Answer Key 9
3.5: 7, 15, 21, 31, 34, 49, 56, 65, 67
3.6: 3-6, 13, 21, 29, 32, 37, 43, 58, 65
4.1: 2, 19, 23, 58, 63
4.2: 10, 11, 16, 24, 35

3.5

7) $x^4+4x^2=x^2\left(x^2+4\right)=$ $x^2\left(x+2i\right)\left(x-2i\right)$ zeros are $0, \pm 2i$	15) $x^3+8=x^3+2^3=$ $\left(x+2\right)\left(x^2-2x+4\right)$ $\frac{2\pm\sqrt{4-16}}{2}=1\pm\sqrt{3}i$ $\left(x+2\right)\left(x-\left(1+\sqrt{3}i\right)\right)\left(x-\left(1-\sqrt{3}i\right)\right)$ zeros are -2, $1\pm\sqrt{3}i$
21) x^2+2x+2 $\frac{-2\pm\sqrt{4-8}}{2}=-1\pm 2i$ $\left(x-\left(-1+2i\right)\right)\left(x-\left(-1-2i\right)\right)$ zeros are $-1\pm 2i$	31) x^4+2x^2+1 $y=x^2$ $y^2+2y+1=\left(y+1\right)^2=\left(x^2+1\right)^2=$ $\left(x+i\right)^2\left(x-i\right)^2$ zeros are *i* and -*i* each with multiplicity 2
34) $x^5+7x^3=x^3\left(x^2+7\right)=$ $x^3\left(x+\sqrt{7}i\right)\left(x-\sqrt{7}i\right)$ zeros are 0, $\pm\sqrt{7}i$ 0 has multiplicity 3	49) $P\left(x\right)=x^3-2x^2+2x-1$ $P\left(1\right)=0$ $\begin{array}{\|ccccc} 1 & 1 & -2 & 2 & -1 \\ & & 1 & -1 & 1 \\ & 1 & -1 & 1 & 0 \end{array}$ $P\left(x\right)=\left(x-1\right)\left(x^2-x+1\right)$ $\frac{1\pm\sqrt{1-4}}{2}=\frac{1}{2}\pm\frac{\sqrt{3}}{2}i$ zero are 0, $\frac{1}{2}\pm\frac{\sqrt{3}}{2}i$

56)

$P(x) = x^4 - 2x^3 - 2x^2 - 2x - 3$

Possible rational roots are $\pm 1, \pm 3$

$P(-1) = 1 + 2 - 2 + 2 - 3 = 0$

Dividing using synthetic division

$$\begin{array}{r|rrrrr} -1 & 1 & -2 & -2 & -2 & -3 \\ & & -1 & 3 & -1 & 3 \\ & 1 & -3 & 1 & -3 & 0 \end{array}$$

$Q(x) = x^3 - 3x^2 + x - 3$

We could try but it seems obvious
that grouping will work.

$x^3 - 3x^2 + x - 3 = 0$

$x^2(x-3) + 1 \cdot (x-3) = 0$

$(x^2+1)(x-3) = 0$

So the roots are clearly -1, 3, *i*, and -*i*.

65)

$P(x) = x^3 - 5x^2 + 4x - 20 =$

$x^2(x-5) + 4(x-5) =$

$(x^2+4)(x-5)$

$(x+2i)(x-2i)(x-5)$

67)

$x^4 + 8x^2 - 9 = (x^2+9)(x^2-1) =$

$(x^2+9)(x+1)(x-1) =$

$(x+3i)(x-3i)(x+1)(x-1)$

3.6

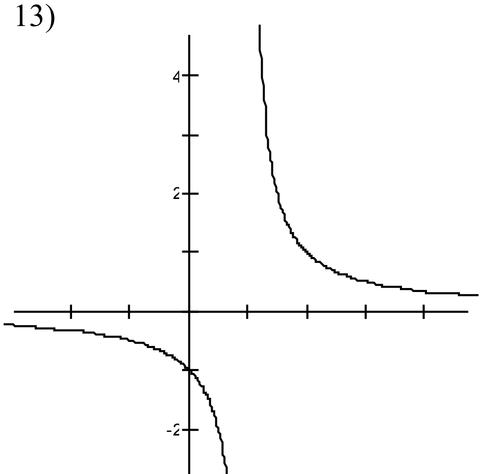
3) The function *r* has *x*-intercepts <u>-1 </u>and <u>2</u>

4) The function *r* has *y*-intercept <u>1/3</u>

5) The function *r* has vertical asymptotes $x =$ <u>-2</u> and $x =$ <u>3</u>

6) The function *r* has horizontal asymptote *y* = 1

13)



Domain = $\{x : x \in \mathbb{R}, x \neq 1\}$

Range = $\{y : y \in \mathbb{R}, y \neq 0\}$

21)

$r(x) = \dfrac{x-1}{x+4}$

$r(0) = \dfrac{-1}{4}$

So *y*-intercept is $y = \dfrac{-1}{4}$

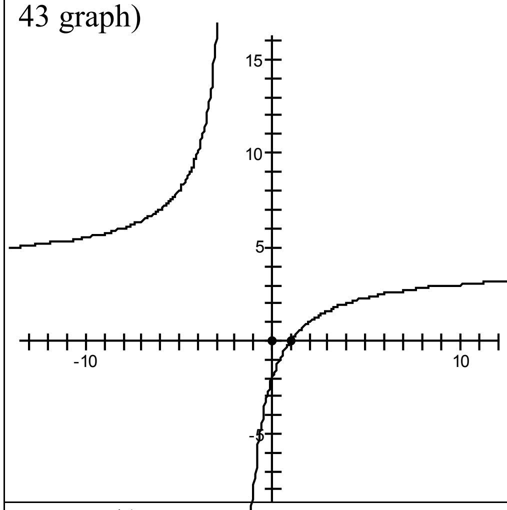
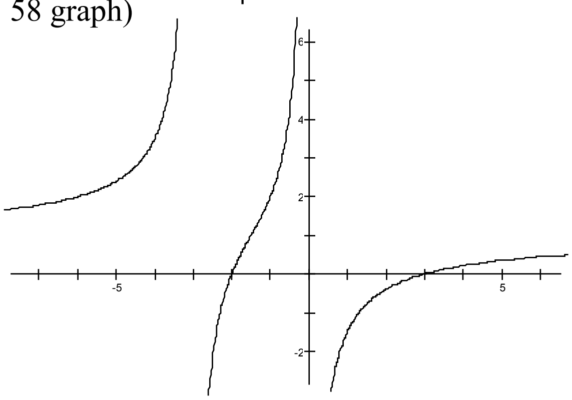
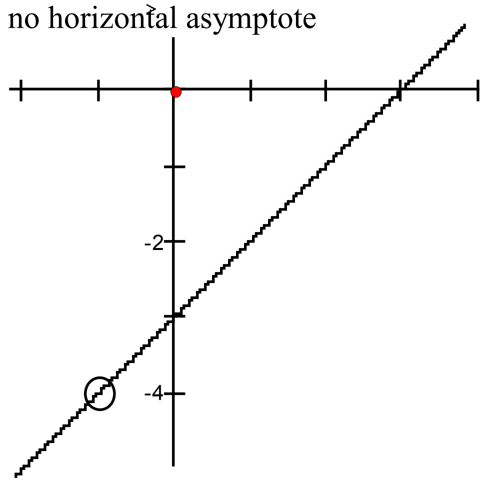
>

$\dfrac{x-1}{x+4} = 0$

$x - 1 = 0$

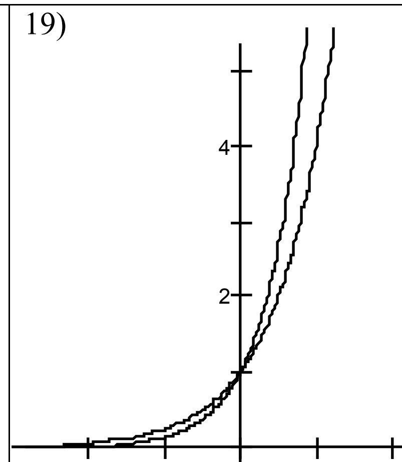
$x = 1$

So *x*-intercept is *x*=1

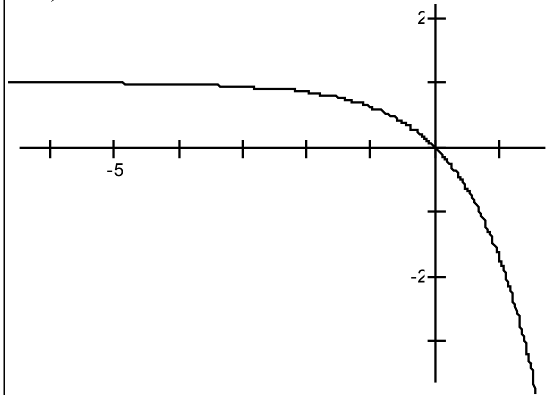
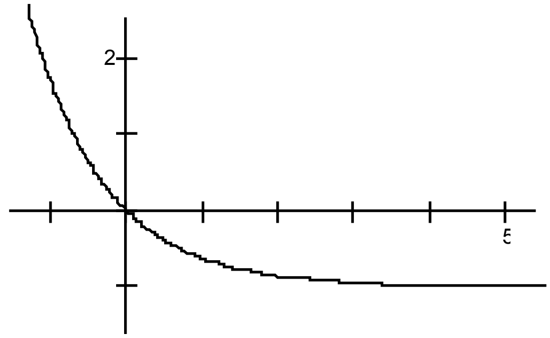
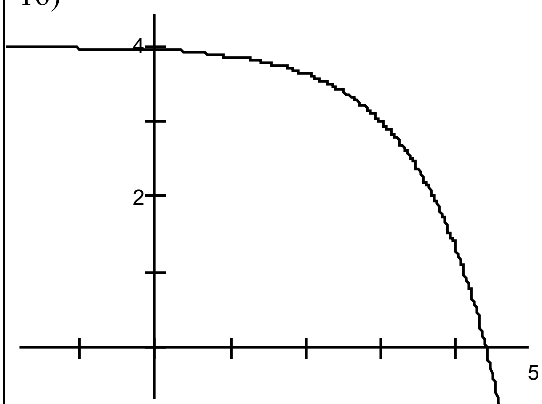
29) x-intercepts 1, -1 y-intercept about .2 vertical asymptotes at x=-2, x=2 horizontal asymptote at y=1	32) vertical asymptotes at x=1, x=-1 horizontal asymptote at y=0
37) vertical asymptotes at x=2, x=-7/4 horizontal asymptote at y=2	43) x-intercept at 1 y-intercept at -2 vertical asymptote at x=-2 horizontal asymptote at y=4 Domain $x \neq -2$ Range $y \neq 4$
43 graph) 	58) x-intercept at 3, -2 y-intercept undefined vertical asymptote at x=0, x= -3 horizontal asymptote at y=1 Domain $x \neq 0, x \neq -3$ Range $\mathbb{R}$ >
58 graph) 	65) $\frac{x^2-2x-3}{x+1}=\frac{(x+1)(x-3)}{(x+1)}$ x-intercept at 3 y-intercept at -3 no vertical asymptote no horizontal asymptote 

<

4.1

2) a) - III b) - I c) - II d) - IV	19) 
23) $f(x) = a^{-x}$ $f(2) = \frac{1}{16} = a^{-2}$ $16 = a^2$ $a = 4$ $f(x) = 4^{-x}$	58) $P_f(y) = 2500\left(1 + \frac{.025}{365}\right)^{365y}$ $a) P_f(2) = 2628.17$ $b) P_f(3) = 269470$ $c) P_f(6) = 2904.57$
63) $P_f = P_0\left(1 + \frac{.08}{12}\right)^{12}$ $\frac{P_f - P_0}{P_0} = \frac{P_0\left(1 + \frac{.08}{12}\right)^{12} - P_0}{P_0} =$ $\left(1 + \frac{.08}{12}\right)^{12} - 1 = .0829$ So approximately 8.29%	

4.2

10)  Domain $\mathbb{R}$ Range $x<1$ horizontal asymptote $y=1$	11)  Domain $\mathbb{R}$ Range $x>-1$ horizontal asymptote $y=-1$
16)  Domain $\mathbb{R}$ Range $x<4$ horizontal asymptote $y=4$	24) $m(t)=13e^{-0.015t}$ a) $m(0)=13e^{0}=13kg$ b) $m(45)=13e^{-0.015\cdot 45}=6.619kg$
35) a) $P_f=600\left(1+\frac{.025}{1}\right)^{1\cdot 10}=\$768.05$ b) $P_f=600\left(1+\frac{.025}{2}\right)^{2\cdot 10}=\$769.22$ c) $P_f=600\left(1+\frac{.025}{4}\right)^{4\cdot 10}=\$769.82$ d) $P_f=600e^{.025\cdot 10}=\$770.42$	