C12 - 9.0 - Rationals Review

Holes: Factor the top, Factor the bottom. If a factor cancels, there is a hole when the factor equals zero.

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

$$\begin{array}{c} x - 3 = 0 \\ x = 3 \end{array}$$

$$y = \frac{1}{(3) + 2} = \frac{1}{5}$$ $Hole:$ $\left(3, \frac{1}{5}\right)$

Domain Restriction: $x \neq 3$

$\boxed{R: y \neq hole}$

Vertical Asymptote: $denominator = 0$

$$y = \frac{1}{x + 1}$$ $\begin{array}{c} x + 1 = 0 \\ x = -1 \end{array}$ *Set denominator equal to zero and solve.*

$$VA: \quad x = -1$$ $\boxed{\text{Domain Restriction: } x \neq VA \text{ or Holes}}$

VA

x	y
-2	-1
-1	*und*
0	1

Point on Both sides of VA
(And between VA's)

Horizontal Asymptote:

Case 1:   *Case 2:*   *Case 3:*

$$x^2, \frac{x^2}{x}$$ $$\frac{1}{x}, \frac{1}{x^2}$$ $HA: \quad y = 0$ $$\frac{3x^2}{2x^2}$$ $HA: \quad y = \frac{3}{2}$

$HA: \quad none$ $$\frac{1}{x} + c, \frac{1}{x^2} + c$$ $HA: \quad y = c$ $$\frac{3x^2}{2x^2} + c$$ $HA: \quad y = \frac{3}{2} + c$

x	y
$-\infty$	?
∞	?

$\boxed{\text{Range Restrictions: } y \neq HA \text{ or Holes}}$

Intercepts $x - intercepts: Set\ y = 0\ and\ Solve$ $(x, 0)$

$y - interceptes: Set\ x = 0\ and\ Solve$ $(0, y)$

$\boxed{\begin{array}{l} \text{Close to asymptote} \\ \text{Through point/s} \\ \text{Close to asymptote} \end{array}}$

Slant Asymptote: *Do Synthetic or Long Division and if the Quotient, the Answer, is a linear function that is the equation of the slant asymptote. (Case \#1)*

$Graph:$ $Holes, VA, HA, TOV, x - int, y - int, SA$

$\frac{2}{x-1} + 3$	$\frac{2}{x-1} + 3$ $\frac{2}{x-1} + 3 \times \frac{x-1}{x-1}$ $\frac{2}{x-1} + \frac{3x-3}{x-1}$ $\frac{3x-1}{x-1}$	$\begin{array}{r} 3 \\ x-1 \overline{)\ 3x - 1} \\ \underline{3x - 3} \\ 2 \end{array}$ $3 + \frac{2}{x-1}$	$\begin{array}{c} x - 1 = 0 \\ x = +1 \end{array}$ $\begin{array}{r} 3x - 1 \\ +1 | 3 \quad -1 \\ + \Big\downarrow \ +3 \\ \hline 3 \quad 2 \end{array}$ $3 \ R:2$	$\frac{2}{x-1} + 3 = \frac{3x-1}{x-1}$

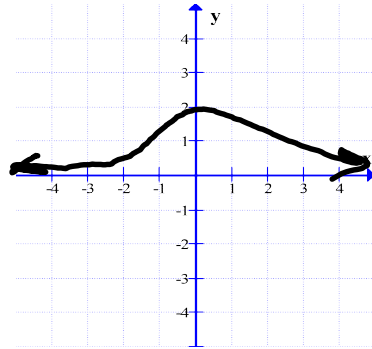$\boxed{y = \frac{a}{x - h} + k}$ $\boxed{y = \frac{a}{VA} + HA}$ $\boxed{y = \frac{a(HA)(x - int)(holes)}{(HA)(VA's)(holes)}}$
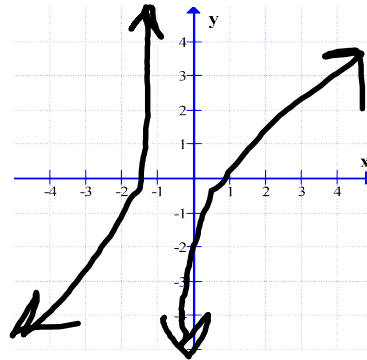
C12 - 9.0 - Rationals Graphs

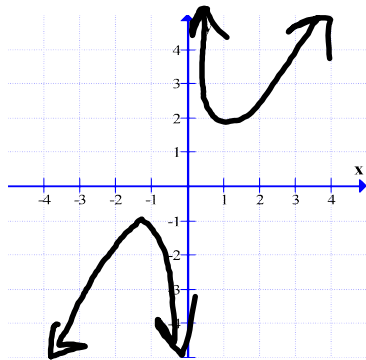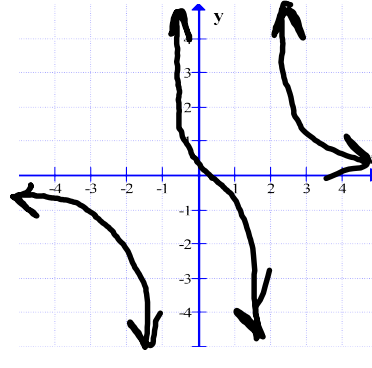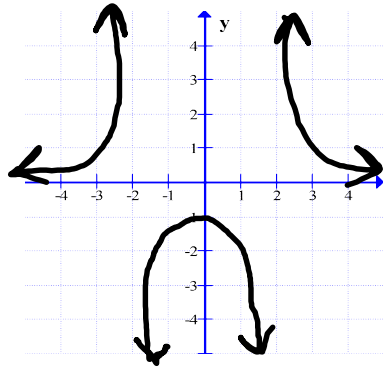$y = \dfrac{1}{x}$
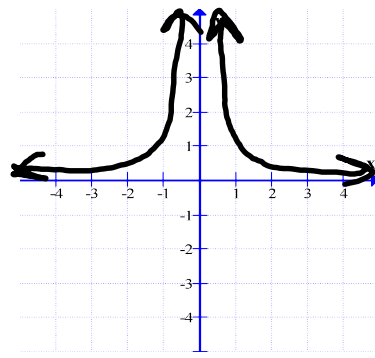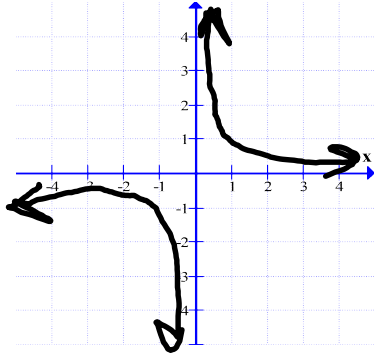
$y = \dfrac{1}{x^2}$

$y = \dfrac{1}{x^2 + 1}$

C12 - 9.1 - Graph TOV HT xy-int Notes

$$y = \frac{a}{x - h} + k$$

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

$$y = \frac{1}{\left(-\frac{1}{10}\right)}$$

$$y = 1\left(-\frac{10}{1}\right)$$

$$y = -10$$
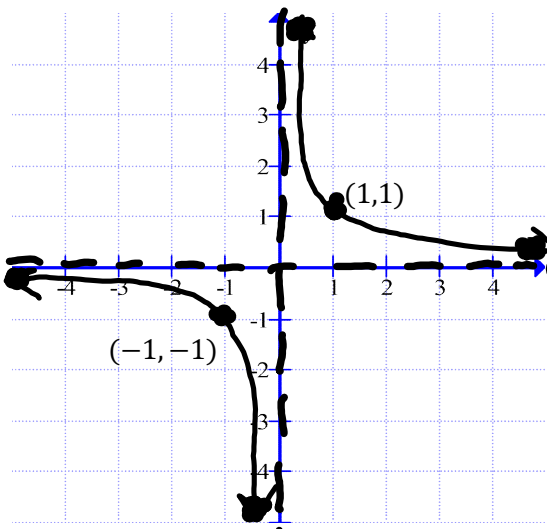
x	y
-5	$-\frac{1}{5} = -0.2$
-1	-1
$-\frac{1}{10} = -0.1$	-10
0	und
$\frac{1}{10} = 0.1$	10
1	1
5	$\frac{1}{5}$

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

(1,1)

(−1,−1)

HA: $y = 0$

HA: $y = k$

VA: $x = 0$

VA: Set Denominator $= 0$ and $solve$

$x = 0$ Domain: $x \neq 0$
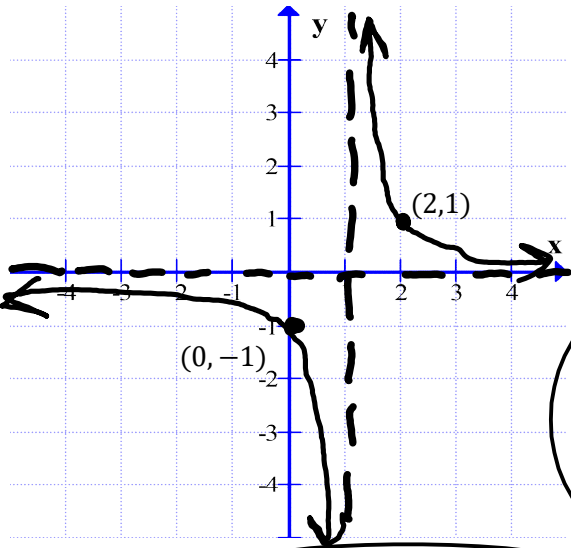
$x - int:$

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

$0 = \frac{1}{x}$

$0 \neq 1$

$y - int:$

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

$y = \frac{1}{0}$

$y \neq$

HT $= +1$

$y = \frac{1}{x - 1}$

HA: $y = 0$

Range

$y \neq 0$

(2,1)

(0,−1)

VA: $x = 1$ Domain: $x \neq 1$

End Behavior

$x \to \infty,$ $y \to 0^+$
$x \to -\infty,$ $y \to 0^-$

As x gets close to …

Behavior near Asymptote

$x \to 1^+,$ $y \to \infty$
$x \to 1^-,$ $y \to -\infty$

$VA:$

$x - 1 = 0$

$x = 1$

$x - int:$

$y = \frac{1}{x - 1}$

$0 = \frac{1}{x - 1}$

Careful! $(x - 1) \times 0 = \frac{1}{x - 1} \times (x - 1)$

$0 \neq 1$

$y - int:$

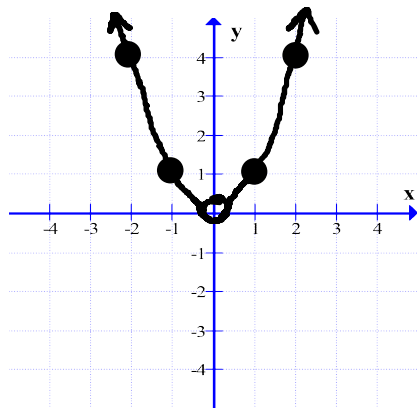$y = \frac{1}{x - 1}$

$y = \frac{1}{0 - 1}$

$y = -1$

(0,−1)

x	y
0	-1
1	und
2	1

C12 - 9.1 - Horizontal Asymptotes Cases Notes

$$y = \frac{ax^m}{bx^n} \quad \begin{array}{ll} m > n & HA: \;\; none \\ m < n & HA: \; y = 0 \quad or \quad HA: \; y = c \\ m = n & HA: \; y = \dfrac{a}{b} \quad or \quad HA: \; y = \dfrac{a}{b} + c \end{array}$$

Case 1:

$$y = \frac{x^3}{x^1}$$

If the exponent of x is higher on the top than the bottom

$$HA: \;\; none$$

Case 2:

$$y = \frac{x^1}{x^2}$$

$$\frac{x^1}{x^2} + 1 = \frac{1x^1 + 1x^2}{1x^2}$$

$$LCD$$
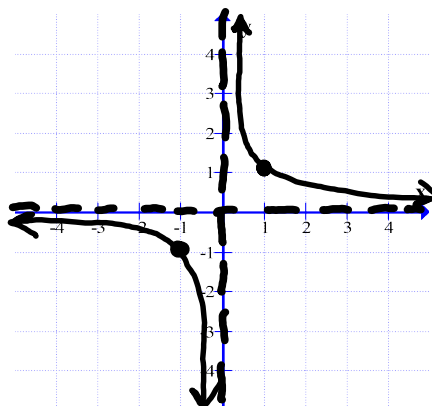
$$y = \frac{x^1}{x^2} + 1$$

If the exponent of x is higher on the bottom

$$HA: \; y = 0$$
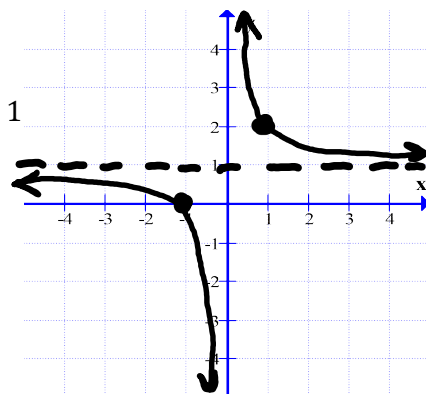
If case 2 is shifted up or down $= c$

$$HA: \; y = c \qquad y = 1$$

Case 3:

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

$$\frac{4x^2}{1x^2 + 1} + 1 = \frac{5x^2 + 1}{1x^2 + 1}$$

$$LCD$$
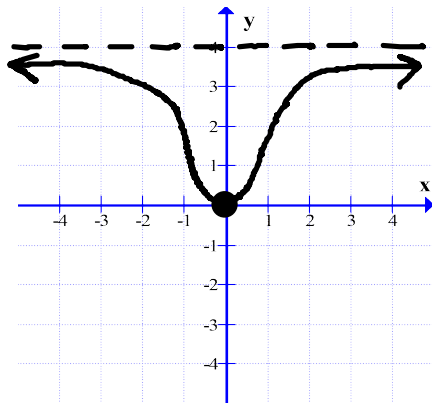
$$y = \frac{4x^2}{1x^2 + 1} + 1$$

If the exponent of x is the same on the top as the bottom

$$HA: \; y \; = \; fraction \; of \; coefficients$$

$$HA: \; y = \frac{4}{1}$$
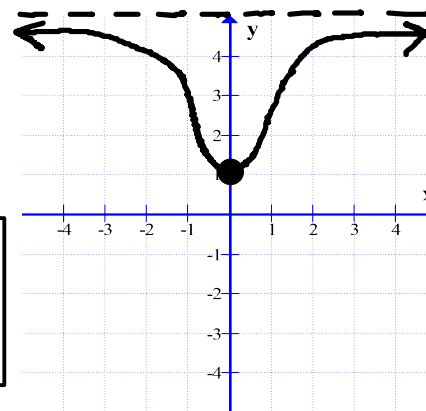
If case 3 is shifted up or down $= c$

$$HA: \; y = \; fraction \; of \; coefficients \; + \; c$$

$$HA: \; y = \frac{4}{1} + 1 = 5$$

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

$(1,1)$

$(-1,-1)$

$HA:\ y = 0$

$VA:\ x = 0$

x	y
-1	-1
0	und
1	1

$VT = +1$

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

$(1,2)$

$HA:\ y = 1$

$(-1,0)$

$y = \frac{a}{VA} + HA$

$VA:\ x = 0$

Add Fractions

$$\frac{1}{x} + 1$$

$$\frac{1}{x} + 1 \times \frac{x}{x}$$

LCD
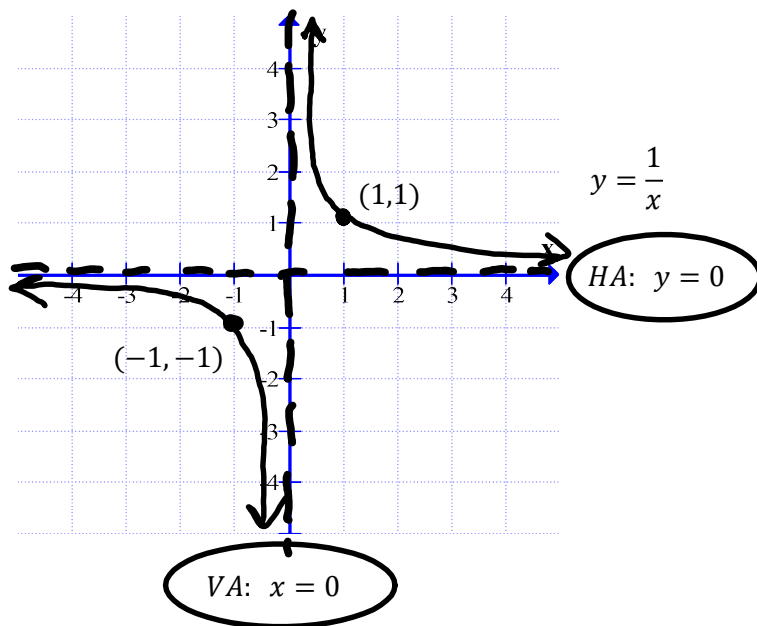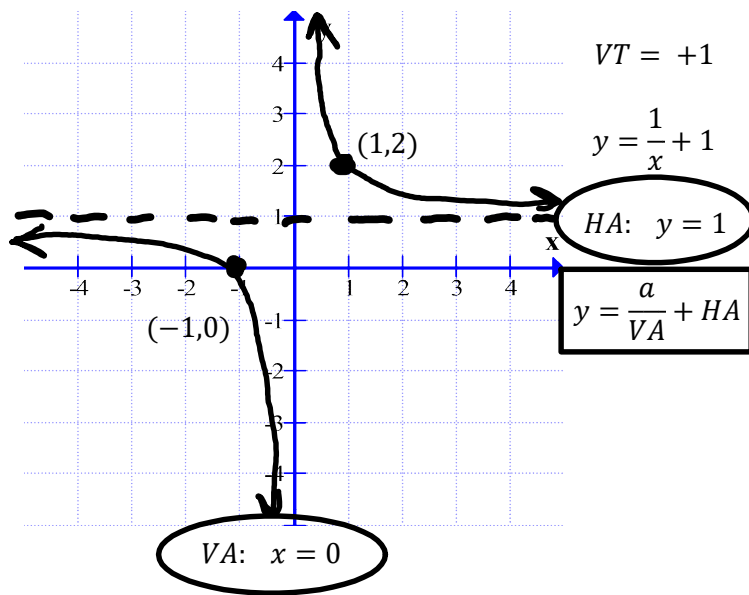
$$\frac{1}{x} + \frac{x}{x}$$

$$\frac{x+1}{x}$$

Long Division

$$x \overline{\smash{\big)}\, \begin{array}{c} 1 \\ x + 1 \end{array}}$$

$$\underline{}\ x$$

$$1$$

remainder

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

$$y = \frac{x+1}{x} \qquad \frac{P(x)}{x-a} = Q(x) + \frac{R}{x-a}$$

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

Separate Fractions

$$\frac{a+b}{c} = \frac{a}{c} + \frac{b}{c}$$

$x - int$:

$$y = \frac{1}{x} + 1$$
$$0 = \frac{1}{x} + 1$$
$$-1 = \frac{1}{x}$$
$$-1x = 1$$
$$x = -1$$

$$y = \frac{x+1}{x}$$
$$0 = \frac{x+1}{x}$$
$$x \times 0 = \frac{x+1}{x} \times x$$
$$0 = x + 1$$
$$x = -1$$

$(-1,0)$

$y - int$:
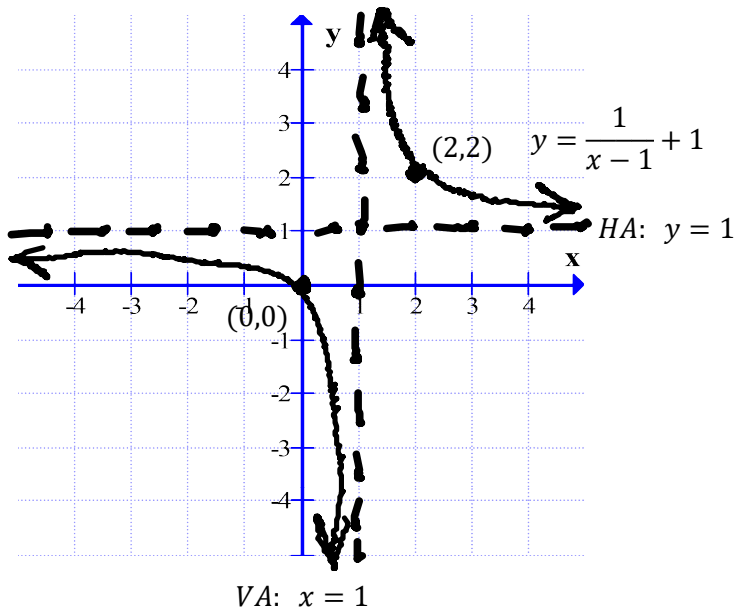
$$y = \frac{1}{x} + 1$$
$$y = \frac{1}{0} + 1$$

$y \neq$

$$y = \frac{x+1}{x}$$
$$y = \frac{0+1}{0}$$

$y \neq$

x	y
-1	0
0	und
1	2

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

(2,2)

$HA: \ y = 1$

$VA: \ x = 1$

(0,0)

$$\frac{1}{x-1} + 1$$

$$\frac{1}{x-1} + 1 \times \frac{x-1}{x-1}$$

$$\frac{1}{x-1} + \frac{x-1}{x-1}$$

$$\frac{1 + x - 1}{(x-1)(x-1)}$$

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

$$y = \frac{x}{x-1}$$

$$x-1 \overline{\smash{)}\ x + 0}$$
$$\underline{x - 1}$$
$$1$$

$$\frac{x}{x-1} = \frac{1}{x-1} + 1$$

$x - int$:

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

$$0 = \frac{1}{x-1} + 1$$

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

$$(x-1) \times -1 = \frac{1}{x-1} \times (x-1)$$

$$-x + 1 = 1$$

$$x = 0$$

$$y = \frac{x}{x-1}$$

Careful!

$$0 = \frac{x}{x-1}$$

$$(x-1) \times 0 = \frac{x}{x-1} \times (x-1)$$

$$0 = x$$

$$x = 0$$

(0,0)

$y - int$:

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

$$y = \frac{1}{0-1} + 1$$

$$y = -1 + 1$$

$$y = 0$$

$$y = \frac{x}{x-1}$$
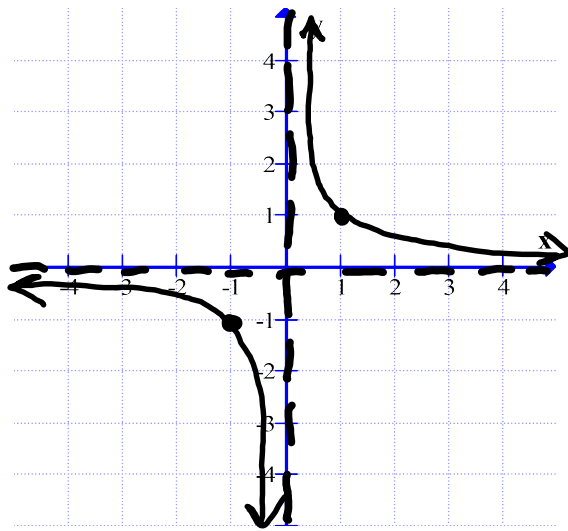
$$y = \frac{0}{0-1}$$

$$y = 0$$

(0,0)

x	y
0	0
1	und
2	2

$y = \dfrac{1}{x}$

$HA: \ y = 0$

x	y
-1	1
0	und
1	1

$VA: \ x = 0$

$VE = 2$

$y = \dfrac{2}{x}$

(1,2)
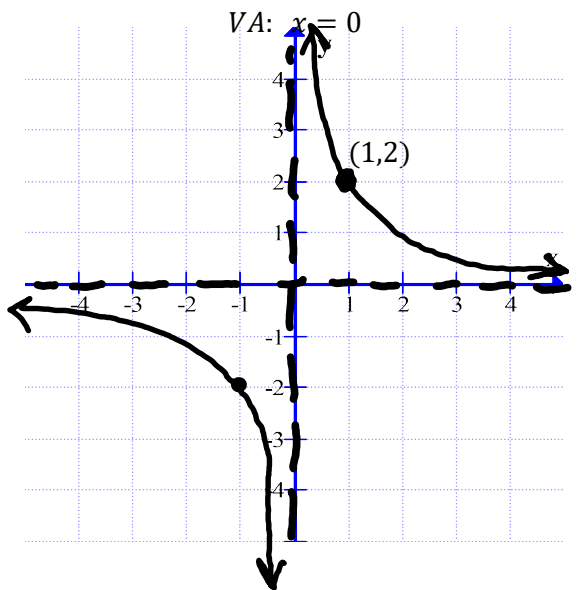
$HA: \ y = 0$

x	y
-1	-2
0	und
1	2

$VA: \ x = 0$
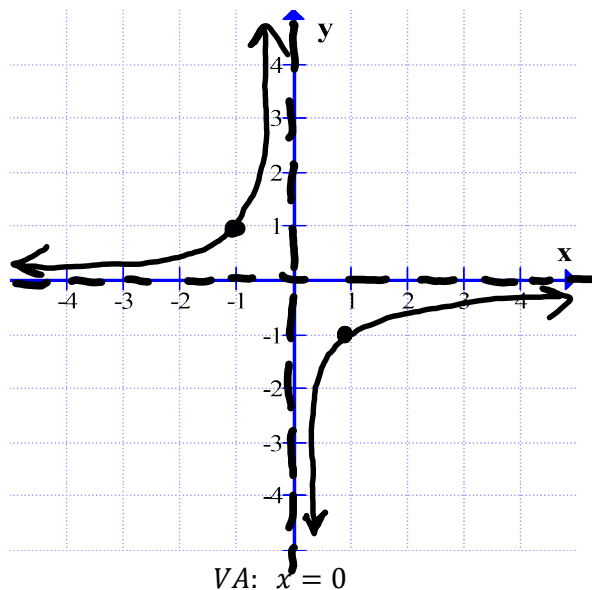
VR

$y = -\dfrac{1}{x}$

$HA: \ y = 0$

x	y
-1	1
0	und
1	-1

$VA: \ x = 0$

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

$HA: \ y = 0$

$\left(-2, \frac{1}{3}\right)$ $\left(2, \frac{1}{3}\right)$ $(0, -1)$

x	y
-2	$\frac{1}{3}$
-1	und
0	-1
1	und
2	$\frac{1}{3}$
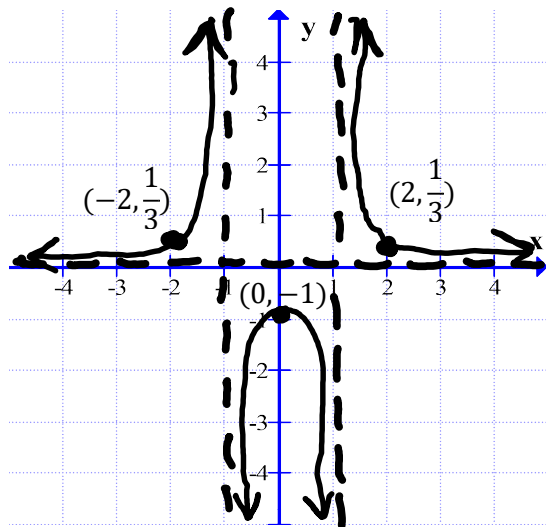
$VA: \ x = -1$ $VA: \ x = 1$

$VA:$

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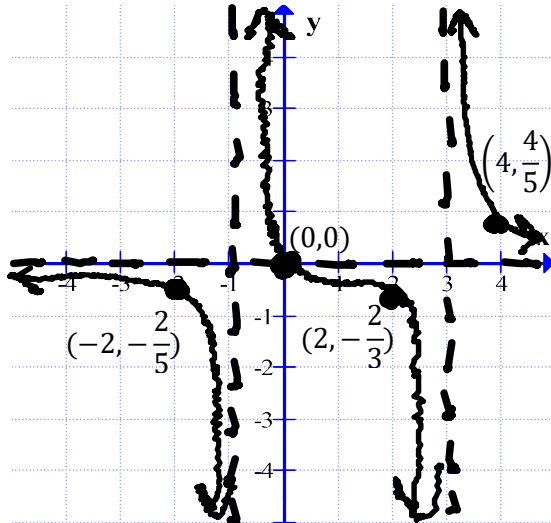
$$x + 1 = 0 \qquad x - 1 = 0$$
$$x = -1 \qquad x = 1$$

$x - int:$

$$y = \frac{1}{x^2 - 1}$$
$$0 = \frac{1}{x^2 - 1}$$
$$0 \neq 1$$

$y - int:$

$$y = \frac{1}{x^2 - 1}$$
$$y = \frac{1}{0^2 - 1}$$
$$y = -1$$

$$(0, -1)$$

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

$HA: \ y = 0$

$\left(4, \frac{4}{5}\right)$ $(0,0)$ $\left(-2, -\frac{2}{5}\right)$ $\left(2, -\frac{2}{3}\right)$

x	y
-2	$-\frac{2}{5}$
-1	und
0	0
2	$-\frac{2}{3}$
3	und
4	$\frac{4}{5}$

$VA: \ x = -1$ $VA: \ x = 3$

$VA:$

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

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

$x - int:$

$$0 = \frac{x}{x^2 - 2x - 3}$$
$$0 = x$$
$$x = 0$$

$y - int:$

$$y = \frac{0}{0^2 - 2(0) - 3}$$
$$y = 0$$

$$(0,0)$$

C12 - 9.5 - Holes Notes

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

$$y = \frac{(x-1)(\cancel{x+2})}{\cancel{x+2}}$$

$$y = x - 1$$

Hole: $x + 2 = 0$
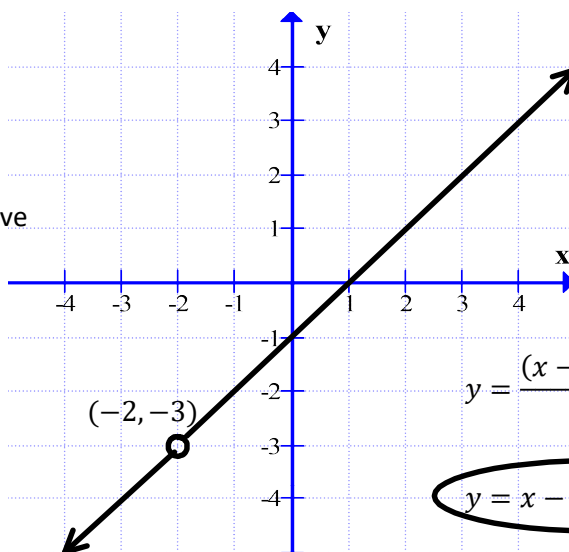$x = -2$

Set what you've crossed off equal to zero and solve.

$y = x - 1$
$y = -2 - 1$
$y = -3$

$(-2, -3)$

x	y
-2	-3

$(-2, -3)$

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

$y = x - 1 \quad x \neq -2$

$x \neq -2$

$$y = \frac{x+3}{(x-1)(x+3)}$$

$$y = \frac{\cancel{x+3}}{(x-1)\cancel{(x+3)}}$$

$$y = \frac{1}{x-1}$$

Hole: $x + 3 = 0$
$x = -3$

$y = \frac{1}{x-1}$
$y = \frac{1}{(-3)-1}$
$y = \frac{1}{-4}$

$\left(-3, -\frac{1}{4}\right)$

x	y
-3	$-\frac{1}{4}$

VA: $x - 1 = 0$
$x = 1$

$$y = \frac{x+3}{(x-1)(x+3)}$$

$y = \frac{1}{x-1} \quad x \neq -3$

HA: $y = 0$

VA: $x = 1$

Rat Page 9
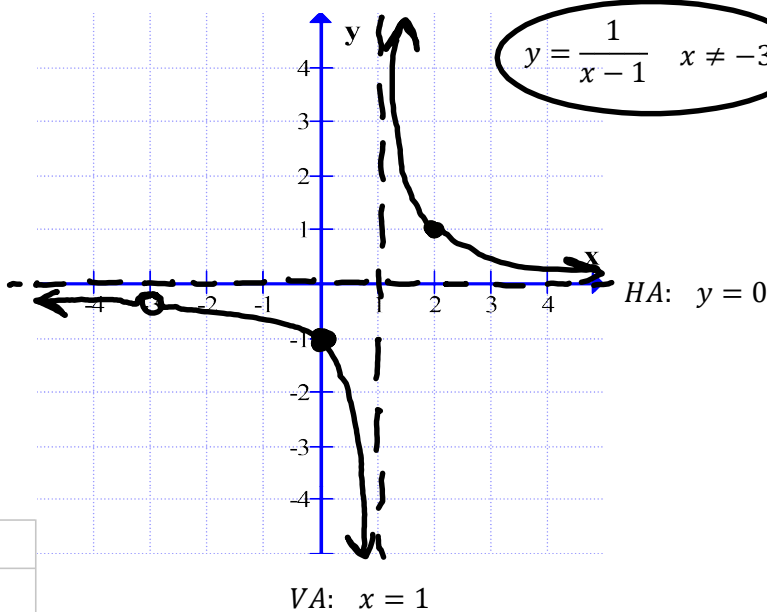
$$y = \frac{x^2}{x+1}$$

$VA:$ $\quad x + 1 = 0$ $\qquad HA:$ $\quad \dfrac{x^2}{x}$ $\quad none$
$\qquad\qquad x = -1$

Slant Asymptote

$$\begin{array}{r} x - 1 \\ x+1\overline{)\,x^2 + 0 + 0} \\ \underline{x^2 + x} \\ -x + 0 \\ \underline{-x - 1} \\ +1 \end{array}$$

$x + 1 = 0$
$\qquad x = -1$

x^2

$$\begin{array}{r|rrr} -1 & 1 & 0 & 0 \\ & & -1 & +1 \\ \hline & 1 & -1 & +1 \end{array}$$

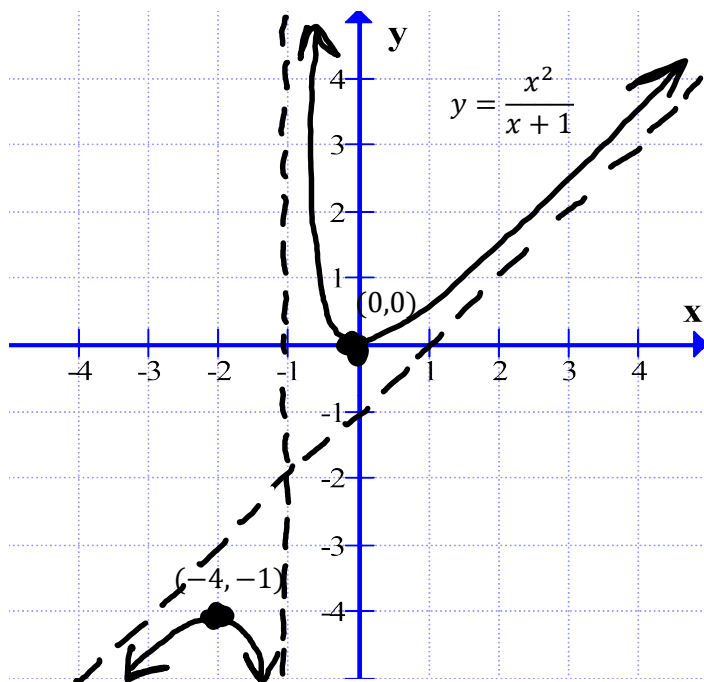*Slant Asymptote*

$y = x - 1$

$x - 1 \quad R: +1$

$$\boxed{\dfrac{x^2}{x+1} = x - 1 + \dfrac{1}{x+1}}$$

$\qquad x - 1 + \dfrac{1}{x+1}$

$x - 1 + \dfrac{1}{x+1}$

$$\frac{P(x)}{x-a} = Q(x) + \frac{R}{x-a} \qquad\qquad Slant + \frac{R}{Divisor}$$
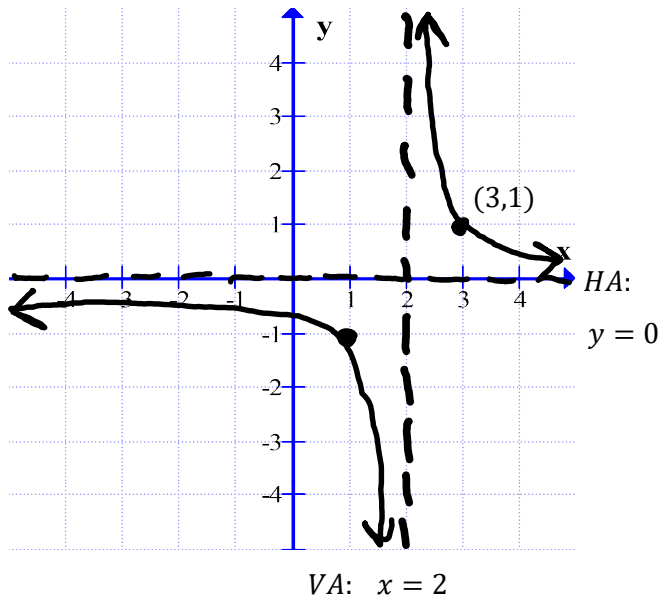

Slant Asymptote

$y = x - 1$

VA: $x = -1$

x	y
-4	-1
-1	und
0	0

$$\boxed{\begin{array}{l} \dfrac{x^2}{x+1} = x - 1 + \dfrac{1}{x+1} \\[3mm] \qquad x - 1 \times \dfrac{x+1}{x+1} + \dfrac{1}{x+1} \\[2mm] \qquad\qquad \dfrac{x^2 - 1 + 1}{x+1} \\[2mm] \qquad\qquad\quad \dfrac{x^2}{x+1} \end{array}}$$

C12 - 9.7 - HT/VT Graph -> Equation Notes

$$y = \frac{a}{x-h} + k \qquad y = \underline{\hspace{2cm}}$$

$$y = \frac{a}{x-2} + k$$

$$x = 2$$
$$x - 2 = 0 \quad VA: \ x = 2$$

$$y = \frac{a}{x-2} + 0$$

$$k = 0 \quad HA: \ y = 0$$

$$\boxed{HA: \ y = k}$$

$$y = \frac{a}{x-2}$$

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

(3,1)
(x, y)

$$a = 1$$

$$\boxed{y = \frac{1}{x-2}}$$

HA: $y = 0$

VA: $x = 2$

$$\boxed{y = \frac{a}{x-h} + k} \qquad \boxed{y = \frac{a}{VA's} + HA}$$

$$y = \frac{a}{x-0} + k$$

$$x = 0 \quad VA: \ x = 0$$

$$y = \frac{a}{x} + k$$

$$y = \frac{a}{x} - 1$$

$$k = -1 \quad HA: \ y - 1$$

$$\boxed{HA: \ y = k}$$

$$0 = \frac{a}{1} - 1$$

(1,0)
(x, y)

$$a = 1$$

$$\boxed{y = \frac{1}{x} - 1}$$

HA: $y = -1$

VA: $x = 0$

(1,0)

$$y = \frac{a(x-r)}{x-h} \qquad y = \frac{HA(x-int)}{VA's}$$

$$y = \frac{a(x-r)}{x}$$

VA: $x = 0$

$$y = \frac{a(x-1)}{x}$$

$x = 1$
$x - 1 = 0$

$x: int: (1,0)$

$$y = \frac{-(x-1)}{x}$$

HA: $y = -1$ Case 3: $\dfrac{-1x}{1x}$

$$\frac{\frac{1}{x} - 1}{}$$
$$\frac{1}{x} - 1 \times \frac{x}{x}$$
$$\frac{\frac{1}{x} - \frac{x}{x}}{}$$
$$\frac{1 - x}{x}$$

Add Fractions: LCD

$$y = -\frac{x-1}{x}$$

Rat Page 11

(1,3)

HA: $y = 0$

VA: $x = 0$

$$y = \frac{a}{x - h} + k$$

$y = \frac{a}{x} + k$ $\qquad x = 0$ $\qquad$ VA: $x = 0$

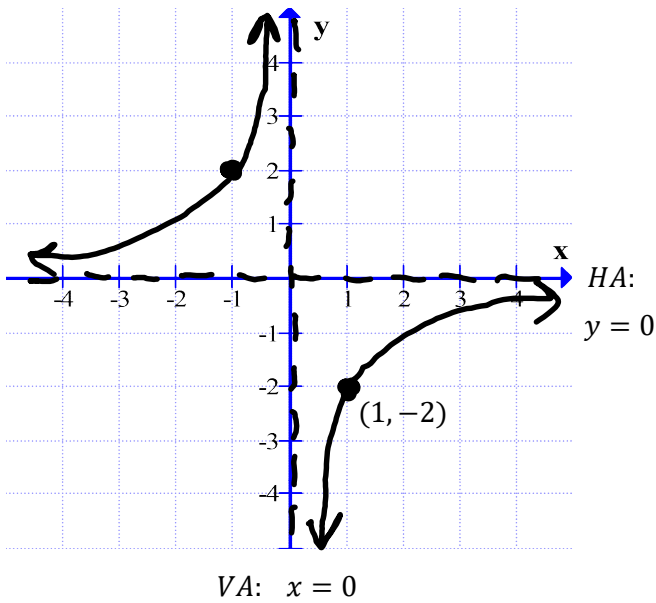$y = \frac{a}{x} + 0$ $\qquad k = 0$ $\qquad$ HA: $y = 0$

$\boxed{HA:\ y = k}$

$y = \frac{a}{x}$

$3 = \frac{a}{1}$ $\qquad$ (1,3)

$\qquad\qquad$ (x, y)

$a = 3$

$\left(\, y = \dfrac{3}{x} \,\right)$

$$y = \frac{a}{x - h} + k$$

$y = \frac{a}{x - 0} + k$ $\qquad x = 0$ $\qquad$ VA: $x = 0$

$y = \frac{a}{x} + k$
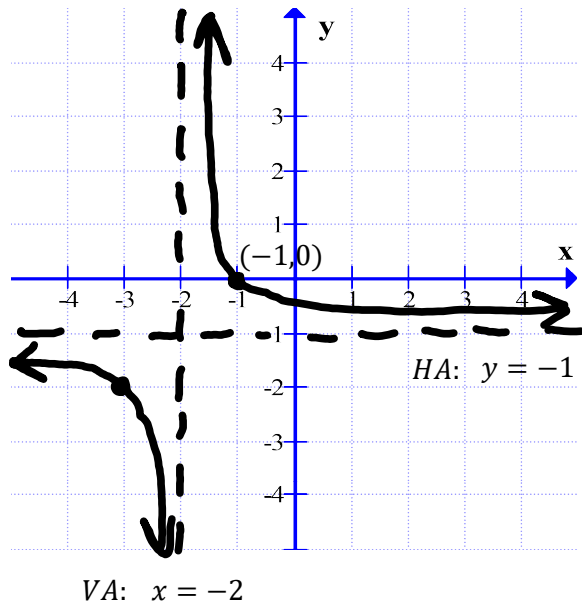
$y = \frac{a}{x} + 0$ $\qquad k = 0$ $\qquad$ HA: $y = 0$

$\boxed{HA:\ y = k}$

$-2 = \frac{a}{1}$ $\qquad$ (1, -2)

$\qquad\qquad$ (x, y)

$a = -2$

$\left(\, y = \dfrac{-2}{x} \,\right)$

(1, -2)

HA: $y = 0$

VA: $x = 0$

$$y = \frac{a}{x - h} + k$$

$$y = \frac{a}{x + 2} + k \qquad \begin{array}{l} x = -2 \\ x + 2 = 0 \end{array} \qquad VA: \ x = -2$$

$$y = \frac{a}{x + 2} - 1 \qquad k = -1 \quad HA: \ y = -1$$

$$y = \frac{a}{x + 2} - 1 \qquad \boxed{HA: \ y = k}$$

$$0 = \frac{a}{-1 + 2} - 1 \qquad (-1, 0)$$
$$(x, y)$$

$$a = 1$$

$$\boxed{y = \frac{1}{x + 2} - 1}$$

(−1,0)

HA: $y = -1$

VA: $x = -2$

$$y = \frac{a(x - r)}{x - h} \qquad \boxed{y = \frac{HA(x - int)}{VA's}} \qquad \frac{1}{x + 2} - 1$$

$$y = \frac{a(x - r)}{x + 2} \qquad VA: x = -2 \qquad \frac{1}{x + 2} - 1 \times \frac{x + 2}{x + 2}$$

$$y = \frac{a(x + 1)}{x + 2} \qquad \begin{array}{l} x = -1 \quad x - int: (-1, 0) \\ x + 1 = 0 \end{array} \qquad \frac{\frac{1}{x + 2} - \frac{x + 2}{x + 2}}{}$$

$$\frac{-x - 1}{x + 2}$$

$$y = \frac{-(x + 1)}{x + 2} \qquad HA: y = -1 \qquad Case\ 3: \ \frac{-1x}{1x} \qquad y = \frac{-(x + 1)}{x + 2}$$

VA: $x = -2$ VA: $x = 2$

HA:

$y = 0$

$$y = \frac{a}{x - h} + k$$

$$y = \frac{a}{(x + 2)(x - 2)} + k$$

$$y = \frac{a}{(x + 2)(x - 2)} + 0$$
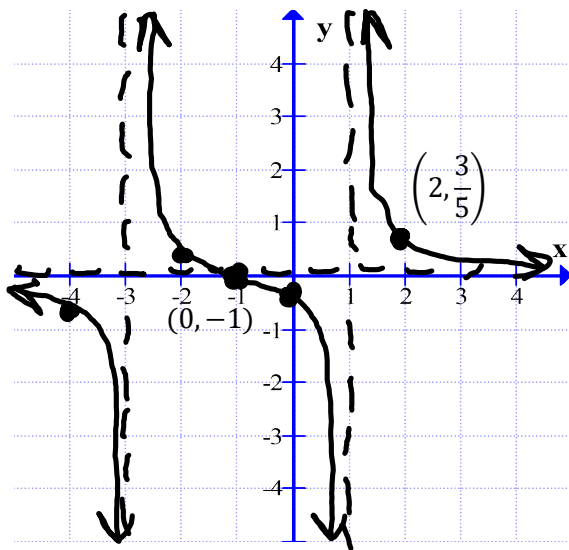
$$y = \frac{a}{(x + 2)(x - 2)}$$

$$\frac{1}{5} = \frac{a}{(3 + 2)(3 - 2)}$$ $\left(3, \frac{1}{5}\right)$

(x, y)

$$a = 1$$

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

$$\boxed{y = \frac{1}{x^2 - 4}}$$

VA: $x = -3$ VA: $x = 1$

HA:

$y = 0$

$$y = \frac{a}{x - h} + k \qquad y = \frac{a(x - int)}{VA's} + HA$$

$$y = \frac{a(x + 1)}{(x + 3)(x - 1)} + k$$

$$y = \frac{a(x + 1)}{(x + 3)(x - 1)} + 0$$

$$y = \frac{a(x + 1)}{(x + 3)(x - 1)}$$

$$\frac{3}{5} = \frac{a(2 + 1)}{(2 + 3)(2 - 1)} \qquad \left(2, \frac{3}{5}\right)$$
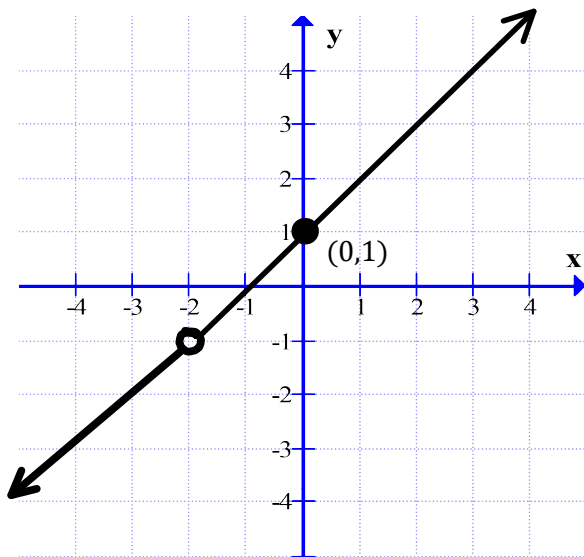
(x, y)

$$\frac{3}{5} = \frac{3a}{5}$$

$$a = 1$$

$$\boxed{y = \frac{x + 1}{(x + 3)(x - 1)}}$$

$$y = \frac{a(x - r)}{x - h} \qquad y = \frac{HA(x - int)}{VA's}$$

$$y = \frac{(x + 1)}{(x + 3)(x - 1)} \qquad HA: y = 0 \qquad \text{Case 2:} \quad \frac{x}{x^2}$$

$$y = \frac{a}{x - h}$$

$$y = \frac{a(x - int)(holes)}{(VA's)(holes)}$$

$$y = \frac{a(x + 2)}{(x + 2)} + k$$

$x = -2$ hole:

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

$$y = \frac{a(x + 1)(x + 2)}{(x + 2)}$$

$$y = \frac{a(x + 1)(x + 2)}{(x + 2)}$$

$x = -1$

$x + 1 = 0$ $x - int: (0, -1)$

$y = a(x + 1)$ $(0, 1)$
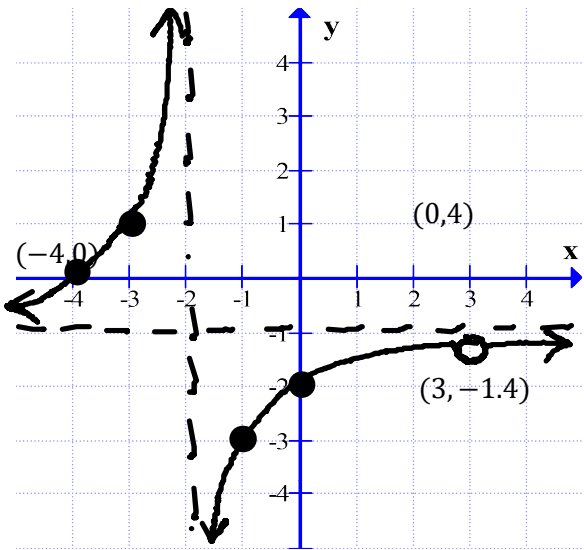
                  (x, y)

$1 = a(0 + 1)$

$a = 1$

$$y = \frac{(x + 2)(x + 1)}{(x + 2)}$$

$HA:$ $none$

$$y = \frac{a}{x - h}$$

$$y = \frac{a(x - int)(holes)}{(VA's)(holes)}$$

$$y = \frac{a(x - 3)}{(x - 3)}$$

$x = 3$ hole: $(3, -1.4)$

$x - 3 = 0$

$$y = \frac{a(x - 3)}{(x + 2)(x - 3)}$$

$x = -2$ $VA:$ $x = -2$

$x + 2 = 0$

$$y = \frac{a(x + 4)(x - 3)}{(x + 2)(x - 3)}$$

$x = -4$ $x - int:$

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

$$y = \frac{a(x + 4)(x - 3)}{(x + 2)(x - 3)}$$

$$-2 = \frac{a(0 + 4)}{(0 + 2)}$$ $(0, -2)$

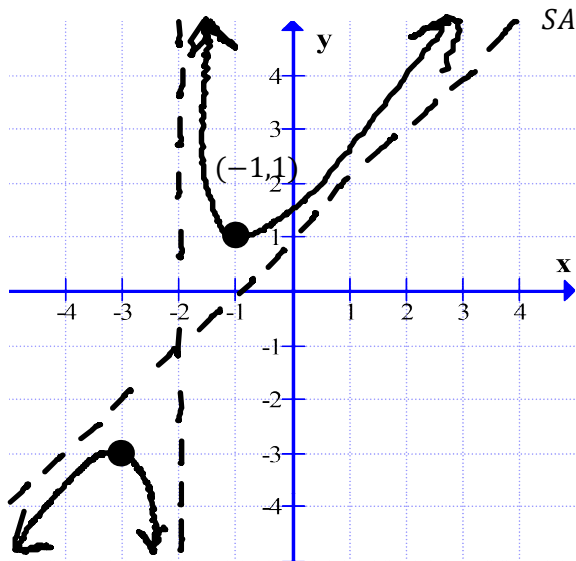 (x, y)

$$-2 = \frac{4a}{2}$$

$a = -1$

$$y = \frac{-1(x + 4)(x - 3)}{(x + 2)(x - 3)}$$ $HA:$ Case 3: $\frac{-1x^2}{1x^2}$

$$y = -\frac{1}{1}$$

C12 - 9.7 - Slant Graph -> Equation Notes

SA: $\quad y = x + 1$

$$y = \frac{a}{x-h} + Slant$$

SA: $\quad y = x + 1$

$$y = \frac{a}{x+2} + x + 1 \qquad y = Slant + \frac{R}{Divisor}$$

$$1 = \frac{a}{-1+2} - 1 + 1 \qquad (-1,1)$$
$$\qquad\qquad\qquad\qquad (x,y)$$

$$a = a$$

$$y = \frac{1}{x+2} + x + 1$$

$$\frac{1}{x+2} + x + 1$$

$$\frac{1}{x+2} + x + 1 \times \frac{x+2}{x+2}$$

$$\frac{1}{x+2} + x + 1 \times \frac{x+2}{x+2}$$

$$\frac{1}{x+2} + \frac{x^2+3x+2}{x+2}$$

$$\frac{x^2+3x+3}{x+2} \qquad y = \frac{x^2+3x+3}{x+2}$$