College Algebra

Name: Key

Final Exam Review – Semester 1

Date: _____ Period: _____

Solve. Check for extraneous solutions.

1.) $\log_x 11 = \frac{1}{2}$

$x^{\frac{1}{2}} = 11$ ← (square both sides)

$x = 11^2$

$x = 121$

2.) $\log_3 x = 4$

$3^4 = x$

$81 = x$

3.) $\log_3 6 + \log_3(4x+1) = \log_3(x+4) + \log_3 8$

$\log_3 6(4x+1) = \log_3 8(x+4)$

$24x+6 = 8x+32$

$-8x \quad -6 \quad -8x \quad -6$

$16x = 26$

$x = 13/8 = 1.625$

4.) $27^{(4x+3)} = 81^{\left(\frac{3}{4}x - \frac{1}{4}\right)}$

$(3^3)^{4x+3} = (3^4)^{3/4x - 1/4}$

$12x+9 = 3x-1$

$9x = -10$

$x = \frac{-10}{9} = -1.1111$

5.) $7^{2x+1} = 11$

$\log 7^{2x+1} = \log 11$

$(2x+1)\log 7 = \log 11$

$2x+1 = \frac{\log 11}{\log 7}$

$x = \left(\frac{\log 11}{\log 7}\right) - 1 / 2$

$x = .1161$

6.) $\log_8(x+6) - \log_8(x-4) = \log_8 46$

$\log_8 \frac{(x+6)}{(x-4)} = \log_8 46$

$\frac{x+6}{x-4} = 46$

$46x - 184 = x + 6$

$45x = 190$

$x = 4.2222 \quad \frac{38}{9}$

7.) $\ln(x+7) + \ln(x+12) = \ln 66$

$\ln(x+7)(x+12) = \ln 66$

$x^2 + 19x + 84 = 66$

$x^2 + 19x + 18 = 0$

$(x+18)(x+1) = 0$

$x = -18$ $\quad x = -1$

8.) $9^{3x-10} = 50$

$(3x-10)\log 9 = \log 50$

$3x - 10 = \frac{\log 50}{\log 9}$

$x = \left(\frac{\log 50}{\log 9}\right) + 10 / 3$

$x = 3.9268$

Expand or condense the following expressions.

9.) $5\ln x + 7\ln y - 3\ln z$

$\ln \frac{x^5 y^7}{z^3}$

10.) $\log_5\left(\frac{\sqrt{x}}{y^4}\right)$

$\frac{1}{2}\log_5 x - 4\log_5 y$

11.) $\log_3\left(\frac{9x}{y^2}\right)$

$\log_3 9 + \log_3 x - 2\log_3 y$

12.) $\frac{1}{2}\log_2 x - 8\log_2 y - 5\log_2 z$

$\log_2 \frac{\sqrt{x}}{y^8 z^5}$

13.) $\ln\left(7x^3y^8\right)$

$\ln 7 + 3\ln x + 8\ln y$

14.) $3\log_7 x + 6\log_7 y + 2\log_7 (z-3)$

$\log_7 x^3 y^6 (z-3)^2$

Multiply the following matrices.

15.) $\begin{bmatrix} 5 & 2 \\ -1 & -6 \end{bmatrix} \cdot \begin{bmatrix} 1 & -4 \\ 2 & 3 \end{bmatrix}$

2x2 · 2x2 → 2x2

$\begin{bmatrix} 9 & -14 \\ -13 & -14 \end{bmatrix}$

$5 \cdot 1 = 5$, $2 \cdot 2 = 4$, 9

$5 \cdot -4 = -20$, $2 \cdot 3 = 6$, -14

$-1 \cdot 1 = -1$, $-6 \cdot 2 = -12$, -13

$-1 \cdot -4 = 4$, $-6 \cdot 3 = -18$, -14

16.) $\begin{bmatrix} -3 \\ 7 \\ 8 \end{bmatrix} \cdot \begin{bmatrix} 9 & -4 \\ -5 & 3 \\ -2 & 6 \end{bmatrix}$

3x1 · 3x2

Can't multiply

Find the inverse of each matrix.

17.) $\begin{bmatrix} 5 & 2 \\ -1 & -6 \end{bmatrix}$

$-30 - -2$

-28

$-\frac{1}{28} \cdot \begin{bmatrix} -6 & -2 \\ 1 & 5 \end{bmatrix} = \begin{bmatrix} \frac{3}{14} & \frac{1}{14} \\ \frac{-1}{28} & \frac{-5}{28} \end{bmatrix}$

18.) $\begin{bmatrix} -3 & 6 \\ -2 & 4 \end{bmatrix}$

$-12 - -12$

0

$\frac{1}{0}\begin{bmatrix} \quad \end{bmatrix}$

$\emptyset$

no inverse

Solve the following systems using inverse matrices.

19.) $5x+3y=4$
$3x+4y=-2$

$\begin{bmatrix} 5 & 3 \\ 3 & 4 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 4 \\ -2 \end{bmatrix}$

inverse

$20 - 9$

11

$\frac{1}{11}\begin{bmatrix} 4 & -3 \\ -3 & 5 \end{bmatrix} \Rightarrow \begin{bmatrix} \frac{4}{11} & \frac{-3}{11} \\ \frac{-3}{11} & \frac{5}{11} \end{bmatrix} \cdot \begin{bmatrix} 4 \\ -2 \end{bmatrix} = \begin{bmatrix} 2 \\ -2 \end{bmatrix}$

$\frac{-3}{11} \cdot 4 \quad \frac{-12}{11}$

$\frac{5}{11} \cdot -2 \quad \frac{-10}{11}$

-2

$\frac{4}{11} \cdot 4 \quad \frac{16}{11}$

$\frac{-3}{11} \cdot -2 \quad \frac{6}{11}$

2

(2, -2)

20.) $x-2y=5$
$2x-3y=10$

$\begin{bmatrix} 1 & -2 \\ 2 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ 10 \end{bmatrix}$

$-3 - -4$

1

$\frac{1}{1}\begin{bmatrix} -3 & 2 \\ -2 & 1 \end{bmatrix}$

$\begin{bmatrix} -3 & 2 \\ -2 & 1 \end{bmatrix} \cdot \begin{bmatrix} 5 \\ 10 \end{bmatrix} = \begin{bmatrix} \frac{5}{0} \end{bmatrix}$

$-3 \cdot 5 \quad -15 \quad -2 \cdot 5 \quad -10$

$2 \cdot 10 \quad \frac{20}{5} \quad 1 \cdot 10 \quad \frac{10}{0}$

(-5, 0)

21.) $x+2y=2$
$5x+4y=-14$

$\begin{bmatrix} 1 & 2 \\ 5 & 4 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ -14 \end{bmatrix}$

$4 - 10$

-6

$-\frac{1}{6}\begin{bmatrix} 4 & -2 \\ -5 & 1 \end{bmatrix} = \begin{bmatrix} -\frac{2}{3} & \frac{1}{3} \\ \frac{5}{6} & -\frac{1}{6} \end{bmatrix} \cdot \begin{bmatrix} 2 \\ -14 \end{bmatrix} = \begin{bmatrix} \frac{-6}{4} \end{bmatrix}$

$-\frac{2}{3} \cdot 2 \quad \frac{-4}{3}$

$\frac{1}{3} \cdot -14 \quad \frac{-14}{3}$

-6

$\frac{5}{6} \cdot 2 \quad \frac{10}{6}$

$-\frac{1}{6} \cdot -14 \quad \frac{14}{6}$

4

(-6, 4)

22.) $-x-2y=1$
$-5x+y=-28$

$\begin{bmatrix} -1 & -2 \\ -5 & 1 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 1 \\ -28 \end{bmatrix}$

$-1 - 10$

-11

$-\frac{1}{11}\begin{bmatrix} 1 & 2 \\ 5 & -1 \end{bmatrix}$

$\begin{bmatrix} \frac{-1}{11} & \frac{-2}{11} \\ \frac{-5}{11} & \frac{1}{11} \end{bmatrix} \cdot \begin{bmatrix} 1 \\ -28 \end{bmatrix} = \begin{bmatrix} 5 \\ -3 \end{bmatrix}$

$\frac{-1}{11} \cdot 1 \quad \frac{-1}{11}$

$\frac{-2}{11} \cdot -28 \quad \frac{56}{11}$

5

$\frac{-5}{11} \cdot 1 \quad \frac{-5}{11}$

$\frac{1}{11} \cdot -28 \quad \frac{-28}{11}$

-3

(5, -3)

Create a matrix equation and solve the following using inverse matrices.

23.) Ally is making goody bags for her volleyball team. Each basket will contain packages of candy, gum, and chocolate bars. Bags of candy cost $1.75, packages of gum cost $1.50, and chocolate bars cost $2. Each goody bag contains 5 items costing a total of $9. You include twice as many chocolate bars as you do packages of gum. How many of each item will be in each goody bag?

x = # of candy
y = # of gum
z = # of chocolate bars

$1.75x + 1.5y + 2z = 9$
$x + y + z = 5$
$z = 2y$

$1.75x + 1.5y + 2z = 9$
$x + y + z = 5$
$-2y + z = 0$

$$\begin{bmatrix} 1.75 & 1.5 & 2 \\ 1 & 1 & 1 \\ 0 & -2 & 1 \end{bmatrix}^{-1} \cdot \begin{bmatrix} 9 \\ 5 \\ 0 \end{bmatrix} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \\ 2 \end{bmatrix} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

2 candy, 1 gum and 2 chocolate bars

24.) Steve invests $250,000 into three investments: bonds paying 6% annual interest, stocks paying 7%, and mutual funds paying 8.5%. The annual interest from the three different investments is $16,750 and he invests the same amount in stocks as he does in mutual funds. How much does he have invested in each fund?

x = $ in 6% bonds
y = $ in 7% stocks
z = $ in 8.5% mutual funds

$.06x + .07y + .085z = 16750$
$x + y + z = 250{,}000$
$y = z \Rightarrow y - z = 0$

$$\begin{bmatrix} .06 & .07 & .085 \\ 1 & 1 & 1 \\ 0 & 1 & -1 \end{bmatrix}^{-1} \begin{bmatrix} 16750 \\ 250000 \\ 0 \end{bmatrix} = \begin{bmatrix} \$150{,}000 \\ \$50{,}000 \\ \$50{,}000 \end{bmatrix}$$

$150,000 → in 6% bonds
$50,000 → in 7% stocks
$50,000 → in 8.5% mutual funds

25.) Billy's Restaurant ordered 200 flowers for Mother's Day. They ordered carnations at $1.50 each, roses at $5.75 each, and daisies at $2.60 each. They ordered 20 fewer roses than daisies. The total order came to $589.50. How many of each type of flower was ordered?

x = # of carnations
y = # of roses
z = # of daisies

$x + y + z = 200$
$1.5x + 5.75y + 2.6z = 589.50$
$z - 20 = y \Rightarrow 0x - y + z = 20$

$$\begin{bmatrix} 1 & 1 & 1 \\ 1.5 & 5.75 & 2.6 \\ 0 & -1 & 1 \end{bmatrix}^{-1} \begin{bmatrix} 200 \\ 589.50 \\ 20 \end{bmatrix} = \begin{matrix} 80 \\ 50 \\ 70 \end{matrix}$$

80 carnations
50 roses
and
70 daises

Sketch the following rational functions and identify all of the key information for the function.

26.) $f(x)=\dfrac{1x^2-7x+12}{1x^2-9}$ $\dfrac{(x-4)(x-3)}{(x-3)(x+3)}$

a.) Zero(s): $x=4$ ($x-4=0$)

b.) VA: $x=-3$ ($x+3=0$) c.) HA: $y=1/1$

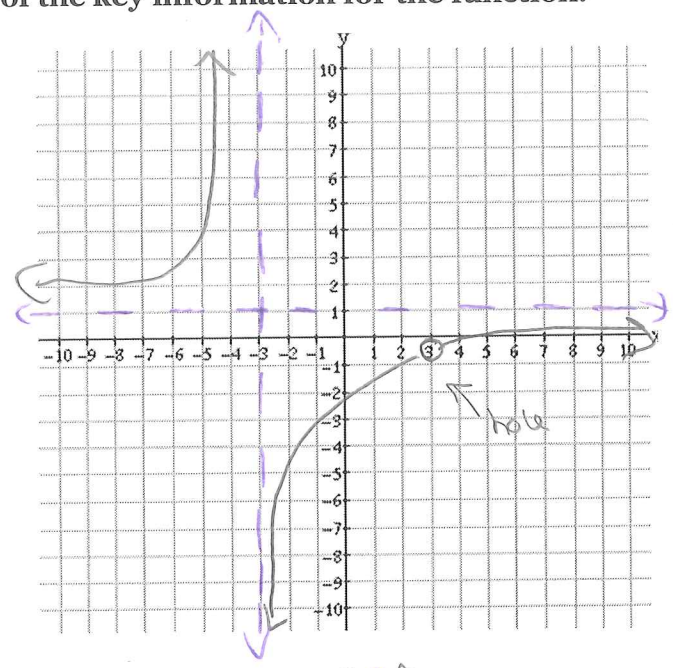
d.) Hole(s): $(3, -1/6)$ ($x-3=0$, $x=3$, $\frac{3-4}{3+3}=\frac{-1}{6}$)

e.) Domain: $(-\infty,-3)\cup(-3,3)\cup(3,\infty)$

f.) Range: $(-\infty,-\frac{1}{6})\cup(-1/6,1)\cup(1,\infty)$

g.) End Behavior: As $x\to-\infty$, $f(x)\to$ 1

As $x\to\infty$, $f(x)\to$ 1



27.) $f(x)=\dfrac{2x^2+10x+12}{1x^2+x-2}$ $2(x^2+5x+6)$ $\dfrac{2(x+3)(x+2)}{(x+2)(x-1)}$

a.) Zero(s): $x=-3$ ($x+3=0$)

b.) VA: $x=1$ ($x-1=0$) c.) HA: $y=\frac{2}{1}$ $y=2$

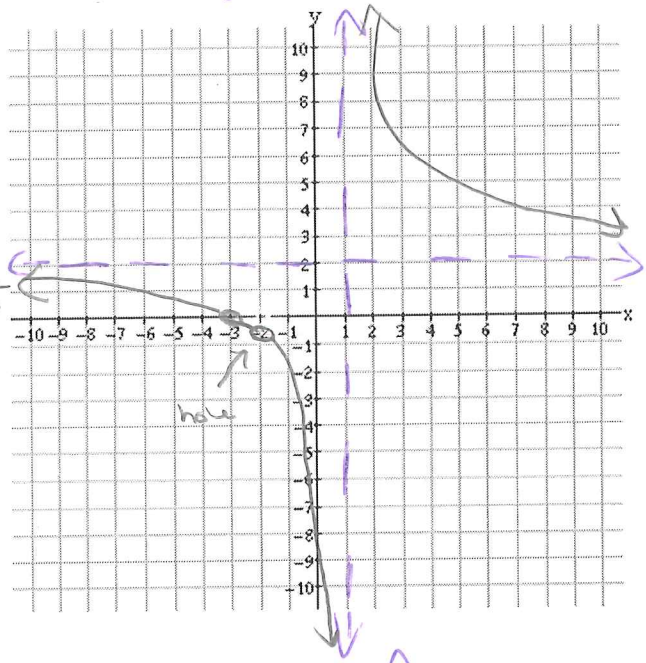
d.) Hole(s): $(-2, -2/3)$ ($x+2=0$, $x=-2$, $\frac{2(-2+3)}{(-2-1)}=\frac{2}{-3}$)

e.) Domain: $(-\infty,-2)\cup(-2,1)\cup(1,\infty)$

f.) Range: $(-\infty,-\frac{2}{3})\cup(-\frac{2}{3},2)\cup(2,\infty)$

g.) End Behavior: As $x\to-\infty$, $f(x)\to$ 2

As $x\to\infty$, $f(x)\to$ 2



28.) $f(x)=\dfrac{4x}{x^2-3x}$ $\dfrac{4x}{x(x-3)}$

a.) Zero(s): none

b.) VA: $x=3$ ($x-3=0$) c.) HA: $y=0$

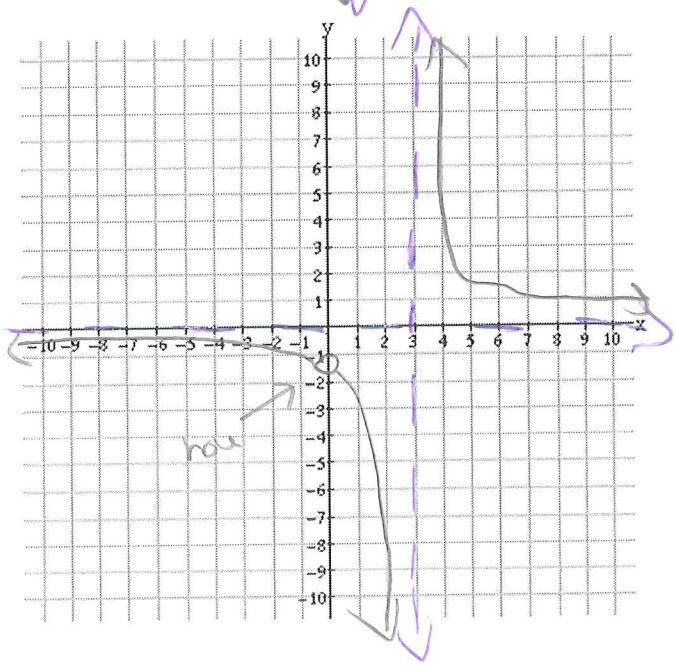
d.) Hole(s): $(0, -4/3)$ ($x=0$, $\frac{4}{(0-3)}=\frac{4}{-3}$)

e.) Domain: $(-\infty,0)\cup(0,3)\cup(3,\infty)$

f.) Range: $(-\infty,-\frac{4}{3})\cup(-\frac{4}{3},0)\cup(0,\infty)$

g.) End Behavior: As $x\to-\infty$, $f(x)\to$ 0

As $x\to\infty$, $f(x)\to$ 0



Solve each rational equation. Check for extraneous solutions.

29.) $\frac{4x}{x+4}+\frac{3}{x-1}=\frac{15}{x^2+3x-4}$ $(x+4)(x-1)$

$4x^2-4x+3x+12=15$

$4x^2-1x-3=0$ -12, -4, 3, -1

$4x^2-4x+3x-3$

$4x(x-1)\quad 3(x-1)$

$(x-1)(4x+3)=0$

~~$x=1$~~ $\boxed{x=-3/4}$

30.) $1+\frac{1}{x^2-3x-4}=\frac{x-1}{x-4}$ $(x-4)(x+1)$ (x^2-3x-4)

$x^2-3x-4+1=x^2-1$

$-3x-3=-1$

$-3x=2$

$\boxed{x=-2/3}$

31.) $9+\frac{x^2-7x-30}{x^2+9x}=\frac{1}{x}$ $x(x+9)$ (x^2+9x)

$9x^2+81x+x^2-7x-30=x+9$

$10x^2+73x-39=0$ -390, 78, -5, 73

$10x^2-5x+78x-39$

$5x(2x-1)\quad 39(2x-1)$

$(5x+39)(2x-1)=0$

$\boxed{x=-\frac{39}{5}\quad x=\frac{1}{2}}$

32.) careful!

$\frac{x-5}{x}-\frac{x-5}{x^2+3x}=1$ $x(x+3)$ $(x+3)$ (x^2+3x)

$x^2-2x-15-(x-5)=x^2+3x$

$x^2-2x-15-x+5=x^2+3x$

$x^2-3x-10=x^2+3x$

$-10=6x$

$\boxed{-1.6667=x \text{ or } -5/3}$

Given the polynomial find the following information. *Use calculator!

33.) $f(x)=x^4-x^3-4x^2+5$

Zeros: (1.14,0) (2.32,0)

Max: (0,5)

Min: (-1.09, 2.95) (1.83, -3.31)

34.) $f(x)=x^2-2x-8$

Zeros: (4,0) (-2,0)

Max: none

Min: (1, -9)

35.) $f(x)=30x^3-47x^2+7$

Zeros: (-.35,0) (.46,0) (1.46,0)

Max: (0,7)

Min: (1.04, -10.1)

$x^4+0x^3-6x^2+0x-27$ Use calc to find 1st one... (3, 0)

36.) Find all of the zeros of the polynomial $f(x) = x^4 - 6x^2 - 27$.

$$\begin{array}{c|ccccc} 3 & 1 & 0 & -6 & 0 & -27 \\ & & 3 & 9 & 9 & 27 \\ \hline & 1 & 3 & 3 & 9 & \boxed{0} \end{array}$$

x^3+3x^2+3x+9

$x^2(x+3)\quad 3(x+3)$

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

$x=-3 \qquad x^2=-3$

$x=\pm i\sqrt{3}$

Zeros: $x=3, -3, \pm i\sqrt{3}$

37.) Find all of the zeros of the polynomial $f(x) = x^3 - 9x^2 - 21x - 11$.

$$\begin{array}{c|ccc} -1 & 1 & -9 & -21 & -11 \\ & & -1 & 10 & 11 \\ \hline & 1 & -10 & -11 & \boxed{0} \end{array}$$

$x^2-10x-11$

$(x-11)(x+1)=0$

$x=11 \qquad x=-1$

bonus

Zeros: $-1, -1, 11$ $\boxed{-1, 11}$

38.) Find all of the zeros of the polynomial $f(x) = x^5 - 5x^4 - 6x^3 + 30x^2 - 7x + 35$.

$$\begin{array}{c|cccccc} 5 & 1 & -5 & -6 & 30 & -7 & 35 \\ & & 5 & 0 & -30 & 0 & -35 \\ \hline & 1 & 0 & -6 & 0 & -7 & 0 \end{array}$$

$x^4-6x^2-7=0$

$(x^2-7)(x^2+1)$

$x^2=7 \qquad x^2=-1$

$x=\pm\sqrt{7} \qquad x=\pm i$

Zeros: $x=5, \pm\sqrt{7}, \pm i$

Which of the following functions are polynomial functions? Write YES or NO.

39.) $f(x)=-5$ yes

40.) $f(x)=\log(x-8)$ no

41.) $f(x)=3x^3+x-6$ yes

42.) $f(x)=x^{\frac{2}{3}}-x^{\frac{1}{3}}$ no

43.) $f(x)=x^5-2x^3+x+11$ yes

44.) $f(x)=2x^{-3}+7$ no

45.) $f(x)=\dfrac{1}{x^4}$ no

46.) $f(x)=\sqrt{x-1}+9$ no

47.) $f(x)=-x^2+x-10$ yes

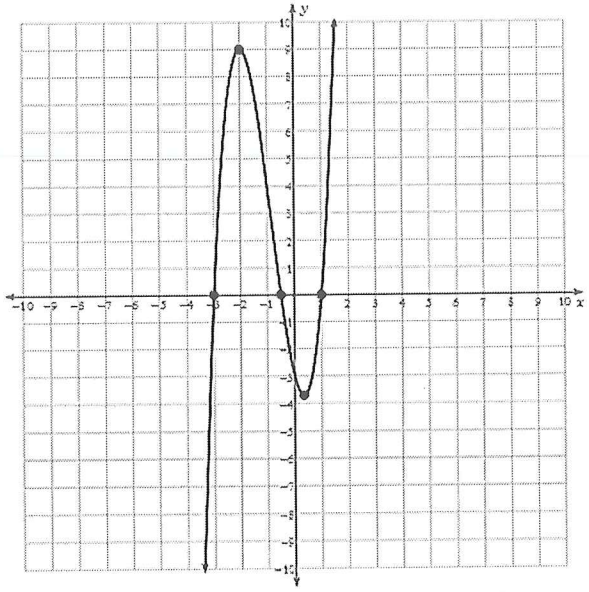
Write the equation of the following polynomial graphs. Then use your calculator to find the key information.

$x = -3$ $x = -\frac{1}{2}$ $x = 1$

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

$(2x+1)$

48.)



Equation: $f(x) = (x+3)(2x+1)(x-1)$

Relative Max: $(-2, 9)$ Relative Min: $(.33, -3.70)$

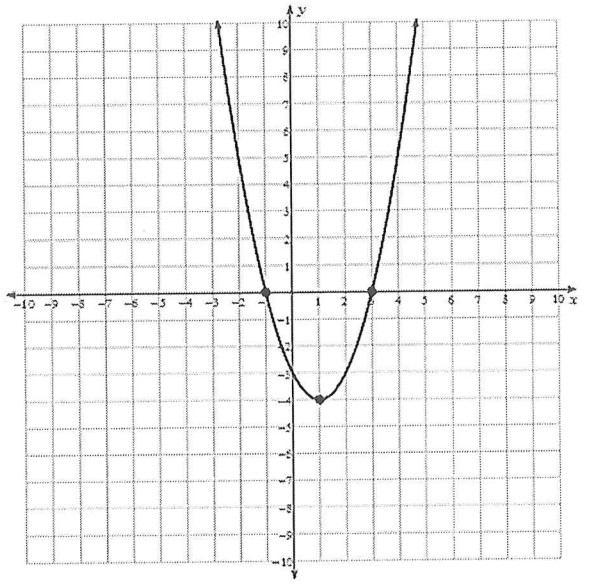
Increasing Interval: $(-\infty, -2)$ $(.33, \infty)$

Decreasing Interval: $(-2, .33)$

End Behavior: As $x \to -\infty$, $f(x) \to -\infty$

$x \to \infty$, $f(x) \to \infty$

49.)



Equation: $f(x) = (x+1)(x-3)$

Relative Max: none Relative Min: $(1, -4)$

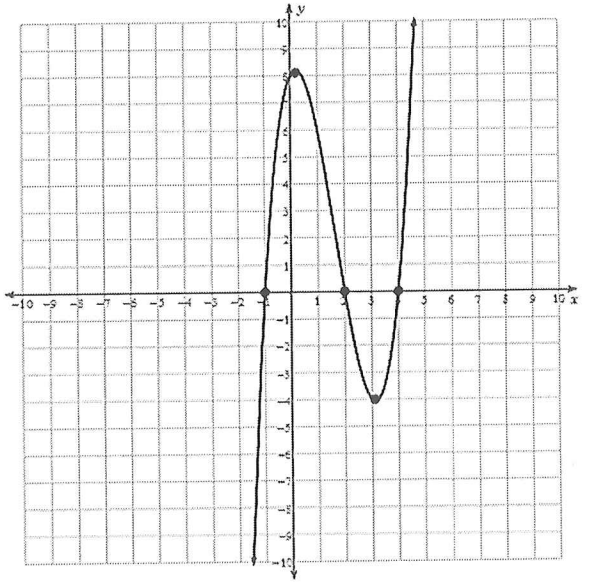
Increasing Interval: $(1, \infty)$

Decreasing Interval: $(-\infty, 1)$

End Behavior: As $x \to -\infty$, $f(x) \to \infty$

$x \to \infty$, $f(x) \to \infty$

50.)



Equation: $f(x) = (x+1)(x-2)(x-4)$

Relative Max: $(.21, 8.2)$ Relative Min: $(3.11, -4.06)$

Increasing Interval: $(-\infty, .21)$ $(3.11, \infty)$

Decreasing Interval: $(.21, 3.11)$

End Behavior: As $x \to -\infty$, $f(x) \to -\infty$

$x \to \infty$, $f(x) \to \infty$

Use the following functions to answer the questions below.

51.) $f(x) = x^2 - 6$ and $g(x) = 6x - 1$

a.) Domain of $f(x)$: $(-\infty, \infty)$

Range of $f(x)$: $[-6, \infty)$

b.) Domain of $g(x)$: $(-\infty, \infty)$

Range of $g(x)$: $(-\infty, \infty)$

c.) $g^{-1}(x)$

$x = 6y - 1$

$x + 1 = 6y$

$\frac{x+1}{6} = y$

or

$\frac{x}{6} + \frac{1}{6} = y$

d.) $f(x) \cdot g(x)$

$(x^2 - 6)(6x - 1)$

$6x^2 - x^2 - 36x + 6$

e.) $f(g(x))$

$(6x-1)^2 - 6$

$36x^2 - 12x + 1 - 6$

$36x^2 - 12x - 5$

f.) $f(g(-8))$

or $f(g(-8))$

$6(-8) - 1$

$f(-49)$

$36(-8)^2 - 12(-8) - 5$

$(-49)^2 - 6$

2395

52.) $f(x) = |x + 3| - 1$ and $g(x) = 4x - 8$

a.) Domain of $f(x)$: $(-\infty, \infty)$

Range of $f(x)$: $[-1, \infty)$

b.) Domain of $g(x)$: $(-\infty, \infty)$

Range of $g(x)$: $(-\infty, \infty)$

c.) $g^{-1}(x)$

$x = 4y - 8$

$x + 8 = 4y$

$\frac{x+8}{4} = y$

or

$\frac{x}{4} + 2 = y$

d.) $f(g^{-1}(x))$

$\left|\frac{x+8}{4} + 3\right| - 1$

$\left|\frac{x+20}{4}\right| - 1$

or

$\left|\frac{x}{4} + 2 + 3\right| - 1$

$\left|\frac{x}{4} + 5\right| - 1$

e.) $f(g(x))$

$|4x - 8 + 3| - 1$

$|4x - 5| - 1$

f.) $f(g(-2))$

$|4(-2) - 5| - 1$

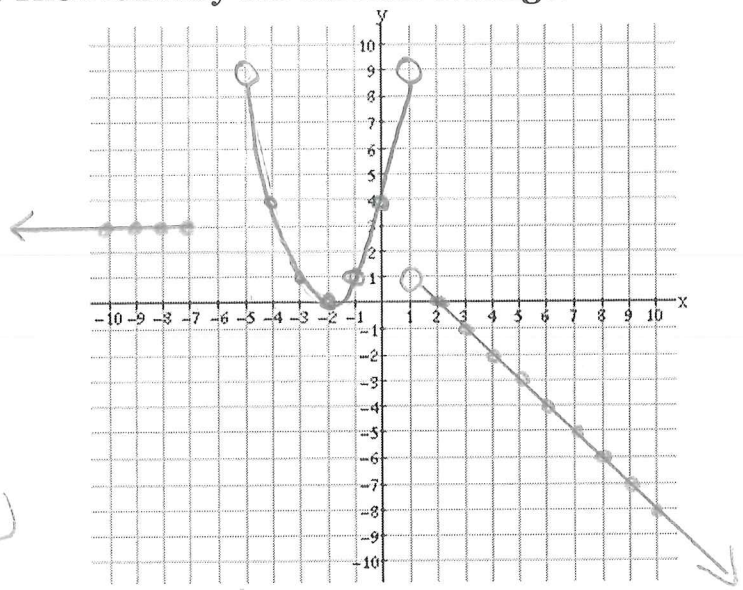
$|-13| - 1$

$13 - 1$

12

Graph the following piecewise function. Then identify the domain & range.

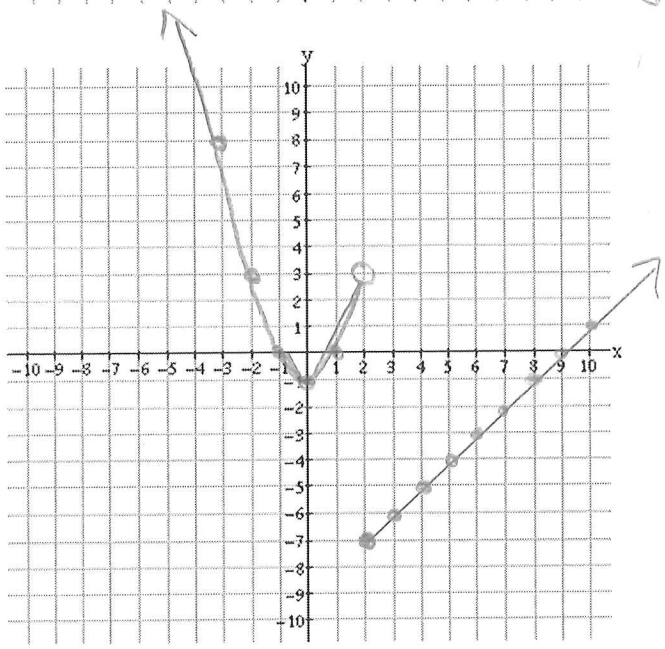
53.) $f(x)=\begin{cases}3 & x\le -7\\ (x+2)^2 & -5<x<1\\ -x+2 & x>1\end{cases}$



Domain: $(-\infty,-7]\cup(-5,1)\cup(1,\infty)$

Range: $(-\infty,9)$

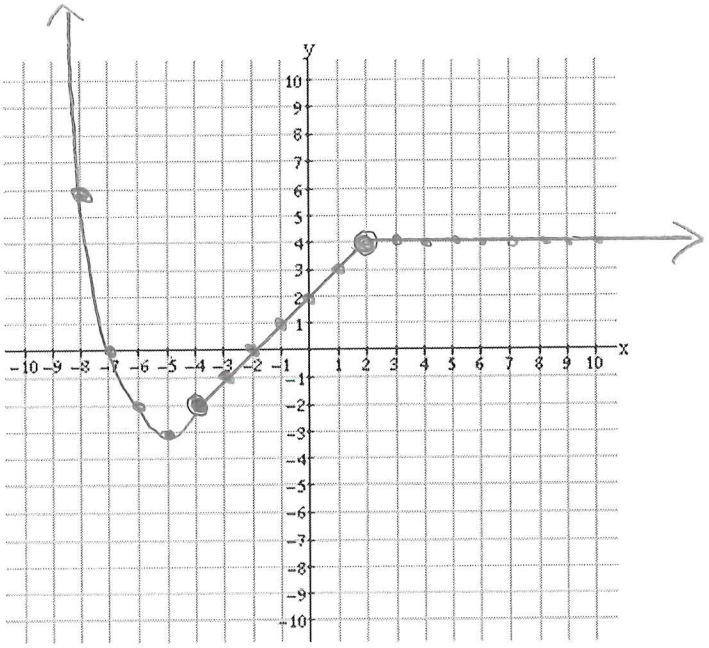
54.) $f(x)=\begin{cases}x^2-1 & x<2\\ x-9 & x\ge 2\end{cases}$



Domain: $(-\infty,\infty)$

Range: $[-7,\infty)$

55.) $f(x)=\begin{cases}(x+5)^2-3 & x<-4\\ x+2 & -4\le x<2\\ 4 & x\ge 2\end{cases}$



Domain: $(-\infty,\infty)$

Range: $[-3,\infty)$

Name each function. Then write the letter of the transformation(s) for the equation. List ALL that apply.

A. Reflects over the x-axis	B. Stretch – expands	C. Stretch – compresses
D. Shifts left	E. Shifts right	F. Shifts up
G. Shifts down		

56.) $f(x) = -\frac{1}{3}|x+2| - 7$

Name: absolute value

Transformations: A, B, D, G

57.) $f(x) = -\sqrt{x-5} + 1$

Name: square root

Transformations: A, E, F

58.) $f(x) = 3(x+4)^2$

Name: quadratic

Transformations: C, D

59.) $f(x) = x^3 - 3$

Name: cubic

Transformations: G

60.) $f(x) = \frac{1}{x+2} + 3$

Name: rational

Transformations: D, F

61.) $f(x) = \sqrt[3]{x-9}$

Name: cube root

Transformations: E

Identify the degree and leading coefficient of the following polynomials.

62.) $f(x) = 4x^2 + 5x^3 - 31x + 6$

Degree: 3

LC: 5

63.) $f(x) = 6x^3 - 25x^2 + 5x$

Degree: 3

LC: 6

64.) $f(x) = 23x - 13x^2 - 12$

Degree: 2

LC: -13

65.) $f(x) = -9 + 2x$

Degree: 1

LC: 2

66.) $f(x) = x^2 - 8x + 7$

Degree: 2

LC: 1

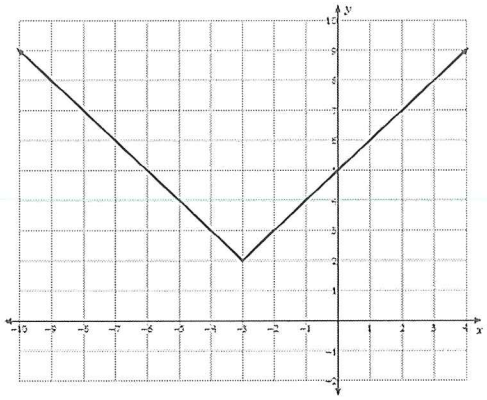
67.) $f(x) = -4x^4 + 5x^3$

Degree: 4

LC: -4

Identify the parent function for each of the following graphs. Then state the domain and range.

68.)

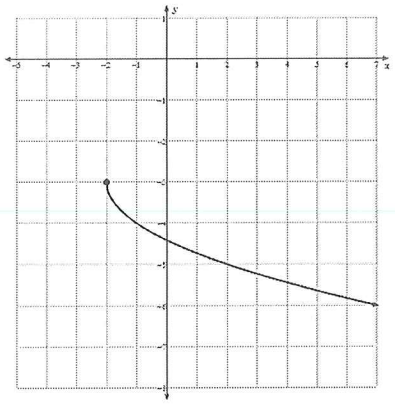


Name: absolute value

Domain: $(-\infty, \infty)$

Range: $[2, \infty)$

69.)

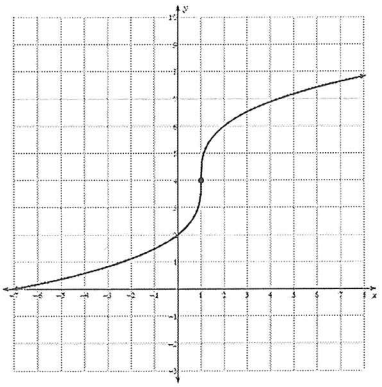


Name: square root

Domain: $[-2, \infty)$

Range: $(-\infty, -3]$

70.)

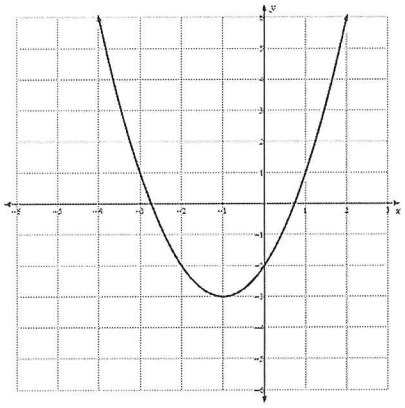


Name: cube root

Domain: $(-\infty, \infty)$

Range: $(-\infty, \infty)$

71.)

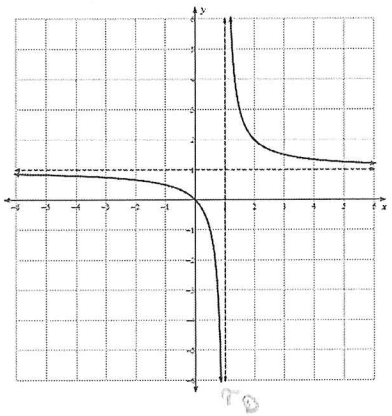


Name: quadratic

Domain: $(-\infty, \infty)$

Range: $[-3, \infty)$

72.)

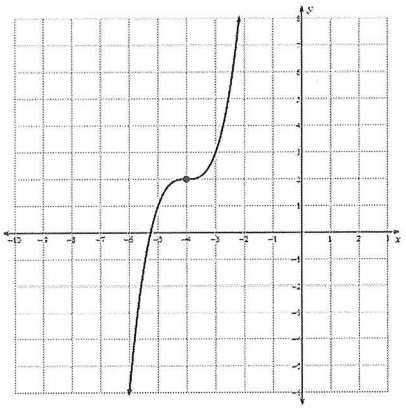


Name: rational

Domain: $(-\infty, 1) \cup (1, \infty)$

Range: $(-\infty, 1) \cup (1, \infty)$

73.)



Name: cubic

Domain: $(-\infty, \infty)$

Range: $(-\infty, \infty)$