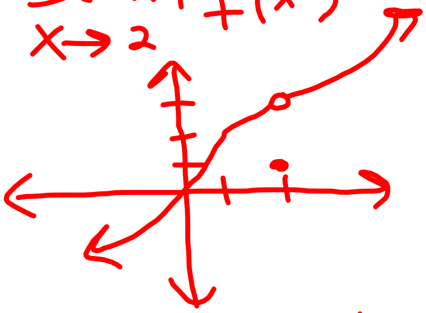
Warm-up

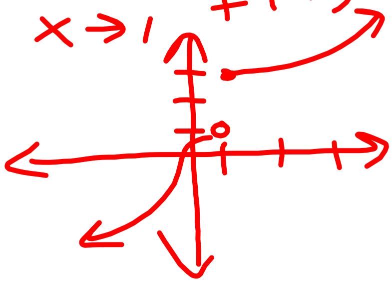
Find the limit graphically:

1) $\lim_{x \to 2} f(x) = 3$

$f(2) = 1$



2) $\lim_{x \to 1} f(x)$ DNE



Find the limit numerically:

3) $\lim_{x \to 1} \frac{x^2+3x-4}{x-1}$

$= 5$

4) $\lim_{x \to 0} \frac{\sin x}{x} = 1$

Analytical limits (1.3)

Try to plug-in 1st

1. Factor, cancel + plug-in
2. rationalize using the conjugate (sq. rt.)
3. simplify complex fractions
4.
5.

ex: $\lim_{x \to 1} \boxed{\dfrac{x^2+3x-4}{x-1}}$

$= \lim_{x \to 1} \dfrac{\cancel{(x-1)}(x+4)}{\cancel{x-1}}$

$= \lim_{x \to 1} (x+4)$

$= \boxed{5}$

ex: $\dfrac{x^2+3x-4}{x-1} = \dfrac{(x+4)\cancel{(x-1)}}{\cancel{x-1}}$

removable discontinuity
(hole) at $x=1$

ex: $\dfrac{x}{x-1}$ cannot remove
red flag

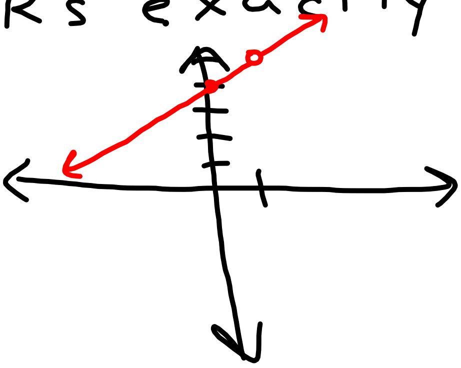
non-removable (asymptote)
disc. at $x=1$.

$$\lim_{x \to 1} \frac{(x+4)\cancel{(x-1)}}{\cancel{x-1}}$$

$$= 5$$

hole is at $(1, 5)$

looks exactly like $x+4$



ex: $\lim_{x \to 2} \frac{x^3 - 8}{x - 2}$

$\lim_{x \to 2} \frac{\cancel{(x-2)}(x^2+2x+4)}{\cancel{x-2}}$

$\lim_{x \to 2} (x^2+2x+4)$

$= \boxed{12}$

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ex: $\lim_{x \to 1} (x^2 + 5)$

$= \boxed{6}$

If continuous at the x-value you will always be able to plug-in.

ex: $\lim_{x \to 0} \left(\frac{\sqrt{x+1} - 1}{x} \right) \left(\frac{\sqrt{x+1} + 1}{\sqrt{x+1} + 1} \right)$

$\lim_{x \to 0} \frac{x \cancel{+1} \cancel{-1}}{x(\sqrt{x+1} + 1)}$

$\lim_{x \to 0} \frac{\cancel{x}}{\cancel{x}(\sqrt{x+1} + 1)} = \lim_{x \to 0} \frac{1}{\sqrt{x+1} + 1}$

$= \boxed{\frac{1}{2}}$

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Try

1. $\lim_{x \to 5} \frac{x^2 - 25}{x - 5} = 10$

2. $\lim_{x \to 2} \frac{x^2 + 5x - 14}{x - 2} = 9$

3. $\lim_{x \to \pi} \sin x = 0$

4. $\lim_{x \to 4} \frac{\sqrt{x+5} - 3}{x - 4} = \frac{1}{6}$

ex: $$\lim_{x\to 0}\frac{4(\cancel{x+4})\cdot\boxed{\frac{1}{\cancel{x+4}}} - \boxed{\frac{1}{\cancel{4}}}\cdot\cancel{4}(x+4)}{\frac{x}{1}\cdot 4(x+4)}$$

$$\lim_{x\to 0}\frac{4-(x+4)}{4x(x+4)}$$

$$\lim_{x\to 0}\frac{\cancel{4}-x-\cancel{4}}{4x(x+4)} = \lim_{x\to 0}\frac{-\cancel{x}}{4\cancel{x}(x+4)}$$

$$\lim_{x\to 0}\frac{-1}{4(x+4)} = \boxed{\frac{-1}{16}}$$