(1.)

M1314 Free response 53 SLp 11/12/17

① $x^2 - x - 72 = 0$

$(x+8)(x-9) = 0$

Let $x+8=0$ or $x-9=0$

$x+8-8 = 0-8$ or $x-9+9=0+9$

$x=-8$ or $x=9$

---

use Quadratic formula

$1x^2 - 1x - 72 =$

$a=1,\ b=-1,\ c=-72$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(1)(-72)}}{2(1)}$$

$$x = \frac{1 \pm \sqrt{1+288}}{2}$$

$$x = \frac{1 \pm \sqrt{289}}{2}$$

$$x = \frac{1 \pm 17}{2}$$

$x = \frac{1-17}{2}$ or $x = \frac{1+17}{2}$

$x = \frac{-16}{2}$ OR $x = \frac{18}{2}$

$x=-8$ or $x=9$

(2) $x^2 = 3x + 40$

$x^2 - 3x - 40 = 0$

$(x+5)(x-8) = 0$

Let $x+5=0$ or $x-8=0$

$x+5-5=0-5$ or $x-8+8=0+8$

$x=-5$ or $x=8$

(21)

use Quadratic formula

$1x^2 - 3x - 40 = 0$

$a=1, \; b=-3, \; c=-40$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(-40)}}{2(1)}$$

$$x = \frac{3 \pm \sqrt{9+160}}{2}$$

$$x = \frac{3 \pm \sqrt{169}}{2}$$

$$x = \frac{3 \pm 13}{2}$$

$x = \frac{3-13}{2}$ or $x = \frac{3+13}{2}$

$x = \frac{-10}{2}$ or $x = \frac{16}{2}$

$x = -5$ or $x = 8$

3

$14x^2+3x-2=0$

$(2x+1)(7x-2)=0$

Let $2x+1=0$ OR $7x-2=0$

$2x+1-1=0-1$ OR $7x-\cancel{2}+\cancel{2}=0+2$

$2x=-1$ OR $7x=2$

$\frac{2x}{2}=\frac{-1}{2}$ OR $\frac{7x}{7}=\frac{2}{7}$

$x=-\frac{1}{2}$ OR $x=\frac{2}{7}$

14.1 2.7 2.1 3.

Use Quadratic Formula

$14x^2+3x-2=0$

$a=14,\quad b=3,\quad c=-2$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$x=\frac{-(3)\pm\sqrt{(3)^2-4(14)(-2)}}{2(14)}$$

$$x=\frac{-3\pm\sqrt{9+112}}{28}$$

$$x=\frac{-3\pm\sqrt{121}}{28}$$

$$x=\frac{-3\pm 11}{28}$$

$x=\frac{-3-11}{28}$ OR $x=\frac{-3+11}{28}$

$x=\frac{-14}{28}$ OR $x=\frac{8}{28}$

$x=\frac{\cancel{14}(-1)}{\cancel{14}(2)}$ OR $x=\frac{\cancel{4}(2)}{\cancel{4}(7)}$

$x=-\frac{1}{2}$ OR $x=\frac{2}{7}$

④ $16x^2+2x-3=0$

$(8x-3)(2x+1)=0$

let $8x-3=0$ OR $2x+1=0$

$8x-\cancel{3}+\cancel{3}=0+3$ OR $2x+\cancel{1}-\cancel{1}=0-1$

$8x=3$ OR $2x=-1$

$\frac{\cancel{8}x}{\cancel{8}}=\frac{3}{8}$ OR $\frac{\cancel{2}x}{\cancel{2}}=\frac{-1}{2}$

$x=3/8$ OR $x=-1/2$

use Quadratic formula

$16x^2+2x-3=0$

$a=16,\ b=2,\ c=-3$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$x=\frac{-(2)\pm\sqrt{(2)^2-4(16)(-3)}}{2(16)}$$

$$x=\frac{-2\pm\sqrt{4+192}}{32}$$

$$x=\frac{-2\pm\sqrt{196}}{32}$$

$$x=\frac{-2\pm14}{32}$$

$x=\frac{-2+14}{32}$ OR $x=\frac{-2-14}{32}$

$x=\frac{12}{32}$ OR $x=\frac{-16}{32}$

$x=\frac{\cancel{4}(3)}{\cancel{4}(8)}$ OR $x=\frac{\cancel{16}(-1)}{\cancel{16}(2)}$

$x=3/8$ OR $x=-1/2$

16·1
8·2
4·4

3·1

4.

5.

$5x^2 = 4x + 12$

$5x^2 - 4x - 12 = 0$

$(5x + 6)(x - 2) = 0$

set $5x + 6 = 0$ or $x - 2 = 0$

$5x + \cancel{6} - \cancel{6} = 0 - 6$ or $x - 2 + 2 = 0 + 2$

$5x = -6$ or $x = 2$

$\frac{5x}{5} = \frac{-6}{5}$

$x = -6/5$

Use Quadratic Formula

$5x^2 - 4x - 12 = 0$

$a = 5, \quad b = -4, \quad c = -12$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(5)(-12)}}{2(5)}$$

$$x = \frac{4 \pm \sqrt{16 + 240}}{10}$$

$$x = \frac{4 \pm \sqrt{256}}{10}$$

$$x = \frac{4 \pm 16}{10}$$

$x = \frac{4 - 16}{10}$ or $x = \frac{4 + 16}{10}$

$x = \frac{-12}{10}$ OR $x = \frac{20}{10}$

$x = \frac{\cancel{2}(-6)}{\cancel{2}(5)}$ or $x = 2$

$x = -6/5$

5.1

12.1
6.2
3.4

KS1

6. Solve by completing the square

6.

$$x^2-2x=6$$

$$x^2-2x+\left(\tfrac{1}{2}(-2)\right)^2= 6+\left(\tfrac{1}{2}(-2)\right)^2$$

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

$$x^2-2x+1=6+1$$

$$x^2-2x+1=7$$

$$(x-1)(x-1)=7$$

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

$$\sqrt{(x-1)^2}=\pm\sqrt{7}$$

$$x-1=\pm\sqrt{7}$$

$$x\cancel{-1}\cancel{+1}=\pm\sqrt{7}+1$$

$$x=1\pm\sqrt{7}$$

$x=1+\sqrt{7}$ or $x=1-\sqrt{7}$

7. Solve by using the Quadratic Formula 7.

$x^2 - 10x + 41 = 0$

$1x^2 - 10x + 41 = 0$

$a = 1,\ b = -10,\ c = 41$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Formula

$\sqrt{-1} = i$

$$x = \frac{-(-10) \pm \sqrt{(-10)^2 - 4(1)(41)}}{2(1)}$$

$$x = \frac{10 \pm \sqrt{100 - 164}}{2}$$

$$x = \frac{10 \pm \sqrt{-64}}{2}$$

$$x = \frac{10 \pm 8i}{2}$$

$x = 5 \pm 4i$

$x = 5 + 4i$ OR $x = 5 - 4i$

8 $2x^2-32x+128=0$ 8

$2(x^2-16x+64)=0$

$2(x-8)(x-8)=0$

Set $\cancel{2=0}$ or $x-8=0$ or $x-8=0$

or $x-8+8=0+8$ or $x-8+8=0+8$

$x=8$ or $x=8$

Use Quadratic formula

$2x^2-32x+128=0$

$a=2,\ b=-32,\ c=128$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$x=\frac{-(-32)\pm\sqrt{(-32)^2-4(2)(128)}}{2(2)}$$

$$x=\frac{32\pm\sqrt{1024-1024}}{4}$$

$$x=\frac{32\pm\sqrt{0}}{4}$$

$$x=\frac{32\pm 0}{4}$$

$x=\frac{32-0}{4}$ or $x=\frac{32+0}{4}$

$x=\frac{32}{4}$ or $x=\frac{32}{4}$

$x=8$ or $x=8$

$\{8\}$

(9) $\sqrt{5x+41} = x+7$ (9.)

$(\sqrt{5x+41})^2 = (x+7)^2$

$5x+41 = (x+7)(x+7)$

$5x+41 = x^2+7x+7x+49$

$5x+41 = x^2+14x+49$

$0 = x^2+14x+49-5x-41$

$0 = x^2+9x+8$

$0 = (x+1)(x+8)$

$x+1=0$ or $x+8=0$

$x+1-1=0-1$ OR $x+8-8=0-8$

$x=-1$ or $\cancel{x=-8}$

$\{-1\}$ ✓

Ck

$\sqrt{5x+41} = x+7$

$\sqrt{5(-1)+41} = (-1)+7$

$\sqrt{-5+41} = -1+7$

$\sqrt{36} = 6$

$6 = 6$ ✓

Good

Ck

$\sqrt{5x+41} = x+7$

$\sqrt{5(-8)+41} = (-8)+7$

$\sqrt{-40+41} = -8+7$

$\sqrt{1} = -1$

$1 \neq -1$

BAD

10. graph

$$f(x) = \begin{cases} x+4 & \text{if } x<3 \quad \text{open} \\ x-4 & \text{if } x \geq 3 \quad \text{close} \end{cases}$$

10.

x	f(x)
0	4
3	7 ← open point

$f(x) = x+4$

$f(0) = (0)+4$

$f(0) = 4$

$f(3) = (3)+4$

$f(3) = 3+4$

$f(3) = 7$

$f(x) = x-4$

$f(3) = (3)-4$

$f(3) = 3-4$

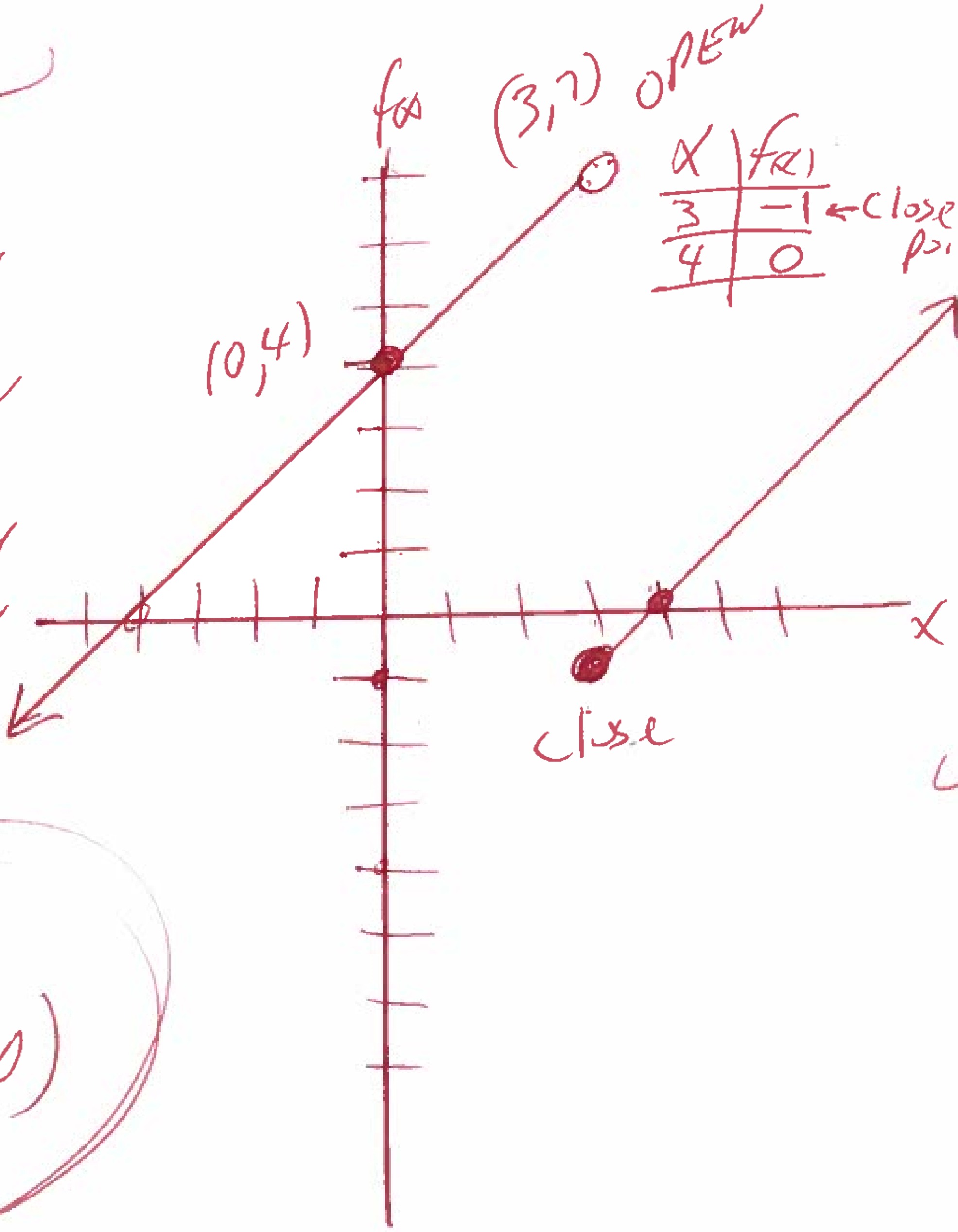
$f(3) = -1$

$f(4) = (4)-4$

$f(4) = 4-4$

$f(4) = 0$

x	f(x)
3	-1 ← close point
4	0



domain

$(-\infty, \infty)$

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

11

$$\frac{f(x+h) - f(x)}{h} =$$

$$\frac{((x+h)^2 - 7(x+h) + 2) - (x^2 - 7x + 2)}{h} =$$

$$\frac{(x+h)(x+h) - 7x - 7h + 2 - x^2 + 7x - 2}{h} =$$

$$\frac{x^2 + xh + xh + h^2 - 7x - 7h + 2 - x^2 + 7x - 2}{h} =$$

$$\frac{\cancel{x^2} + 2xh + h^2 \cancel{- 7x} - 7h \cancel{+ 2} \cancel{- x^2} \cancel{+ 7x} \cancel{- 2}}{h} =$$

$$\frac{2xh + h^2 - 7h}{h} =$$

$$\frac{\cancel{h}(2x + h - 7)}{\cancel{h}} =$$

$$2x + h - 7 =$$

12. Find the domain

12.

formula domain

$f(x) = \sqrt{Ax+B}$

set $Ax+B \geq 0$

$f(x) = \sqrt{18-3x}$

set $18 - 3x \geq 0$

$\cancel{18} - 3x - \cancel{18} \geq 0 - 18$

$-3x \geq -18$

$\frac{\cancel{-3}x}{\cancel{-3}} \leq \frac{-18}{-3}$

divide by a negative and turn the alligator around

$x \leq 6$

$(-\infty, 6]$

(13) $f(x) = 4x^2 + 20x + 24$ and $g(x) = x+3$ (13)

find $f+g$, $f-g$, fg, $\frac{f}{g}$ and find domains

$(f+g)(x) =$

$f(x) + g(x) =$

$(4x^2+20x+24)+(x+3) =$

$4x^2+20x+24+x+3 =$

$4x^2+21x+27 =$ domain $(-\infty, \infty)$

$(f-g)(x) =$

$f(x) - g(x) =$

$(4x^2+20x+24)-(x+3) =$

$4x^2+20x+24-x-3 =$

$4x^2+19x+21 =$ domain $(-\infty, \infty)$

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

$(4x^2+20x+24)(x+3)$

$4x^3+12x^2+20x^2+60x+24x+72 =$

$4x^3+32x^2+84x+72 =$ domain $(-\infty, \infty)$

$\frac{f(x)}{g(x)} =$

$\frac{4x^2+20x+24}{x+3} =$

domain $\{x \mid x \neq -3\}$

$(-\infty, -3) \cup (-3, \infty)$

$\frac{4(x^2+5x+6)}{x+3} =$

$\frac{4(x+2)\cancel{(x+3)}}{\cancel{(x+3)}} = 4(x+2) =$

$4x+8 =$

(14) $f(x) = 3 - x$ and $g(x) = 3x^2 + x + 5$

Find $(f \circ g)(x)$, $g \circ f(x)$, $(f \circ g)(2)$, $(g \circ f)(2)$

14

$(f \circ g)(x) =$

$f(g(x)) =$

$f(3x^2 + x + 5) =$

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

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

$-3x^2 - x - 2 =$

$(f \circ g)(x) = -3x^2 - x - 2$

$(f \circ g)(2) = -3(2)^2 - (2) - 2$

$(f \circ g)(2) = -3(2)(2) - (2) - 2$

$(f \circ g)(2) = -12 - 2 - 2$

$(f \circ g)(2) = -16$

$(g \circ f)(x) =$

$g(f(x)) =$

$g(3 - x) =$

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

$3(3 - x)(3 - x) + (3 - x) + 5 =$

$3(9 - 3x - 3x + x^2) + (3 - x) + 5 =$

$3(x^2 - 6x + 9) + (3 - x) + 5 =$

$3x^2 - 18x + 27 + 3 - x + 5 =$

$3x^2 - 19x + 35 =$

$(g \circ f)(x) = 3x^2 - 19x + 35$

$(g \circ f)(2) = 3(2)^2 - 19(2) + 35$

$(g \circ f)(2) = 3(2)(2) - 19(2) + 35$

$(g \circ f)(2) = 12 - 38 + 35$

$(g \circ f)(2) = 9$

15. Find the distance between the pair of points $(3,8)$ and $(8,20)$.

$x_1 \quad y_1 \qquad x_2 \quad y_2$

15.

$$d=\sqrt{(x_1-x_2)^2+(y_1-y_2)^2}$$

$$d=\sqrt{((3)-(8))^2+((8)-(20))^2}$$

$$d=\sqrt{(3-8)^2+(8-20)^2}$$

$$d=\sqrt{(-5)^2+(-12)^2}$$

$$d=\sqrt{25+144}$$

$$d=\sqrt{169}$$

$$d=13$$

16. Find the midpoint of the line segment with the given endpoints (16)

(10, 8) and (2, 6)
x_1 y_1 x_2 y_2

$$\text{Midpoint} = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

$$\text{Midpoint} = \left(\frac{(10)+(2)}{2}, \frac{(8)+(6)}{2}\right)$$

$$\text{Midpoint} = \left(\frac{10+2}{2}, \frac{8+6}{2}\right)$$

$$\text{Midpoint} = \left(\frac{12}{2}, \frac{14}{2}\right)$$

$$\text{Midpoint} = (6, 7)$$

17. graph

17.

$x^2+y^2+10x+6y+33=0$

$x^2+10x+y^2+6y=-33$

$x^2+10x+\left(\frac{1}{2}(10)\right)^2+y^2+6y+\left(\frac{1}{2}(6)\right)^2=-33+\left(\frac{1}{2}(10)\right)^2+\left(\frac{1}{2}(6)\right)^2$

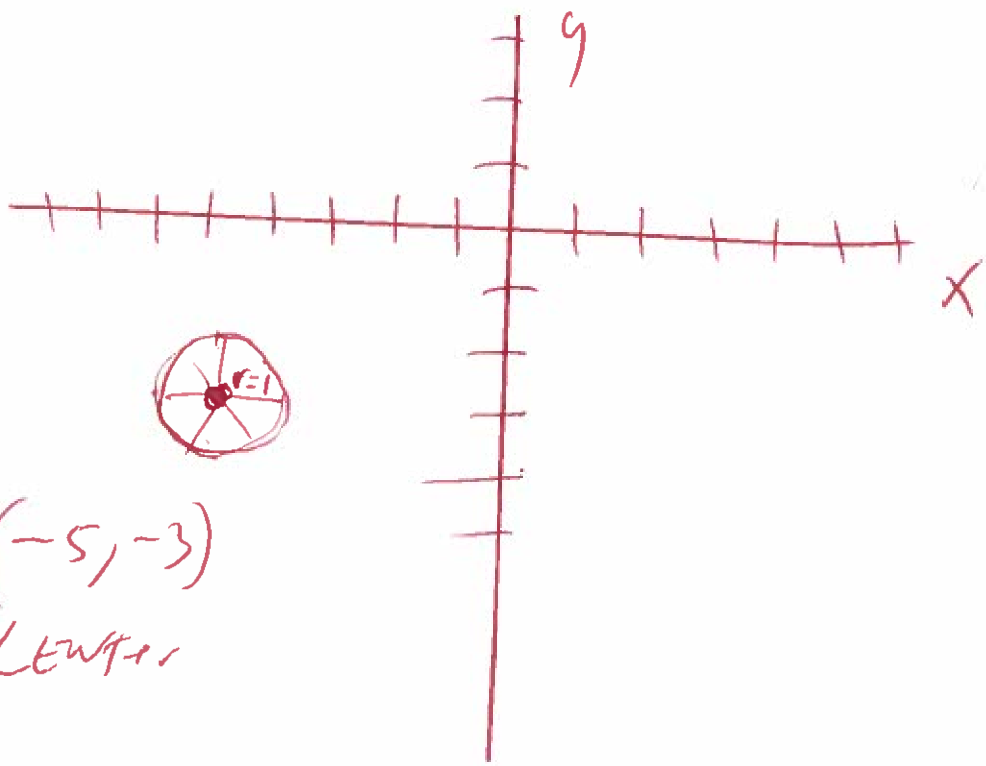
$x^2+10x+(5)^2+y^2+6y+(3)^2=-33+(5)^2+(3)^2$

$\underbrace{x^2+10x+25}+y^2+6y+9=-33+25+9$

$(x+5)(x+5)+(y+3)(y+3)=1$

$(x+5)^2+(y+3)^2=1$

CENTER $=(-5,-3)$ Radius $=\sqrt{1}=1$



$(-5,-3)$

CENTER

18. graph

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

$f(2) = (2-3)^2 + 2$

$f(2) = (-1)^2 + 2$

$f(2) = (-1)(-1) + 2$

$f(2) = 1 + 2$

$f(2) = 3$ ✓

$f(3) = (3-3)^2 + 2$

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

$f(3) = (0)(0) + 2$ ✓

$f(3) = 0 + 2$

$f(3) = 2$

$f(4) = (4-3)^2 + 2$

$f(4) = (1)^2 + 2$

$f(4) = (1)(1) + 2$

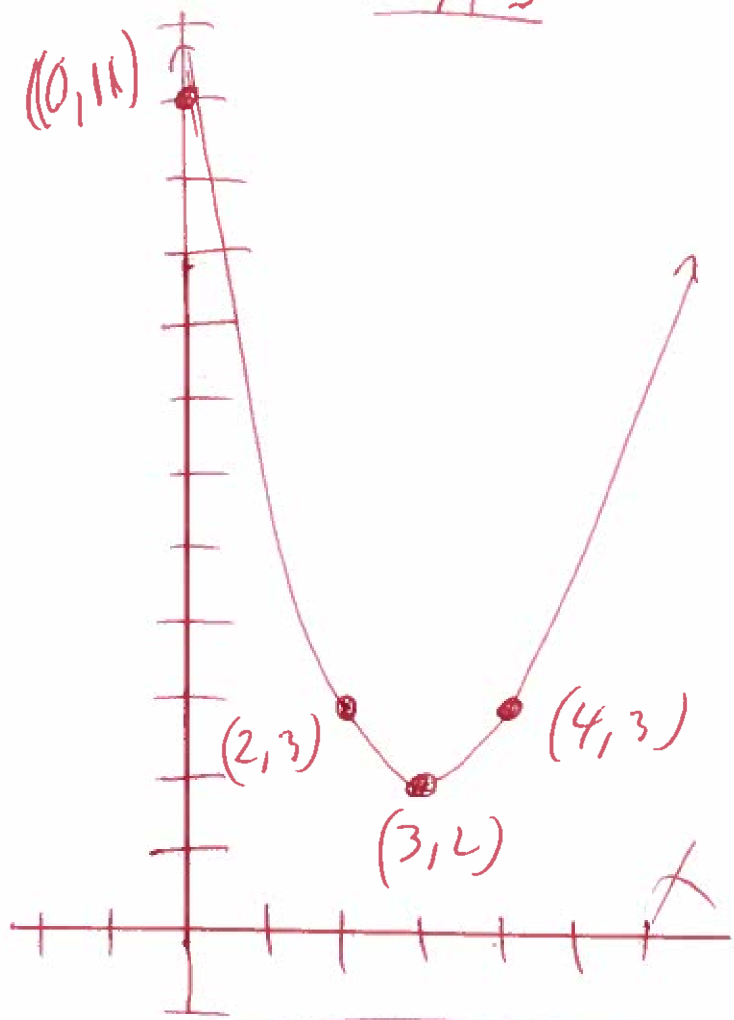
$f(4) = 1 + 2$ ✓

$f(4) = 3$

or f(x)

x	f(x)
2	3
3	2
4	3

18



domain $(-\infty, \infty)$ ✓

range $[2, \infty)$ ✓

OR use graphing calculator

$y_1 = (x-3)^2 + 2$

(19) graph

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

$f(-2) = 2(-2+1)^2 - 1$

$f(-2) = 2(-1)^2 - 1$

$f(-2) = 2(-1)(-1) - 1$

$f(-2) = 2(1) - 1$

$f(-2) = 2 - 1$

$f(-2) = 1$

$f(-1) = 2(-1+1)^2 - 1$

$f(-1) = 2(0)^2 - 1$

$f(-1) = 2(0)(0) - 1$

$f(-1) = 2(0) - 1$

$f(-1) = 0 - 1$

$f(-1) = -1$

$f(0) = 2(0+1)^2 - 1$

$f(0) = 2(1)^2 - 1$

$f(0) = 2(1)(1) - 1$

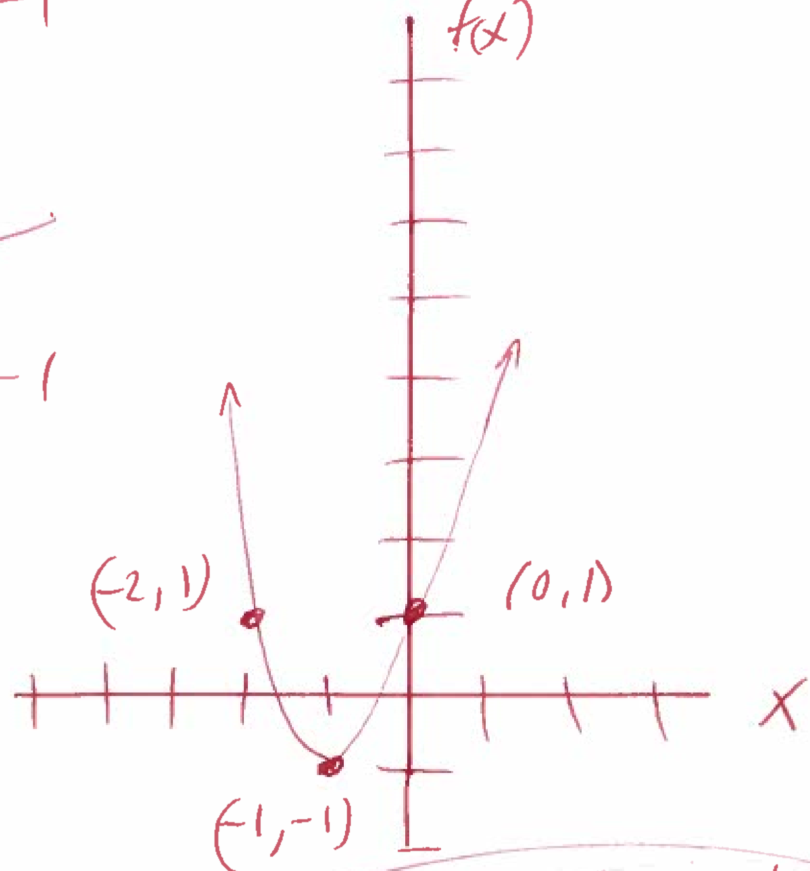
$f(0) = 2(1) - 1$

$f(0) = 2 - 1$

$f(0) = 1$

x	$f(x)$
-2	1
-1	-1
0	1

19.



axis of symmetry
$x = -1$

domain $= (-\infty, \infty)$
Range $= [-1, \infty)$

or use graphing calculator
$y_1 = 2(x+1)^2 - 1$

(20.) graph

$y = f(x) = x^2 + 4x + 3$

find x-intercept let $y=0$

$0 = x^2 + 4x + 3$

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

$x+1=0 \quad x+3=0$ $\quad (-1,0)\ (-3,0)$

$x+1-1=0-1 \quad x+3-3=0-3$

$x=-1 \quad x=-3$

---

find y-intercept let $x=0$

$f(0) = (0)^2 + 4(0) + 3$

$f(0) = (0)(0) + 4(0) + 3$

$f(0) = 0 + 0 + 3$ $\quad (0,3)$

$f(0) = 3$

$f(x) = 1x^2 + 4x + 3$

$a=1,\ b=4,\ c=3$

$\text{Vertex} = \left(\frac{-b}{2a}, f\left(-\frac{b}{2a}\right)\right)$

$\text{Vertex} = \left(\frac{-(4)}{2(1)}, f\left(\frac{-(4)}{2(1)}\right)\right)$

$\text{Vertex} = \left(\frac{-4}{2}, f\left(-\frac{4}{2}\right)\right)$

$\text{Vertex} = (-2, f(-2))$

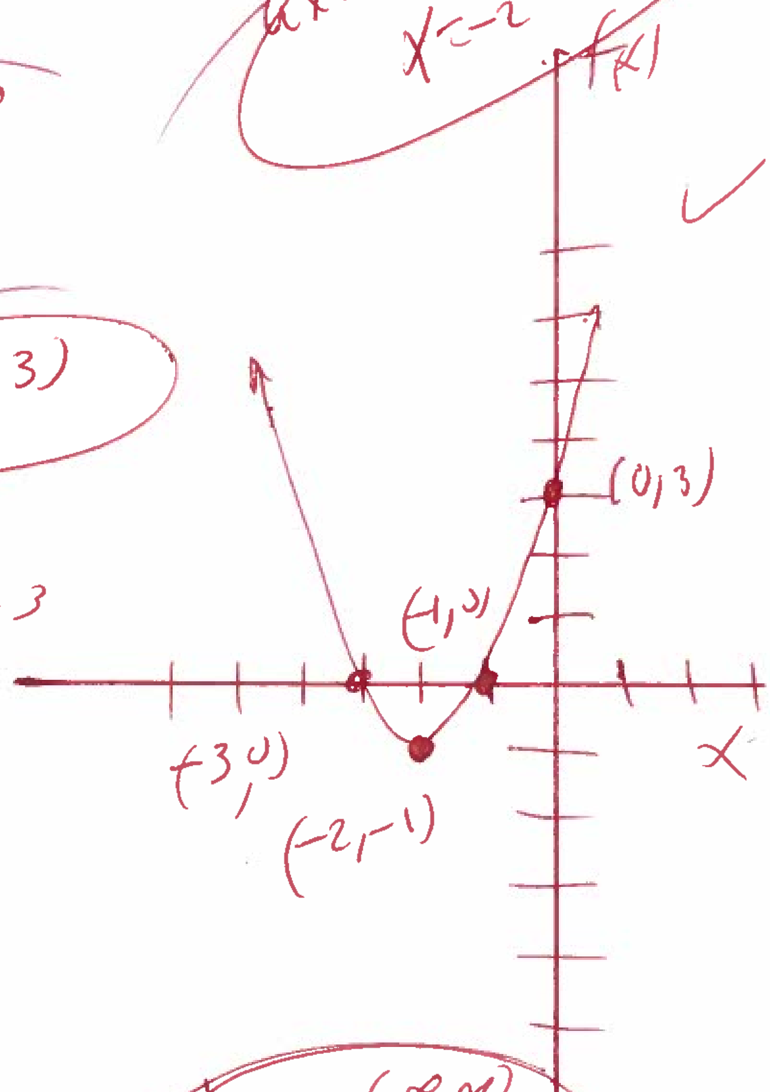
$\text{Vertex} = (-2, (-2)^2 + 4(-2) + 3)$

$\text{Vertex} = (-2, (-2)(-2) + 4(-2) + 3)$

$\text{Vertex} = (-2, -1)$

(20.)

axis of symmetry $x=-2$



domain $(-\infty, \infty)$
range $[-2, \infty)$

use graphing calculator $y_1 = x^2 + 4x + 3$

21. graph

$f(x) = 2x - x^2 + 8$

$y = f(x) = -x^2 + 2x + 8$

find x-intercept let $y = 0$

$0 = -x^2 + 2x + 8$

$-1(0) = -1(-x^2 + 2x + 8)$

$0 = x^2 - 2x - 8$

$0 = (x+2)(x-4)$

set $x + 2 = 0$ or $x - 4 = 0$

$x + 2 - 2 = 0 - 2$ or $x - 4 + 4 = 0 + 4$

$x = -2$ or $x = 4$

$(-2, 0)$ $(4, 0)$

21.

axis of symmetry

$x = 1$

Find the y-intercept let $x = 0$

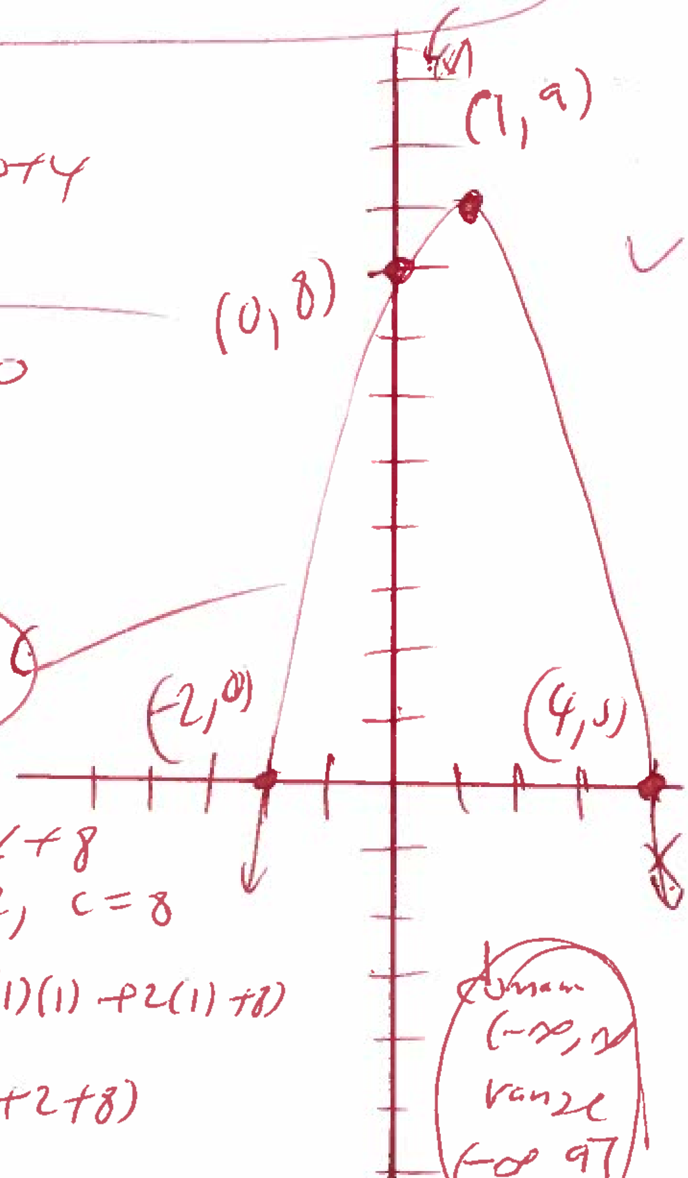
$f(0) = -(0)^2 + 2(0) + 8$

$f(0) = -(0)(0) + 2(0) + 8$

$f(0) = 0 + 0 + 8$

$f(0) = 8$

$(0, 8)$



Find the vertex $f(x) = -x^2 + 2x + 8$

$a = -1$, $b = 2$, $c = 8$

$\text{vertex} = \left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$

$\text{vertex} = \left(-\frac{(2)}{2(-1)}, f\left(-\frac{(2)}{2(-1)}\right)\right)$

$\text{vertex} = \left(\frac{-2}{-2}, f\left(\frac{-2}{-2}\right)\right)$

$\text{vertex} = (1, f(1))$

$\text{vertex} = (1, -(1)^2 + 2(1) + 8)$

$(1, -(1)(1) + 2(1) + 8)$

$(1, -1 + 2 + 8)$

$(1, 9)$

domain

$(-\infty, \infty)$

range

$(-\infty, 9]$

use graphing calculator

$y_1 = -x^2 + 2x + 8$

22 $x^3-5x^2+2x+8=0$ given $x=-1$ is a zero.

22

use synthetic division

$$\begin{array}{r|rrrr} -1 & 1 & -5 & 2 & 8 \\ & & -1 & 6 & -8 \\ \hline & 1 & -6 & 8 & 0 \end{array}$$ rem

Possible rational roots
$\pm 8, \pm 4, \pm 2, \pm 1$

set $x^2-6x+8=0$

$(x-2)(x-4)=0$

$x-2=0$ or $x-4=0$

$x-2+2=0+2$ or $x-4+4=0+4$

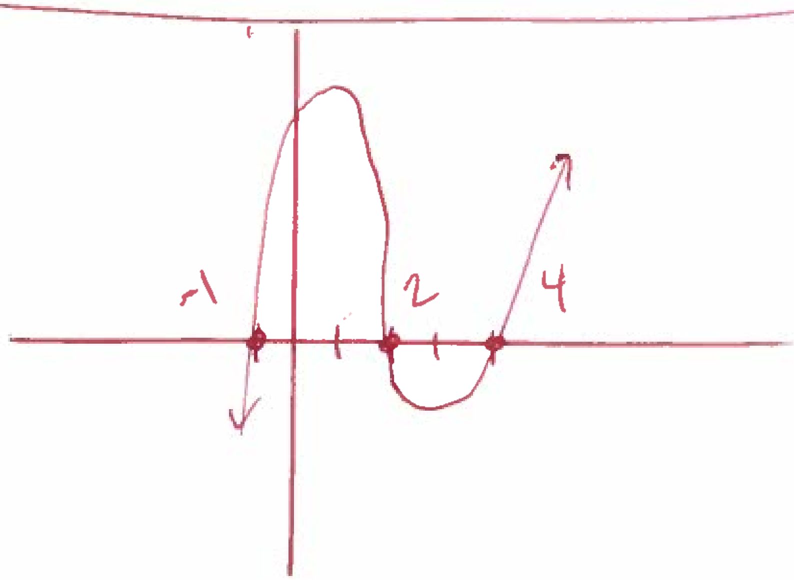
$x=2$ or $x=4$

$\{-1, 2, 4\}$

graph using graphing calculator

$y_1 = x^3-5x^2+2x+8$

$X_{min} = -6$
$X_{max} = 6$
$X_{scl} = 1$
$Y_{min} = -10$
$Y_{max} = 10$
$Y_{scl} = 1$



(23) $f(x) = 3x^3 - 7x^2 - 75x + 175 = 0$

Prime 2, 3, 5, 7....

$$\frac{\text{last}}{\text{first}} = \frac{\pm 175}{3}$$

$$\frac{\pm 175, \pm 25, \pm 35, \pm 5, \pm 7, \pm 1}{3, 1}$$

$5 \mid 175$
$5 \mid 35$
$7 \mid 7$
1

(23)

possible rational roots

$\pm 1, \pm 5, \pm 25, \pm 7, \pm 35, \pm 175, \pm \frac{1}{3}, \pm \frac{5}{3}, \pm \frac{25}{3}, \pm \frac{7}{3}, \pm \frac{35}{3}, \pm \frac{175}{3}$

$$\begin{array}{r|rrrr} 5 & 3 & -7 & -75 & 175 \\ & & 15 & 40 & -175 \\ \hline & 3 & 8 & -35 & 0 \end{array}$$

use synthetic division

possibly
3.1
35.1
7.5

$3x^2 + 8x - 35 = 0$

$(3x - 7)(x + 5) = 0$

Set $3x - 7 = 0$ or $x + 5 = 0$

$3x - \cancel{7} + \cancel{7} = 0 + 7$ or $x + \cancel{5} - \cancel{5} = 0 - 5$

$3x = 7$ or $x = -5$

$\frac{3x}{3} = \frac{7}{3}$ or

$x = \frac{7}{3}$ $x = -5$

$\{5, \frac{7}{3}, -5\}$ ✓

24 $x^3 - 2x^2 - 25x + 50 = 0$

Prime 2, 3, 5, 7...

$\frac{\text{Last}}{\text{First}}$ = possible rational roots

$2\overline{)50}$

$5\overline{)25}$

$5\overline{)5}$

1

24

$\frac{\pm 50}{1}$ = $\frac{\pm 50}{1}$, $\frac{\pm 25}{1}$, $\frac{\pm 10}{1}$, $\frac{\pm 5}{1}$, $\frac{\pm 1}{1}$

$\pm 1, \pm 5, \pm 50, \pm 2, \pm 10, \pm 25$ possible rational roots

use synthetic division

5	1	−2	−25	50
		5	15	−50
	1	3	−10	0 rem

$x^2 + 3x - 10 = 0$ possible 10·1, 2·5

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

set $x - 2 = 0$ or $x + 5 = 0$

$x - 2 + 2 = 0 + 2$ or $x + 5 - 5 = 0 - 5$

$x = 2$ or $x = -5$

$\{5, 2, -5\}$

25

$8x^3 - 46x^2 + 31x - 5 = 0$

$\frac{\text{Last}}{\text{First}} = \frac{\pm 5}{8}$ Possibly rational roots

25a

$\frac{\pm 5, \pm 1}{8, 4, 2, 1} =$

$\frac{\pm 5}{8}, \frac{\pm 5}{4}, \frac{\pm 5}{2}, \frac{\pm 5}{1}, \pm\frac{1}{8}, \pm\frac{1}{4}, \pm\frac{1}{2}, \pm\frac{1}{1} =$

$\pm 1, \pm 5, \pm\frac{1}{2}, \pm\frac{5}{2}, \pm\frac{1}{4}, \pm\frac{5}{4}, \pm\frac{1}{8}, \pm\frac{5}{8} =$

use synthetic division

$$\begin{array}{r|rrrr} 5 & 8 & -46 & 31 & -5 \\ & & 40 & -30 & 5 \\ \hline & 8 & -6 & +1 & 0 \end{array}$$

Possibly 8.1, 4.2, 1.1

$8x^2 - 6x + 1 = 0$

$(4x - 1)(2x - 1) = 0$

Let $4x - 1 = 0$ OR $2x - 1 = 0$

$4x - \cancel{1} + \cancel{1} = 0 + 1$ OR $2x - \cancel{1} + \cancel{1} = 0 + 1$

$4x = 1$ OR $2x = 1$

$\frac{4x}{4} = \frac{1}{4}$ OR $\frac{2x}{2} = \frac{1}{2}$

$x = 1/4$ OR $x = 1/2$

$\{5, \frac{1}{4}, \frac{1}{2}\}$

No graph

(26) $f(x) = -x^3 - 2x^2 + 13x - 10 = 0$

$\frac{\text{Last}}{\text{first}} = \frac{\pm 10}{1}$ Possible ration roots

26

$\frac{\pm 10}{1}, \frac{\pm 5}{1}, \frac{\pm 2}{1}, \frac{\pm 1}{1} =$

$\pm 1, \pm 2, \pm 5, \pm 10$

use synthetic division

$$\begin{array}{r|rrrr} 1 & -1 & -2 & 13 & -10 \\ & & -1 & -3 & 10 \\ \hline & -1 & -3 & 10 & 0 \end{array}$$ Rem

$-1x^2 - 3x + 10 = 0$

$-1(-1x^2 - 3x + 10) = -1(0)$ Mult by

$x^2 + 3x - 10 = 0$

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

Set $x - 2 = 0$ or $x + 5 = 0$

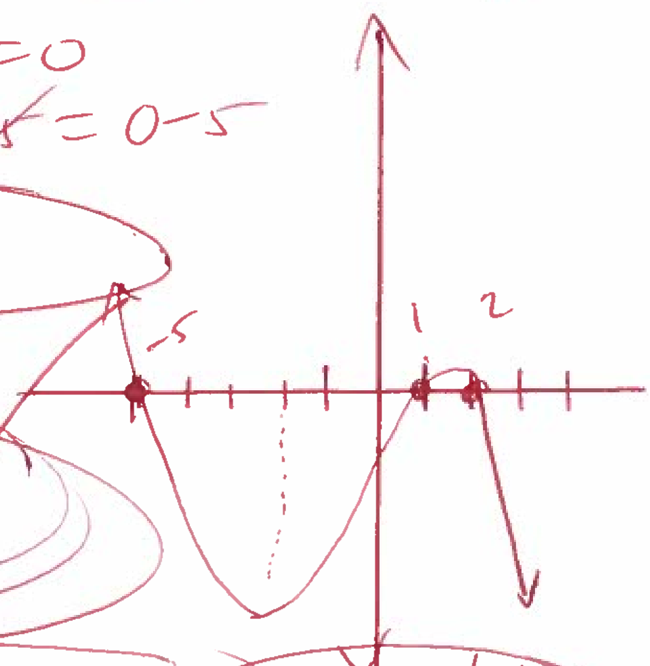
$x - 2 + 2 = 0 + 2$ or $x + \cancel{5} - \cancel{5} = 0 - 5$

$x = 2$ or $x = -5$

$\{1, 2, -5\}$

window
$X_{min} = -10$
$X_{max} = 10$
$X_{scl} = 1$
$Y_{min} = -50$
$Y_{max} = 50$
$Y_{scl} = 1$

10.1
2.5



$Y_1 = -x^3 - 2x^2 + 13x - 10$ use graphing calculator

27. find the horizontal asymptote

(27)

$$y = \frac{x-10}{3x^2+x+1} =$$

$$\lim_{x\to\infty} \frac{x-10}{3x^2+x+1} =$$

$$\lim_{x\to\infty} \left(\frac{x-10}{3x^2+x+1}\right)\left(\frac{\frac{1}{x^2}}{\frac{1}{x^2}}\right) =$$

$$\lim_{x\to\infty} \frac{\frac{x}{x^2} - \frac{10}{x^2}}{\frac{3x^2}{x^2} + \frac{x}{x^2} + \frac{1}{x^2}} =$$

formula

$$\lim_{x\to\infty} \frac{1}{x^n} = 0$$

$$\lim_{x\to\infty} \frac{\frac{1}{x} - \frac{10}{x^2}}{3 + \frac{1}{x} + \frac{1}{x^2}} =$$

$$\frac{0-0}{3+0+0} =$$

$$\frac{0}{3} =$$

$$0 =$$

horizontal asymptote

$$y = 0$$

28. find the slant asymptote

28

$$f(x) = \frac{5x^2-4x+7}{x-6}$$

use synthetic division

$$\begin{array}{r|rrr} 6 & 5 & -4 & 7 \\ & & 30 & 130 \\ \hline & 5 & 26 & 137 \end{array}$$ rem

$y = 5x + 26$

SLANT

29 find the vertical asymptote

29

$$f(x)=\frac{x-5}{x^2-7x+10}$$

$$f(x)=\frac{\cancel{x-5}}{(x-2)\cancel{(x-5)}}$$

hole $x-5=0$

$x-5+5=0+5$

$x=5$

$$f(x)=\frac{1}{x-2}$$

set $x-2=0$

$x-2+2=0+2$

$x=2$ vertical asymptote

30. Find the horizontal asymptote

30.

$$f(x) = \frac{18x}{8x^2+9}$$

$$\lim_{x \to \infty} \left(\frac{18x}{8x^2+9}\right) =$$

$$\lim_{x \to \infty} \left(\frac{18x}{8x^2+9}\right) \frac{\frac{1}{x^2}}{\frac{1}{x^2}} =$$

$$\lim_{x \to \infty} \frac{\frac{18x}{x^2}}{\frac{8x^2}{x^2} + \frac{9}{x^2}} =$$

formula

$$\lim_{x \to \infty} \frac{1}{x^n} = 0$$

$$\lim_{x \to \infty} \frac{\frac{18}{x}}{8 + \frac{9}{x^2}} =$$

$$\frac{0}{8+0} =$$

$$\frac{0}{8} =$$

$$0 =$$

$y = 0$ horizontal asymptote

31. find horizontal asymptote

31.

$$g(x) = \frac{28x^2}{7x^2+6} =$$

$$\lim_{x\to\infty} \frac{28x^2}{7x^2+6} =$$

$$\lim_{x\to\infty} \left(\frac{28x^2}{7x^2+6}\right) \frac{\frac{1}{x^2}}{\frac{1}{x^2}} =$$

$$\lim_{x\to\infty} \left(\frac{\frac{28\cancel{x^2}}{\cancel{x^2}}}{\frac{7\cancel{x^2}}{\cancel{x^2}} + \frac{6}{x^2}}\right) =$$

formula

$$\lim_{x\to\infty} \frac{1}{x^n} = 0$$

$$\lim_{x\to\infty} \frac{28}{7 + \frac{6}{x^2}} =$$

$$\frac{28}{7+0} =$$

$$\frac{28}{7} =$$

$$4 =$$

$y = 4$ horizontal asymptote

32. $f(x) = 1000(0.5)^{\frac{x}{30}}$ 32

find $f(40) = 1000(0.5)^{\left(\frac{40}{30}\right)}$

use graphing calculator

$f(40) = 1000(0.5)^\wedge(40/30)$

$f(40) = 396.850263$

since $f(40) = 396.850263 > 100$

then area is not safe for human habitation

33. Find the domain

$f(x) = \log(10-x)$

set $10 - x > 0$

$\cancel{10} - x - \cancel{10} > 0 - 10$

$-x > -10$

$\frac{-x}{-1} < \frac{-10}{-1}$

$x < 10$

10

$(-\infty, 10)$

33.

formula

$f(x) = \log(Ax+B)$

set $Ax + B > 0$

34 expand

34.

$$\log_b\left(\frac{x^2y}{z^7}\right) =$$

$$\log_b(x^2y) - \log_b(z^7) =$$

$$\log_b(x^2) + \log_b(y) - \log_b(z^7) =$$

$$2\log_b(x) + \log_b(y) - 7\log_b(z) =$$

formulas

$$\log\left(\frac{A}{B}\right) = \log(A) - \log(B)$$

$$\log(AB) = \log(A) + \log(B)$$

$$\log(A^N) = N\log(A)$$

35. expand

$$\ln\left(\frac{x^5\sqrt{x^2+5}}{(x+5)^3}\right) =$$

35.

$$\ln\left(x^5\sqrt{x^2+5}\right) - \ln(x+5)^3 =$$

$$\ln(x^5) + \ln\sqrt{x^2+5} - \ln(x+5)^3 =$$

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

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

formulas

$$\ln\left(\frac{A}{B}\right) = \ln(A) - \ln(B)$$

$$\ln(AB) = \ln(A) + \ln(B)$$

$$\ln(A^N) = N\ln(A)$$

36

$$16^{x+8} = 256^{x-4}$$

$$(4^2)^{x+8} = (4^4)^{x-4}$$

$$4^{2x+16} = 4^{4x-16}$$

$$2x+16 = 4x-16$$

$$2x+\cancel{16}\cancel{-16} = 4x-16-16$$

$$2x = 4x-32$$

$$2x-4x = 4x-32-4x$$

$$-2x = -32$$

$$\frac{-2x}{-2} = \frac{-32}{-2}$$

$$x = 16$$

36.

37.

$4^{x+1} = 471$

$\ln(4^{x+1}) = \ln(471)$

$(x+1)\ln(4) = \ln(471)$

$\frac{(x+1)\cancel{\ln(4)}}{\cancel{\ln(4)}} = \frac{\ln(471)}{\ln(4)}$

$x+1 = \frac{\ln(471)}{\ln(4)}$

$x+\cancel{1}-\cancel{1} = \frac{\ln(471)}{\ln(4)} - 1$

$x = \frac{\ln(471)}{\ln(4)} - 1$

$x = 3.439791625$

OR

Round

$x = 3.44$

37

formula

$\ln(A^N) = N\ln(A)$

38. $\log_9(x) + \log_9(8x-1) = 1$ $\quad$ 38

$\log_9 (x)(8x-1) = 1$

$9^1 = x(8x-1)$

$9 = 8x^2 - x$

$0 = 8x^2 - x - 9$

$0 = (8x-9)(x+1)$

$8 \cdot 1$, $2 \cdot 4$ $\quad$ $9 \cdot 1$, $3 \cdot 3$

set $8x - 9 = 0$ OR $x + 1 = 0$

$8x - \cancel{9} + \cancel{9} = 0 + 9$ OR $x + \cancel{1} - \cancel{1} = 0 - 1$

$8x = 9$ OR $x = -1$

$\frac{8x}{8} = \frac{9}{8}$ OR $\cancel{x = -1}$

$x = 9/8$ $\quad$ $\left\{ \frac{9}{8} \right\}$

Ck

$\log_9(x) + \log_9(8x-1) = 1$

$\log_9(-1) + \log_9(8(-1)-1) = 1$

$\underset{BAD}{\log_9(-1)} + \underset{BAD}{\log_9(-9)} = 1$

$\log_9(9/8) + \log_9(8(9/8) - 1) = 1$

$\underset{Good}{\log_9(9/8)} + \underset{Good}{\log_9(9-1)} = 1$

39.

$\log_5(x+18)+\log_5(x+118)=5$

$\log_5(x+18)(x+118)=5$

39.

$5^5=(x+18)(x+118)$

$3125=x^2+118x+18x+2124$

$3125=x^2+136x+2124$

$0=x^2+136x+2124-3125$

$0=x^2+136x-1001$

{7}

$0=(x-7)(x+143)$

so $x-7=0$ or $x+143=0$

$x-7+7=0+7$ or $\cancel{x+143-143=0-143}$

$x=7$ or $\cancel{x=-143}$

Ck $\log_5(x+18)+\log_5(x+118)=5$

$\log_5(-143+18)+\log_5(-143+118)=5$

$\log_5(-125)+\log_5(-25)=5$

BAD BAD

$\log_5(7+18)+\log_5(7+118)=5$

$\log_5(25)+\log_5(125)=5$

Good Good

---

40. $\log_4(x+13) - \log_4(x-2) = 2$

$$\log_4\left(\frac{x+13}{x-2}\right) = 2$$

40.

$$4^2 = \frac{x+13}{x-2}$$

$$\frac{16}{1} = \frac{x+13}{x-2}$$

$16(x-2) = 1(x+13)$ Cross Mult

$$16x - 32 = 1x + 13$$

$$16x - \cancel{32} + \cancel{32} = 1x + 13 + 32$$

$$16x = 1x + 45$$

$$16x - 1x = \cancel{1x} + 45 - \cancel{1x}$$

$$15x = 45$$

$$\frac{15x}{15} = \frac{45}{15}$$

$$x = 3$$

$$\{3\}$$

Ck

$$\log_4(3+13) - \log_4(3-2) = 2$$

$$\log_4(16) - \log_4(1) = 2$$

Good Good

41

$$\log(x) + \log(x+6) = \log(7)$$

$$\cancel{\log}(x)(x+6) = \cancel{\log}(7)$$

$$x(x+6) = 7$$

$$x^2 + 6x = 7$$

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

$$(x-1)(x+7) = 0$$

then $x - 1 = 0$ or $x + 7 = 0$

$x - 1 + 1 = 0 + 1$ or $x + \cancel{7} - \cancel{7} = 0 - 7$

$x = 1$ or $\cancel{x = -7}$

41.

ck

$$\log(x) + \log(x+6) = \log(7)$$

$$\log(-7) + \log(-7+6) = \log(7)$$

$$\log(-7) + \log(-1) = \log(7)$$

BAD BAD

$\{1\}$

$$\log(1) + \log(1+6) = \log(7)$$

$$\log(1) + \log(7) = \log(7)$$ ✓

Good Good Good

(42)

$$A = P\left(1+\frac{r}{n}\right)^{nt}$$

$P = 11500$
$A = 15000$
$n = 2$
$r = 4.75\%$

find t

(42)

$$15000 = 11500\left(1+\frac{.0475}{2}\right)^{2t}$$

$$\frac{15000}{11500} = \frac{\cancel{11500}\left(1+\frac{.0475}{2}\right)^{2t}}{\cancel{11500}}$$

$$\frac{15000}{11500} = \left(1+\frac{.0475}{2}\right)^{2t}$$

$$\frac{15000}{11500} = (1+.02375)^{2t}$$

$$\frac{15000}{11500} = (1.02375)^{2t}$$

$$\ln\left(\frac{15000}{11500}\right) = \ln(1.02375)^{2t}$$

$$\ln\left(\frac{15000}{11500}\right) = 2t\ln(1.02375)$$

$$\frac{\ln\left(\frac{15000}{11500}\right)}{(2\ln(1.02375))} = \frac{2t\ln(1.02375)}{(2\ln(1.02375))}$$

$$5.659916799 = t$$

or Round

$$5.7 = t$$

43.

$$177 = 134.9e^{0.021t}$$

$$\frac{177}{134.9} = \frac{\cancel{134.9}e^{0.021t}}{\cancel{134.9}}$$

$$\frac{177}{134.9} = e^{0.021t}$$

$$\ln\left(\frac{177}{134.9}\right) = \ln\left(e^{0.021t}\right)$$

$$\ln\left(\frac{177}{134.9}\right) = 0.021t\ln(e)$$

$$\ln\left(\frac{177}{134.9}\right) = 0.021t(1)$$

$$\ln\left(\frac{177}{134.9}\right) = 0.021t$$

$$\frac{\ln\left(\frac{177}{134.9}\right)}{0.021} = \frac{\cancel{0.021}t}{\cancel{0.021}}$$

$$12.93409378 = t$$

Round

$$13 = t$$

YEARS

43.

add YEARS

$$\begin{array}{r} 2003 \\ +\ 13 \\ \hline 2016 \end{array}$$

ANSwer

44.

$$A = 16e^{-0.000121t}$$ eval if $t = 6019$

44

$$A = 16e\text{^}(-0.000121(6019))$$

$$A = 7.7236706\,38$$

or

Round

$$A = 8$$

45

46

$$A = A_0 e^{-0.000121t}$$

$$13 = 100 e^{-0.000121t}$$

$$\frac{13}{100} = \frac{\cancel{100} e^{-0.000121t}}{\cancel{100}}$$

$$.13 = e^{-0.000121t}$$

$$\ln(.13) = \ln\left(e^{-0.000121t}\right)$$

$$\ln(.13) = -0.000121t \ln(e)$$

$$\ln(.13) = -0.000121t(1)$$

$$\frac{\ln(.13)}{-0.000121} = \frac{\cancel{-0.000121}\, t}{\cancel{-0.000121}}$$

$$16861.3296 = t$$

OR Round

$$16861 = t$$

46

46

$$12 = 6e^{0.008t}$$

$$\frac{12}{6} = \frac{\cancel{6}e^{0.008t}}{\cancel{6}}$$

$$2 = e^{0.008t}$$

$$\ln(2) = \ln\left(e^{0.008t}\right)$$

$$\ln(2) = 0.008t\ \ln(e)$$

$$\ln(2) = 0.008t\ (1)$$

$$\ln(2) = 0.008t$$

$$\frac{\ln(2)}{0.008} = \frac{\cancel{0.008}t}{\cancel{0.008}}$$

$r = 0.8\%$

$$86.6433\cancel{9}757 = t$$

OR Round

$$87 = t$$

47.

$$x+y+7z=12$$
$$x+y+5z=10$$
$$x-8y-2z=-24$$

47.

Use graphing calculator

2ND, matrix, Edit, [A], 3x4,

2ND, matrix, Math, rref(2ND matrix [A])

rref([A]) =

$$\begin{bmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 1 \end{bmatrix}$$

$(x, y, z) = (2, 3, 1)$

48.

$$\sum_{x=1}^{3} x(x+2)$$

48.

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

$(1)(3) + (2)(4) + (3)(5) =$

$3 + 8 + 15 =$

$26 =$

Use graphing calculator

Math

Summation Σ

$$\sum_{\square=\square}^{\square} \square$$

$$\sum_{x=1}^{3} \left(x(x+2) \right) = 26$$

49 Expand use Binomial theorem 49

$(X+9)^3$

${}_3C_0(x)^3(9)^0 + {}_3C_1(x)^2(9)^1 + {}_3C_2(x)^1(9)^2 + {}_3C_3(x)^0(9)^3 =$

$(1)(x^3)(1) + (3)(x^2)(9) + (3)(x)(81) + (1)(1)(729) =$

$x^3 + 27x^2 + 243x + 729 =$

3, Math, PRB, nCr, enter, 0, enter = 1
3, Math, Prb, nCr, enter, 1, enter = 3
3, Math, PrB, nCr, enter, 2, enter = 3
3, Math, PrB, nCr, enter, 3, enter = 1

50 expand using Binomial Theorem

50.

$(4x+y)^3$

$_3C_0(4x)^3(y)^0 + {}_3C_1(4x)^2(y)^1 + {}_3C_2(4x)^1(y)^2 + {}_3C_3(4x)^0(y)^3 =$

$(1)(4^3x^3)(1) + (3)(4^2x^2)(y) + (3)(4x)(y^2) + (1)(1)(y^3) =$

$(1)(64x^3)(1) + (3)(16x^2)(y) + (3)(4x)y^2 + (1)(1)(y^3) =$

$64x^3 + 48x^2y + 12xy^2 + y^3 =$

3, math, Prb, nCr, enter, 0, enter = 1

3, math, Prb, nCr, enter, 1, enter = 3

3, math, Prb, nCr, enter, 2, enter = 3

3, math, Prb, nCr, enter, 3, enter = 1

51. expand use Binomial theorem (51)

$(3x-1)^3$

$_3C_0(3x)^3(-1)^0 + {_3C_1}(3x)^2(-1)^1 + {_3C_2}(3x)^1(-1)^2 + {_3C_3}(3x)^0(-1)^3 =$

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

$(1)(27x^3)(1) + (3)(9x^2)(-1) + (3)(3x)(1) + (1)(1)(-1) =$

$27x^3 - 27x^2 + 9x - 1 =$ ✓

3, Math, Prb, nCr, enter, 0, enter = 1

3, Math, Prb, nCr, enter, 1, enter = 3

3, Math, Prb, nCr, enter, 2, enter = 3

3, Math, Prb, nCr, enter, 3, enter = 1

use graphing calculator

52. write the first three terms of the binomial expansion

52

$(x+2)^9 =$

$_9C_0 (x)^9 (2)^0 + {}_9C_1 (x)^8 (2)^1 + {}_9C_2 (x)^7 (2)^2 =$

$(1)(x^9)(1) + (9)(x^8)(2) + (36)(x^7)(4) =$

$x^9 + 18x^8 + 144x^7 =$ ✓

9, math, Prb, nCr, enter, 0, enter = 1

9, math, Prb, nCr, enter, 1, enter = 3

9, math, Prb, nCr, enter, 2, enter = 3

9, math, Prb, nCr, enter, 3, enter = 1

53 write the first three terms of the binomial expansion

5

$(x-2y)^7 =$

${}_7C_0 (x)^7(-2y)^0 + {}_7C_1 (x)^6(-2y)^1 + {}_7C_2 (x)^5(-2y)^2 =$

$(1)(x^7)(1) + (7)(x^6)(-2y) + (21)(x^5)(-2y)(-2y) =$

$(1)(x^7)(1) + (7)(x^6)(-2y) + (21)(x^5)(4y^2) =$

$x^7 - 14x^6y + 84x^5y^2 =$ ✓

1st term 2nd term 3rd term

use graphing calculator

7, Math, Prb, nCr, enter, 0, enter = 1

7, Math, Prb, nCr, enter, 1, enter = 7

7, Math, Prb, nCr, enter, 2, enter = 21