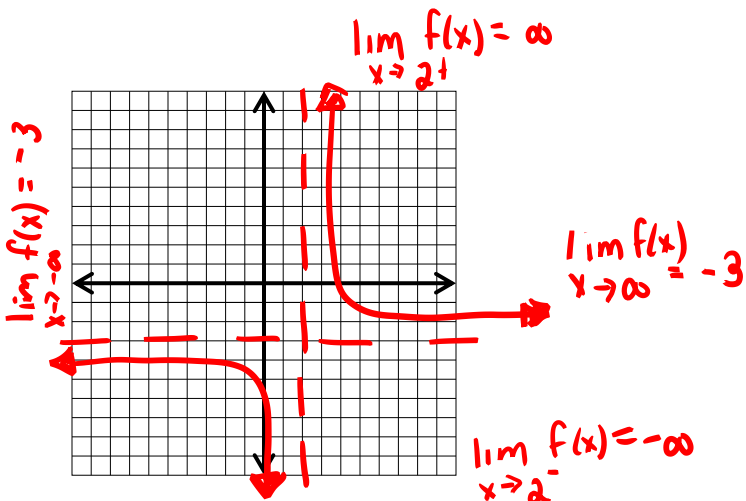


For questions 1 – 2 sketch a graph of the function *without* the aid of a calculator. Find all asymptotes and intercepts. Describe using limit notation what it happening as $x \rightarrow \pm\infty$ and on each side of the vertical asymptote. (HINT – Think about TRANSFORMATIONS on the reciprocal function.)

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

vertical * shift down 3
HA $y = -3$

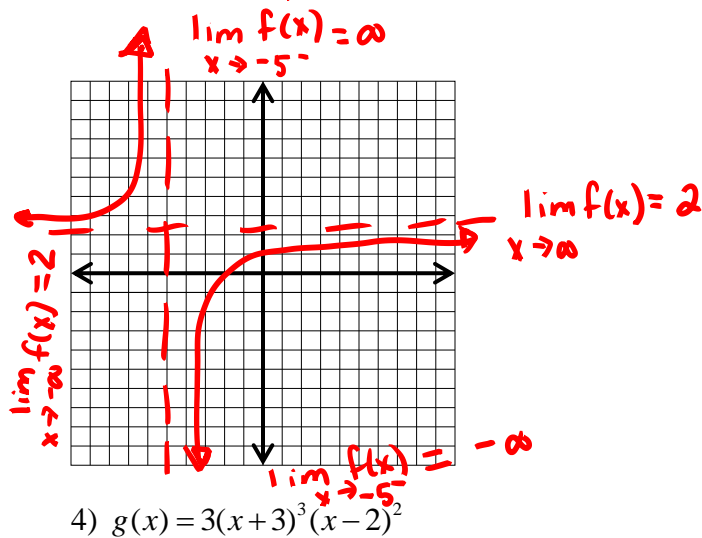
horizontal * shift right 2
VA $x = 2$



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

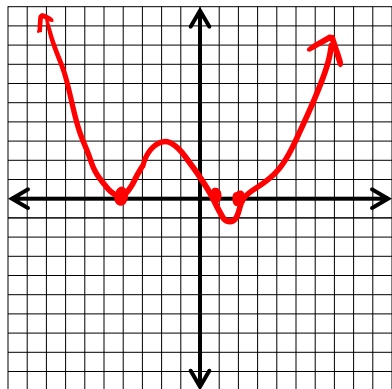
vertical * reflect over x-axis
* vert. stretch BAF 3
* shift up 2

horiz * shift left 5



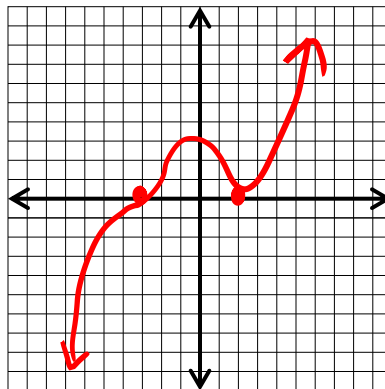
3) $g(x) = (x+4)^2(x-1)(x-2)^3$

B P P
U / ~
 $x^2 \cdot x \cdot x^3$
 $= x^6$ ↗ ↘



4) $g(x) = 3(x+3)^3(x-2)^2$

$x^3 \cdot x^2$
 $= x^5$
↙ ↘



For questions 5 - 6, factor and find all possible zeros and write as linear factors. (Express zeros in exact form.) You will need your calculator to find the real zeros from the graph to begin each problem.

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

6) $f(x) = x^3 - 10x^2 + 44x - 69$

Find x-int. on calc

$$\begin{array}{r|rrrr} 1 & 1 & 0 & 4 & -5 \\ \downarrow & & 1 & 1 & 5 \\ \hline & 1 & 1 & 5 & 0 \end{array}$$

$$x^2 + x + 5 = 0$$

$$x = \frac{-1 \pm \sqrt{1 - 4(5)}}{2}$$

$$x = \frac{-1 \pm \sqrt{19}}{2}$$

$$f(x) = (x-1) \left(x - \left(\frac{-1 + \sqrt{19}}{2}\right)\right) \left(x - \left(\frac{-1 - \sqrt{19}}{2}\right)\right)$$

$$\begin{array}{r|rrrr} 3 & 1 & -10 & 44 & -69 \\ \downarrow & & 3 & -21 & 69 \\ \hline & 1 & -7 & 23 & 0 \end{array}$$

$$x = \frac{7 \pm \sqrt{49 - 92}}{2}$$

$$x = \frac{7 \pm \sqrt{-43}}{2}$$

$$x = \frac{7 \pm i\sqrt{43}}{2}$$

$$f(x) = (x-3) \left(x - \left(\frac{7 + i\sqrt{43}}{2}\right)\right) \left(x - \left(\frac{7 - i\sqrt{43}}{2}\right)\right)$$

For questions 7 - 8, solve the equation or inequality *algebraically*. (Verify graphically.) Remember to check for extraneous solutions!

7) $\frac{3x}{x+5} + \frac{1}{x-2} = \frac{7}{x^2+3x-10}$ $(x+5)(x-2)$
 $x = -\frac{1}{3}$

$$3x(x-2) + 1(x+5) = 7$$

$$3x^2 - 6x + 1x + 5 - 7 = 0$$

$$3x^2 - 5x - 2 = 0$$

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

$x = 2$
(extraneous solution)

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

$$4x(x-1) + 3(x+4) = 15$$

$$4x^2 - 4x + 3x + 12 - 15 = 0$$

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

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

$x = 1$
(Extraneous solution)

For questions 9 and 10, find all asymptotes and intercepts. Sketch a graph of the function without the aid of your calculator.

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

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

VA = $x = 3; x = -1$
 HA = $y = 0$
 x-int: $(2, 0)$
 y-int: $(0, 2/3)$
 $\lim_{x \rightarrow \infty} f(x) = \frac{1}{x}$

