

4-2 Solution Set

5. a. The graph of $f(x) = 2^{x+3}$ is obtained by shifting the graph of $h(x) = 2^x$ by 3 units to the left.

b. $f(x) = 2^{x+3} = 2^x \cdot 2^3 = 2^x \cdot 8 = 8 \cdot 2^x = g(x)$

7. $k = -1.4$

9. $k = -0.7$

11. $k = 1.1$

13. $f(x) = 100e^{-1.4x}$

15. $f(x) = 168e^{-0.7x}$

17. $f(x) = 0.53e^{1.1x}$

19. The graph of h is reflected in the y -axis.

21. The graph of h is translated 2 units to the left.

23. The graph of h is stretched vertically by a factor of 2.

25. The graph of h is reflected in the x -axis and translated 1 unit upwards.

27. The graph of h is translated 1 unit to the right.

29. The graph of h is shrunk but the point of origin is the same as e^x .

31. The graph of h is translated one unit to the right with $x \neq 1$.

33. The graph of h is reflected around $x = 3$ with 2 asymptotes.

35. a. When $t = 3$; $P(3) = \frac{1}{2}$. ie, every 3 minutes, the quantity left is $\frac{1}{2}$ its original amount.

b. $P(t) = \left(\left(\frac{1}{2} \right)^{\frac{1}{3}} \right)^t = 0.7937^t$

c. Decay rate 20.63%

d. $P(10) = 0.7937^{10} = 0.0992$ ie there is 9.92% left

$P(15) = 0.7937^{15} = 0.03124$ ie there is 3.124% left

37. a. $15 = 50(1 - e^{10k})$

$\Rightarrow k = -0.03567$

b. $50(1 - e^{-0.03567t}) = 40$

$\Rightarrow t = 45.12$

After 46 days, the workers will produce 40 units.

39. a. Probability $= e^{-\frac{x}{100}} \cdot e^{-\frac{x}{500}}$
 $= e^{-\left(\frac{x}{100} + \frac{x}{500}\right)}$

$$= e^{-\frac{3}{250}x}$$

b. Probability = $e^{-\frac{x}{100}} + e^{-\frac{x}{500}}$

41. Probability = $(0.99)^{70} = 0.495$ of all 70 parts operating properly

43. a. $y = 10e^{kt}$

$$\Rightarrow 5 = 10e^{-k(140)}$$

$$\Rightarrow \frac{1}{2} = e^{-140k}$$

$$\Rightarrow \ln(0.5) = -140k$$

$$\Rightarrow k = 0.00495$$

Therefore, $\varphi(t) = 10e^{-0.00495t}$

b. $\varphi(30) = 10e^{-0.00495 \cdot 30} = 8.62$ grams

c. $\varphi(365) = 10e^{-0.00495 \cdot 365} = 1.64$ grams

45. a. $k = -4.279 \times 10^{-4}$

b. $\frac{f(500)}{f(0)} = e^{-4.279 \times 10^{-4} \times 500} = 0.807$

$$\Rightarrow 81\% \text{ is left } (0.807 \approx 0.81)$$

$$\frac{f(5000)}{f(0)} = e^{-4.279 \times 10^{-4} \times 5000} = 0.118$$

$$\Rightarrow 11.8\% \text{ is left}$$

47. Linear although exponential is a better fit but you have to keep many decimal places.

$$B(h) = 211.47(0.99)^h \text{ or } B(h) = -0.001525h + 210.885$$

49. a. $\varphi(t) = \varphi_0 \left(\frac{1}{2}\right)^{\frac{t}{2500}}$

$$\Rightarrow 0.2 = 1 \left(\frac{1}{2}\right)^{\frac{t}{25000}}$$

$$\Rightarrow t = 58048.2 \text{ years}$$

b. $1 \times 10^{-6} = 1 \left(\frac{1}{2}\right)^{\frac{t}{25000}}$

$$\Rightarrow t = 498298.2 \text{ years}$$

51. a. At 1 meter: 24.65%

At 5 meters: 0.091%

At 10 meters: 0.000083%

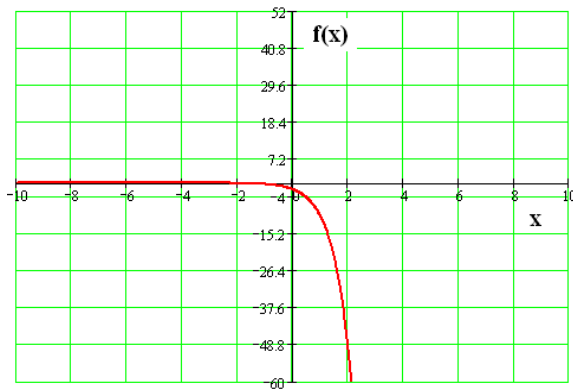
b. 22.3%

53. $y = 3 \cdot 2^x$. The graph of 2^x stretches vertically by a factor of 3.

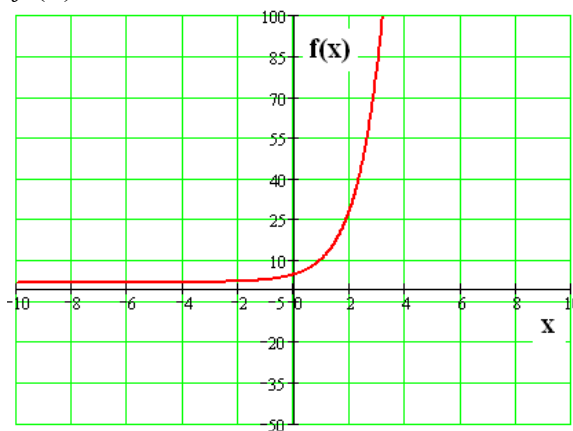
55. $y = 2^{(-x+1)} - 4 = 2^{-(x-1)} - 4$. The graph of 2^x reflects in the y axis and translates 1 unit to the right and 4 units down.

57. $y = \frac{1}{2}(2)^{-x} = 2^{-(x+1)}$. The graph of 2^x is reflected in the y axis and translated 1 unit to the left.

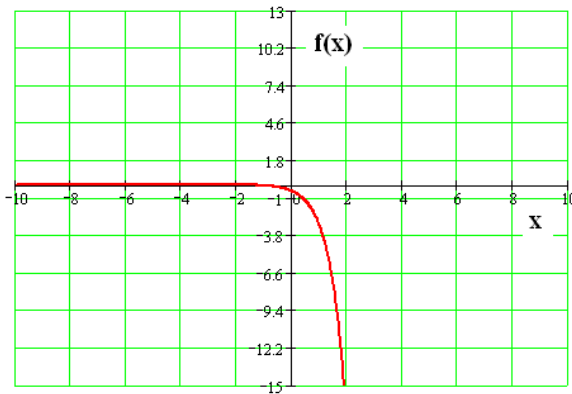
59. $f(x) = -2 \cdot 5^x$



61. $f(x) = 3^{x+1} + 2$



63. $f(x) = -\frac{1}{2}(6^x)$



65. i. f
 ii. a
 iii. d
 iv. c
 v. b
 vi. e

67. (Answers may Vary) $f(x) = e^x + 3$

69. For large x , the graph of $f(x) = x^2 \cdot 2^{-x}$ like 2^{-x} .

71. $L = 4, x = 2, t = 1$

$$P(2) = (4 \cdot 1)^2 e^{-\frac{4 \cdot 1}{2!}}$$

$$= 16e^{-2}$$