f(x + 1) / f(x) = ½$ for any value in the table. Thus this data fits the equation $y = ½^{\,x}$.
   c) No, the constant rate of change tells us that this is a linear function, $f(x) = 0.10x$.
10.
    a) Since the price is decreasing, $a < 1$. In other words, the output is decaying.
    b) Answers will vary depending how this equation is found. Using the price in 1998 for the y-intercept and the averages of $f(x + 1) / f(x)$, we get $p(t) = 600\,(0.74^t)$. Using exponential regression we get $p(t) = 570.7\,(0.733^t$
    c) Using our first equation from part (b) we get $p(2) = \$329$, which is a \$34 difference from the actual price in the table –so, a fairly good match.
    d) Using our first equation from part (b) we get $p(22) = \$0.80$ – way too low! This function models the price only for a limited domain.
11. \$20,701
12.
    a) 5/64
    b) 1.25
    c) 5
    d) 327,680
13.
    a) Yes; $f(x) = 9(3^x)$
    b) Yes; $f(x) = \sqrt{2}^x$
    c) No; $f(0) = 0$
    d) Yes; $f(x) = 1.8^x$
    e) Yes; $f(x) = 3(2^x)$
14.

a) linear
b) exponential

15. Increase of 7.9% per year is a constant growth rate (the growth factor is 1.079), not a constant rate of change.
16.
   a) They assume a constant growth factor.
   b) $f(x) = 48(1.257^x)$
   c) 143,871 people
   d) No; this represents less than 0.04% of the population.
17.
   a) $f(x) = 10^x$
   b) $f(x) = 2(5^x)$
18.
   a) 2
   b) 4
19.
   a) $f(x) = 2(9^x) + 1$
   b) $f(x) = 2^x - 1$
   c) $f(x) = 3(0.25^x) + 2$

20.
   a) $g(x) = 64^x$
   b) $g(x) = \frac{2}{3}(\frac{1}{3}^x)$
   c) $g(x) = 20(3^x)$
21.
   a) $p(t) = 1{,}200{,}000(0.93^t)$
   b) Every year the population is 93% of the previous year. (Or the population decreases by 7% each year.)
   c) 281,087; this number is 148,913 *less* than that when we used 0.95 as the decay rate.
22. $S(t) = 33{,}500(1.023^t)$
23. $214.03
24.
   a) $4.07
   b) $1.23