

1. a.  $a_1 = 3,$   
 $a_n = 4(a_{n-1})$       b.  $a_n = 3(4^{n-1})$       c. 805306368

d. 1073741823

2. a.  $a_1 = 1$   
 $a_n = a_{n-1} + 3$       b.  $a_n = 1 + 3(n-1) = 3n - 2$       c. 178

d. 5370

3. 4624.577 cm<sup>3</sup>

4. 2805 seats

5. a.  $17^{\frac{1}{3}}$       b.  $x^{\frac{3}{4}}$

6. a.  $\sqrt[3]{(-7)^4}$  or  $(\sqrt[3]{-7})^4$       b.  $\sqrt[5]{x^2}$  or  $(\sqrt[5]{x})^2$

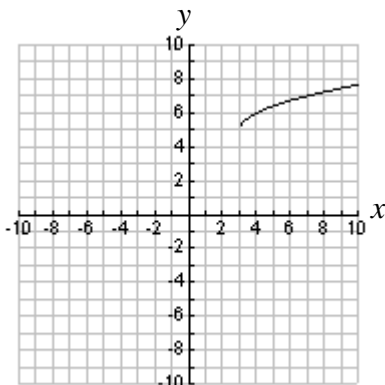
7. a. 81      b.  $\frac{1}{9}$       c.  $\frac{7}{3}$       d.  $2^7 = 128$

8. a.  $a^4b^9$       b.  $\frac{24}{x^{\frac{5}{6}}}$       c.  $\frac{1}{x^{\frac{1}{15}}}$       d.  $\frac{ab^3}{c^{\frac{5}{2}}}$

e.  $x^{\frac{3}{2}}$       f.  $3x$       g.  $2x^6$       h.  $\frac{1}{x^{12}}$

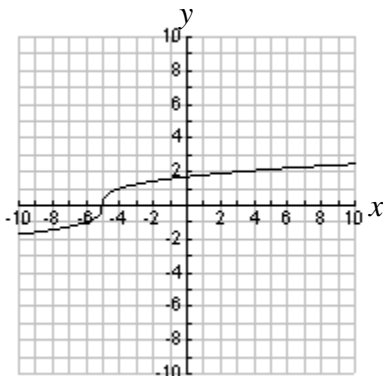
i.  $\frac{1}{2a}$

9. a.  $y = \sqrt{x-3} + 5$



D: all real numbers greater than or equal to 3  
R: all real numbers greater than or equal to 5

b.  $y = \sqrt[3]{x+5}$



D: all real numbers  
R: all real numbers

10. a. Reflect the graph of  $f$  about the  $x$ -axis, then translate 5 units to the right.  
 b. Translate the graph of  $f$  8 units to the left and down 2 units.  
 c. Reflect the graph of  $f$  about the  $y$ -axis, translate two units to the right and up 7 units OR translate two units to the left, translate 7 units up, and reflect over the  $y$ -axis

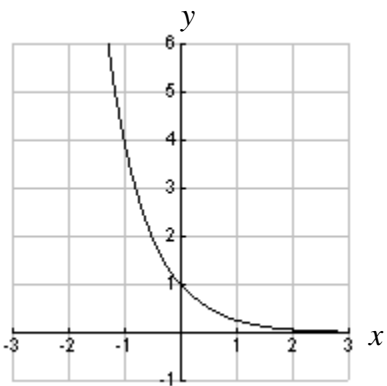
11. 9.2 seconds

12. 88.889 feet

13. a.  $x = 16$                       b.  $x = 32$                       c.  $\emptyset$ , or no solution  
 d.  $x = -198$                       e.  $x = 16$

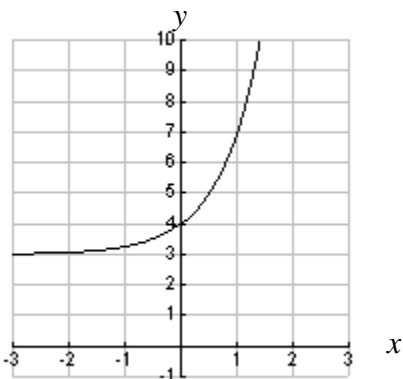
14. a. iii      b. v      c. i      d. iv      e. ii

15. a.  $y = 4^{-x}$



y-intercept: (0, 1)  
 asymptote:  $y = 0$   
 D: all real numbers  
 R: all real numbers greater than 0  
 Function is decreasing

b.  $y = 4^x + 3$



y-intercept: (0, 4)

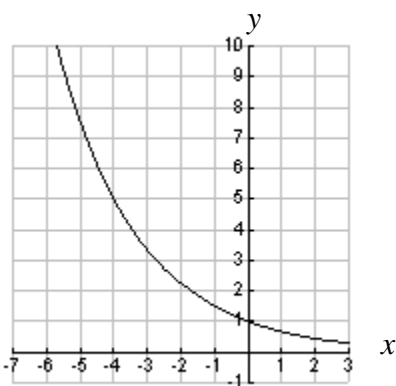
asymptote:  $y = 3$ 

D: all real numbers

R: all real numbers greater than 3

Function is increasing

c.  $y = \left(\frac{2}{3}\right)^x$



y- intercept: (0, 1)

asymptote:  $y = 0$ 

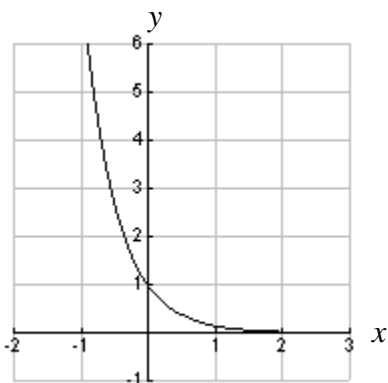
D: all real numbers

R: all real numbers greater than 0

Function is decreasing

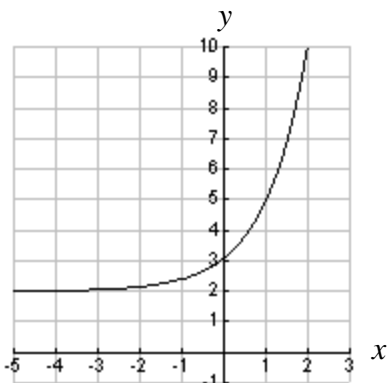
16. a. In 1920, the population was approximately 8193.  
b. In 1950, the population was approximately 17185.
17. There will be \$7325.98 in the account after 5 years.
18. a. After 5 years the car will be worth \$17797.85.  
b. In  $t$  years, it will be worth  $75000(0.75)^t$ .
19. a.  $P = 250000(0.95)^n$ , where  $P$  is the population and  $n$  is the number of years.  
b. In 10 years the population is about 149684.
20. There will be \$1558.93 in the account after 6 years.

21. a.  $y = e^{-2x}$



y-intercept: (0, 1)  
 asymptote:  $y = 0$   
 D: all real numbers  
 R: all real numbers greater than 0  
 Function is decreasing

b.  $y = 3e^{x-1} + 2$



y-intercept: (0, 3.104)  
 asymptote:  $y = 2$   
 D: all real numbers  
 R: all real numbers greater than 2  
 Function is increasing

22. At 5:00 PM there will be approximately 67,225 bacteria present.  
 In 6.931 hours there will be over 120,000 bacteria present.

23. 0.125 or approximately 12.5% per year

24. a.  $10^{-4} = \frac{1}{10000}$     b.  $6^x = 216$     c.  $10^x = 5$     d.  $e^m = 7$

25. a.  $\log_{32} 16 = \frac{4}{5}$     b.  $\ln 2 = 3x$     c.  $\log 100000 = 5$

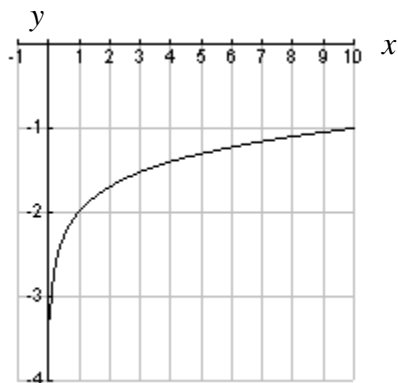
26. a. 4    b. 0    c. 2    d.  $\frac{3}{2}$     e.  $\frac{4}{3}$

27. a.  $x$     b.  $x$     c.  $x$     d.  $x$     e.  $3x$     f.  $4x$

28. The functions  $y = 7^x$  and  $y = \log_7 x$  are inverses of each other.

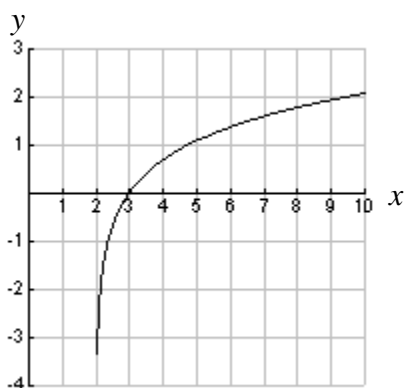
The graph shows this since the graphs of the two functions are reflections of each other through the line  $y = x$ .

29. a.  $y = \log_{10}x - 2$



Vertical asymptote:  $x = 0$   
 D: all real numbers greater than 0  
 R: all real numbers  
 Function is increasing

b.  $y = \ln(x - 2)$



Vertical asymptote:  $x = 2$   
 D: all real numbers greater than 2  
 R: all real numbers  
 Function is increasing

30. a.  $x = 2.5$                       b.  $x = 12$                       c.  $x = \log 40 \approx 1.602$   
 d.  $x = \ln 9 \approx 2.197$               e.  $x = 2$                       f.  $x = e^3 \approx 20.086$   
 g.  $x = 3$                               h.  $x = 32$                       i.  $x = 8$                       j.  $x = 7$   
 k.  $x = \frac{\log(21) + 3}{2} \approx 2.161$               l.  $x = 6$   
 m.  $x = -\frac{9}{4}$                       n.  $x = e^5 - 4 \approx 144.413$
31. a.  $y = 5(3)^x$                       b.  $y = 4(5)^x$
32. i. Exponential,  $y = 4^x$               ii. Linear,  $y = 10 + 5x$   
 iii. Logarithmic,  $y = \log_2 x$               iv. Quadratic,  $y = x^2$   
 v. Exponential,  $y = 400\left(\frac{1}{2}\right)^x$               vi. Radical,  $y = \sqrt{x}$
33. a. Exponential,  $y = 50(3)^x$   
 b. 984150 bacteria present after 9 hours

34. a. ii b. iv c. iii d. i
35. a. iv b. iii c. v d. ii e. i

36. a.  $s = kr$  b.  $y = \frac{k}{x}$  c.  $t = \frac{kr}{s}$
- d.  $V = krh$  e.  $F = \frac{kmn}{v^2}$

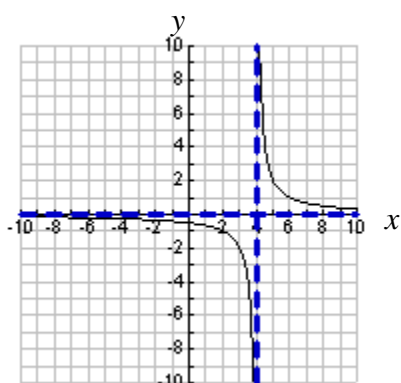
37.  $x = \frac{5}{4}$

38. a.  $t = \frac{k}{r}$ , b.  $k = 13800$  so  $t = \frac{13800}{r}$
- c. It will take 46 minutes with the faster pump.

39.  $y = 16.2$

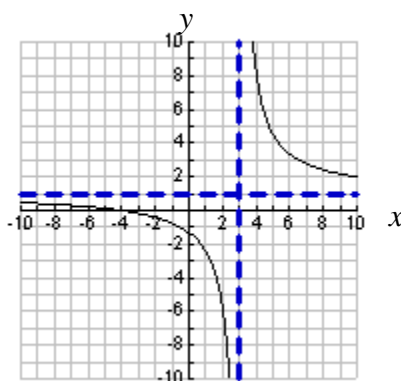
40. a.  $I = \frac{k}{d^2}$ ,  $k = 575$  so  $I = \frac{575}{d^2}$
- b. The intensity will be approximately 13.610 lux.

41. a.  $y = \frac{2}{x-4}$



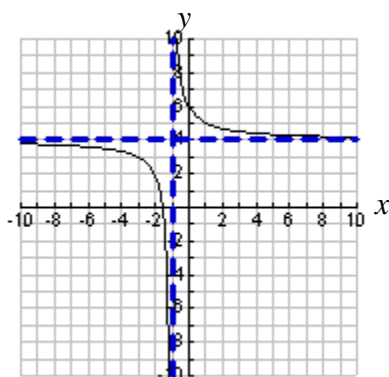
Horizontal asymptote:  $y = 0$   
 Vertical asymptote:  $x = 4$   
 D: all real numbers except 4  
 R: all real numbers except 0

b.  $y = \frac{x+4}{x-3}$



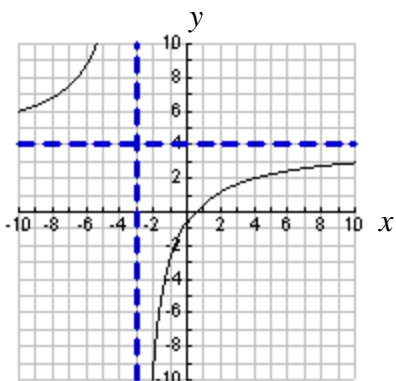
Horizontal asymptote:  $y = 1$   
 Vertical asymptote:  $x = 3$   
 D: all real numbers except 3  
 R: all real numbers except 1

c.  $y = \frac{2}{x+1} + 4$



Horizontal asymptote:  $y = 4$   
 Vertical asymptote  $x = -1$   
 D: all real numbers except  $-1$   
 R: all real numbers except  $4$

d.  $y = \frac{4x-2}{x+3}$



Horizontal asymptote:  $y = 4$   
 Vertical asymptote:  $x = -3$   
 D: all real numbers except  $-3$   
 R: all real numbers except  $4$

42. a.  $x+5$       b.  $\frac{1}{2(x+3)}$       c.  $3$

43. a.  $\frac{x^2+9x+25}{(x+5)(x+4)}$  or  $\frac{x^2+9x+25}{x^2+9x+20}$       b.  $\frac{-14x}{(2x+1)(x-3)}$  or  $\frac{-14x}{2x^2-5x-3}$

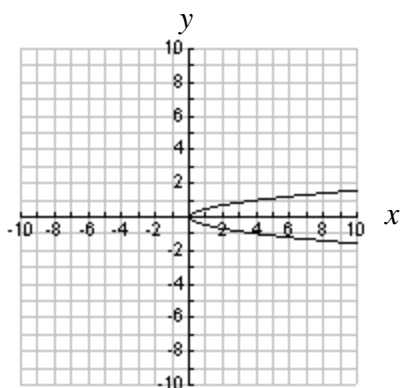
c.  $\frac{x^2-12x}{15x+3}$       d.  $\frac{7x+13}{(x+2)^2}$  or  $\frac{7x+13}{(x+2)(x+2)}$       e.  $\frac{7x^2-2x-104}{17x-12}$

44. a.  $x = \frac{5}{3}$       b.  $x = 7$  or  $x = -5$       c.  $x = -1$

45. a. iii      b. i      c. iv      d. ii

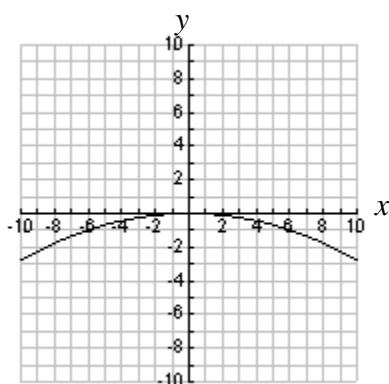
46. a. ellipse      b. hyperbola      c. circle      d. parabola

47. a.  $4y^2 = x$



Focus:  $(1/16, 0)$   
 Directrix:  $x = -1/16$

b.  $x^2 + 36y = 0$

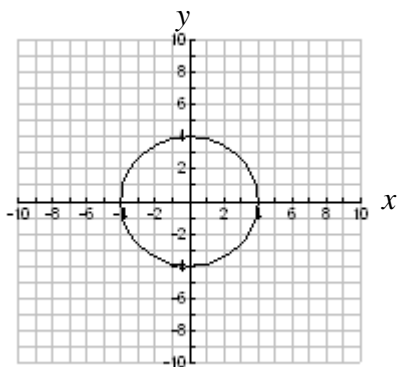


Focus:  $(0, -9)$   
 Directrix:  $y = 9$

48.  $x^2 + y^2 = 25$



49.

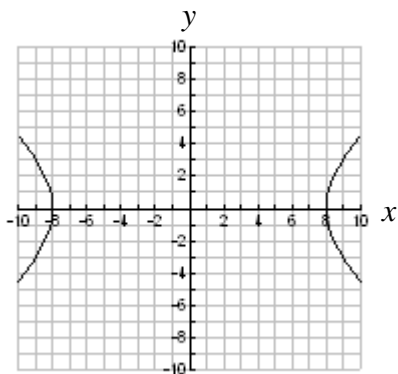


Center: (0, 0)  
 $r = 4$

50.  $\frac{x^2}{64} + \frac{y^2}{100} = 1$

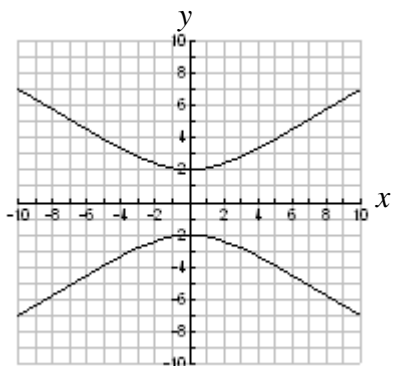
51. An ellipse with horizontal transverse axis, vertices at (6, 0) and (-6, 0), co-vertices at (0, 4) and (0, -4)

52. a.



Center: (0, 0)  
 Vertices: (-8, 0) and (8, 0)

52. b.



Center: (0, 0)  
 Vertices: (0, 2) and (0, -2)

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

54. a. Parabola, focus  $\left(\frac{1}{8}, 0\right)$ , directrix  $x = -\frac{1}{8}$ ,  $y = 0$ , opens to the right  
 b. Hyperbola, vertices  $(-5, 0)$  and  $(5, 0)$ , foci  $(\pm\sqrt{89}, 0)$  or  $(\pm 9.434, 0)$   
 c. Circle, center  $(0, 0)$ , radius = 7  
 d. Ellipse, vertices  $(-11, 0)$  and  $(11, 0)$ , co-vertices  $(0, -7)$  and  $(0, 7)$ , and foci  $(-\sqrt{72}, 0)$  and  $(\sqrt{72}, 0)$ , or  $(\pm 6\sqrt{2}, 0)$ , or  $(\pm 8.485, 0)$
55. a. Parabola,  $x^2 = -4(y-3)$       b. Ellipse,  $\frac{(x+1)^2}{9} + (y-1)^2 = 1$   
 c. Circle,  $(x-2)^2 + (y+4)^2 = 25$       d. Hyperbola,  $\frac{(x-2)^2}{4} - \frac{(y-1)^2}{9} = 1$
56. a. iv                      b. i                      c. iii                      d. ii
57. a.  $(-3, 0)$  and  $(5, 2)$                       b.  $(1, 5), (1, -5), (-1, 5), (-1, -5)$

Practice Student Produced Response Questions

58

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