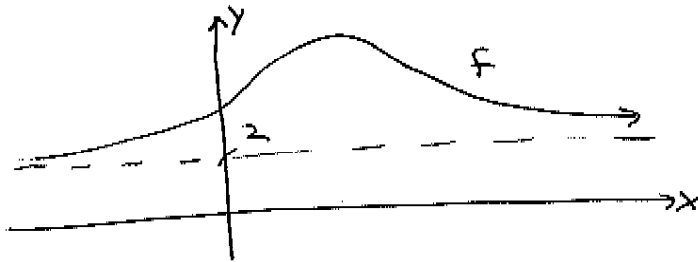


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## 9.2: Limits at Infinity

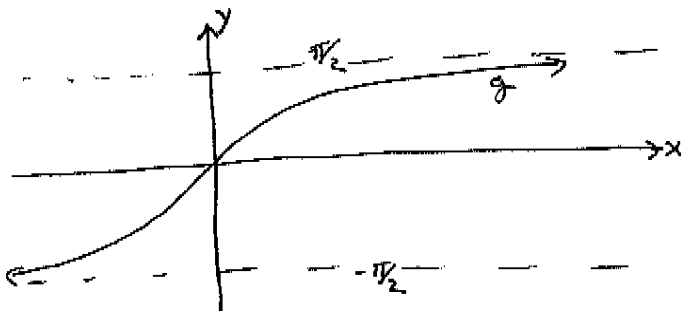
Limits at infinity: Graphically.

Ex 1: Find the following:



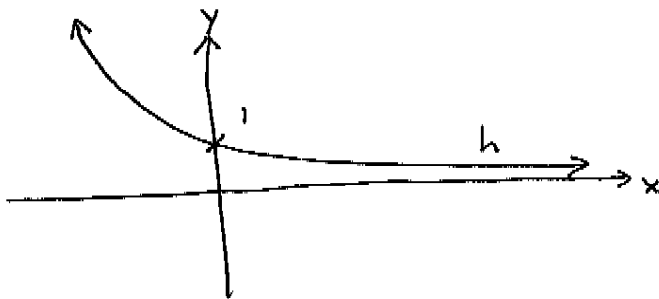
i)  $\lim_{x \rightarrow \infty} f(x)$

ii)  $\lim_{x \rightarrow -\infty} f(x)$



i)  $\lim_{x \rightarrow \infty} g(x)$

ii)  $\lim_{x \rightarrow -\infty} g(x)$



i)  $\lim_{x \rightarrow \infty} h(x)$

ii)  $\lim_{x \rightarrow -\infty} h(x)$

Ex 2: Find  $\lim_{x \rightarrow \pm \infty} \frac{1}{x}$

$\lim_{x \rightarrow \pm \infty} c$

$\lim_{x \rightarrow \pm \infty} x$

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Ex 3: Find the following limits analytically.

a)  $\lim_{x \rightarrow -\infty} \frac{3}{x+2}$

b)  $\lim_{x \rightarrow \infty} \frac{4x^2 + 2}{x^2 - 7}$

c)  $\lim_{x \rightarrow -\infty} \frac{5x^3 - 4x}{2 - 3x^3}$

d)  $\lim_{x \rightarrow -\infty} \frac{3x^6 - 2x}{4x^2 + 7x}$

Ex 4: ~~What~~ the sales volume  $s$  (in \$1000's) is related to advertising expenditures  $d$  (also in \$1000's) according to  $S(d) = \frac{35d}{7+d}$ .

What would happen to sales if there was an infinite advertising budget.

### 9.2: Continuity at a Point

Defn: The function  $f$  is continuous at  $x=c$  if all of the following conditions are satisfied

- 1)  $f(c)$  exists
- 2)  $\lim_{x \rightarrow c} f(x)$  exists
- 3)  $\lim_{x \rightarrow c} f(x) = f(c)$ .

If one or more of the conditions above do not hold, we say the function is discontinuous.

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Show examples where two of the three conditions hold.

When are the following functions discontinuous?

Ex 5: a)  $f(x) = \frac{x^2 - 4}{x - 2}$

b)  $g(x) = \frac{x^2 + 5x - 6}{x + 1}$

c)  $h(x) = \begin{cases} 2 & , x \leq 0 \\ x + 2 & , x > 0 \end{cases}$

d)  $f(x) = \begin{cases} x^2 + 1 & , x \leq 1 \\ 2x^2 - 1 & , x > 1 \end{cases}$

Ex 4 rev: When is the sales tax  $S(d) = \frac{35}{7+d}$  discontinuous? What does this mean?

Examples of piecewise-defined functions

- Cell phones/calling cards.
- Income tax
- Postage rates
- Utility.
- Rental cars.