a) $f(x) = \frac{x}{x-a} \Rightarrow a = 12 \Rightarrow f(x) = \frac{x}{x-12}$

I) $D\,f(x) = \{x \in \mathbb{R} \mid x \neq 12\}$

II) $\lim_{x \to 12} \frac{12}{12-12} = \frac{\text{"}12\text{"}}{\text{"}0\text{"}} \rightarrow$ depende limite lateral

$$\left.\begin{array}{l} \lim_{x \to 12^+} \frac{12}{12-12} = \frac{\text{"}12\text{"}}{\text{"}0^+\text{"}} \quad +\infty \\ \lim_{x \to 12^-} \frac{12}{12-12} = \frac{\text{"}12\text{"}}{\text{"}0^-\text{"}} \quad -\infty \end{array}\right\} \nexists$$

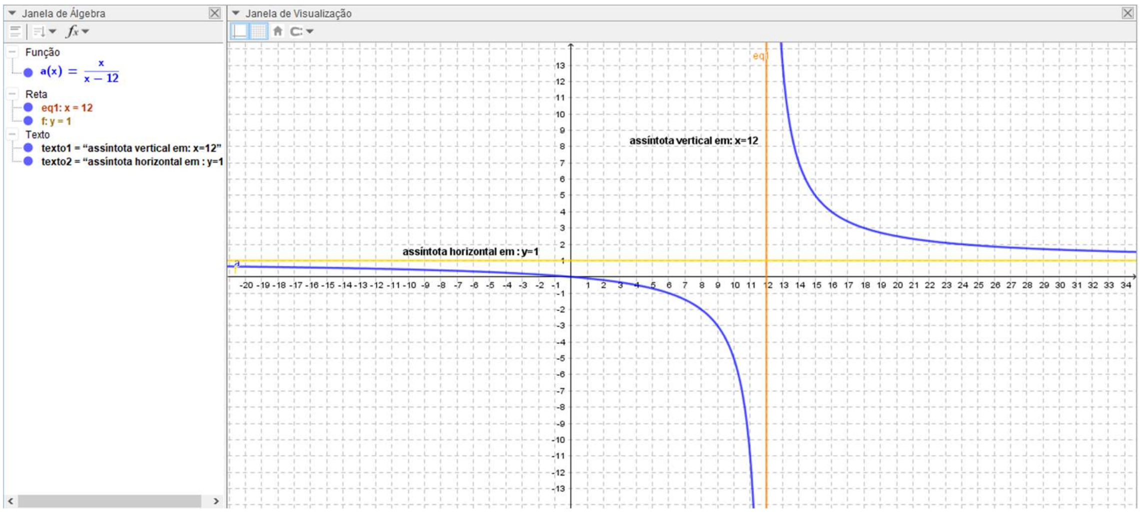
$$\lim_{x \to +\infty} \frac{x}{x-12} = \lim_{x \to +\infty} \frac{\cancel{x}^1}{\cancel{x} \cdot (1 - 12/x)} = \frac{1}{1} = 1$$

$$\lim_{x \to -\infty} \frac{x}{x-12} = \lim_{x \to -\infty} \frac{\cancel{x}^1}{\cancel{x} \cdot (1 - 12/x)} = \frac{1}{1} = 1$$

III) assíntota horizontal $y = 1$

assíntota vertical $x = 12$

V) Descontínua: $]-\infty, 12[$ e $]12, +\infty[$



b) $f(x) = \dfrac{x+12}{x^2-(12^2)}$

I) $D\,f(x) = \{x \in \mathbb{R} \,/\, x \neq 12\}$

II) $\lim\limits_{x \to 12} \dfrac{x+12}{x^2-(12^2)} = \lim\limits_{x \to 12} \dfrac{12+12}{12^2-(12^2)} = \dfrac{“24”}{“0”} \to$ depende

limite lateral

$$\left.\begin{aligned} &\lim_{x \to 12^+} \frac{“12”+12}{“12^2”-(12^2)} = \frac{“24”}{“0^+”} \quad +\infty \\ &\lim_{x \to 12^-} \frac{“12”+12}{“12^2”-(12^2)} = \frac{“24”}{“0^-”} \quad -\infty \end{aligned}\right\} \nexists$$

$$\lim_{x \to +\infty} \frac{x+12}{x^2-(12^2)} = \lim_{x \to +\infty} \frac{x+12}{x^2-144} = \frac{x\cdot(1+{}^{12}/_{x})}{x\cdot(x-{}^{144}/_{x})}$$

$$= \frac{1+{}^{12}/_{x}}{x-{}^{144}/_{x}} : \frac{1+{}^{12}/_{x}}{1+{}^{12}/_{x}} = \frac{1}{x-12} = “0”$$

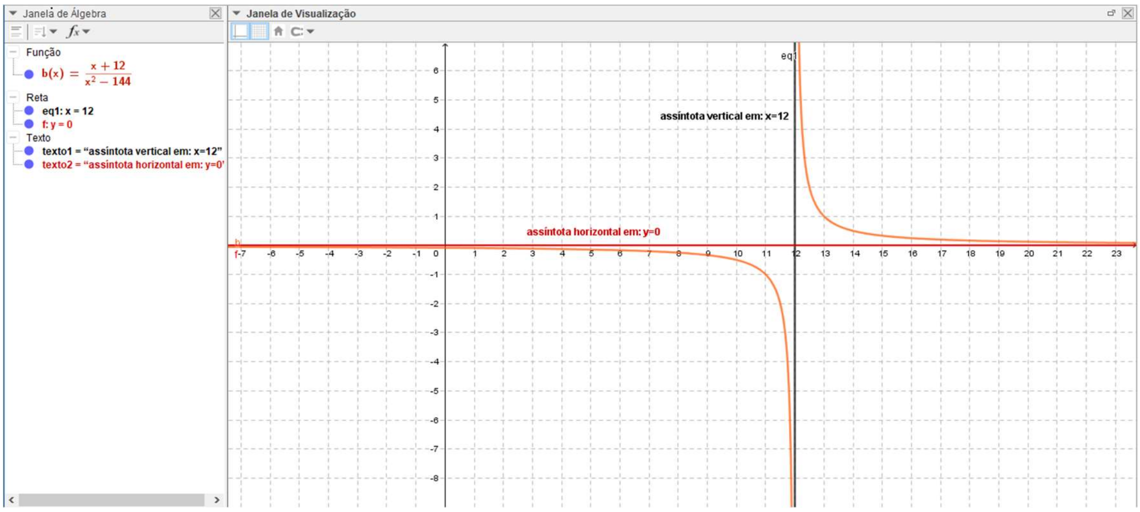
$$\lim_{x \to -\infty} \frac{x+12}{x^2-(12^2)} = \lim_{x \to -\infty} \frac{x+12}{x^2-144} = \frac{\cancel{x}\cdot(1+{}^{12}/_{x})}{\cancel{x}\cdot(x-{}^{144}/_{x})}$$

$$= \frac{1+{}^{12}/_{x}}{x-{}^{144}/_{x}} : \frac{1+{}^{12}/_{x}}{1+{}^{12}/_{x}} = \frac{1}{x-12} = “0”$$

III) assíntota horizontal $y = 0$

assíntota vertical $x = 12$

V) Descontínua: $]-\infty, 12[$ e $]12, +\infty[$



c) $f(x) = \frac{x^2-24x+144}{x-12}$

I) $D f(x) = \{x \in \mathbb{R} / x \neq 12\}$

II) $\lim_{x \to 12} \frac{x^2-24x+144}{x-12} = \frac{144-288+144}{12-12} = \frac{“0”}{“0”}$

$\frac{“0”}{“0”} \Rightarrow$ indet.

$\Downarrow$

$\frac{144-288+144}{12-12} = \frac{(12-12)^2}{(12-12)^1} = 12-12 = “0”$

$\lim_{x \to +\infty} \frac{x^2-24x+144}{x-12} = \frac{(x-12)^2}{x-12} = x-12 \to +\infty$

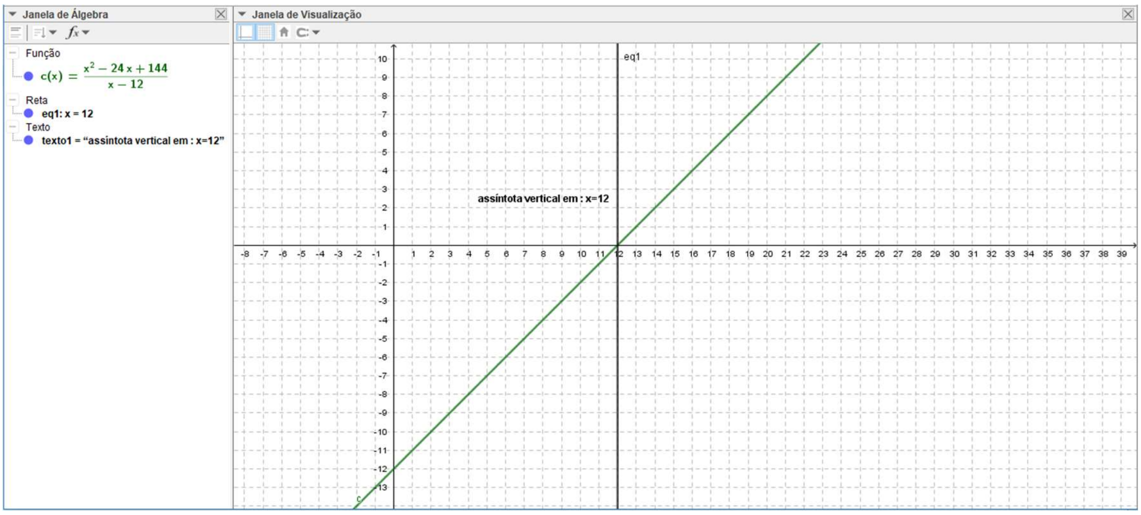
$\nexists \Leftarrow$

$\lim_{x \to -\infty} \frac{x^2-24x+144}{x-12} = \frac{(x-12)^2}{x-12} = x-12 \to -\infty$

III) assíntota vertical em $x = 12$

V) Descontínua: $]-\infty, 12[$ e $]12, +\infty[$

VI) $f(x) = \frac{x^2-24x+144}{x-12} - 1$



d) $f(x) = tg\left(\frac{x}{12}\right)$

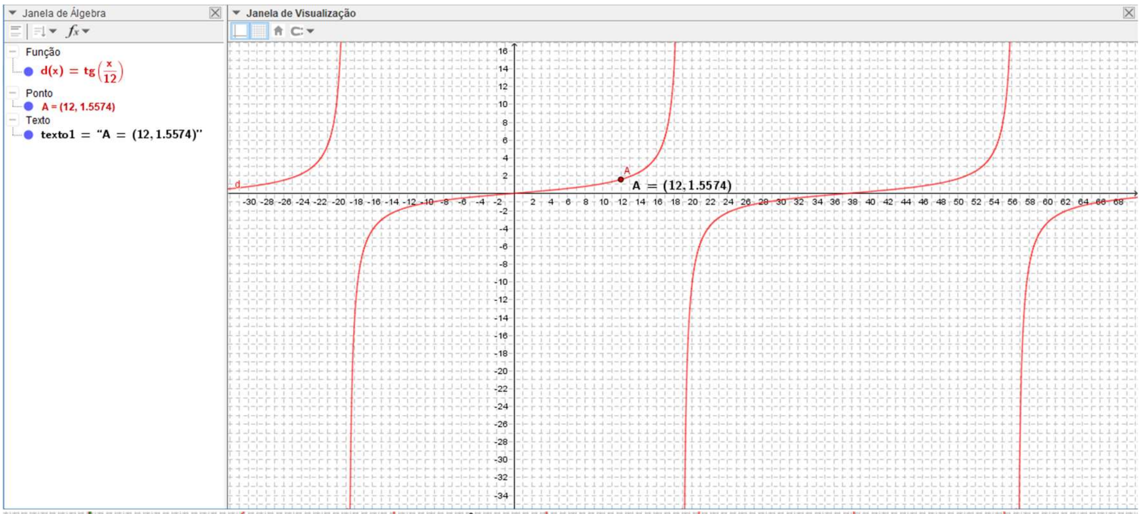
I) $D f(x) = \{x \in \mathbb{R} / x \neq (6\pi + 12n\pi) \text{ com } n \in \mathbb{Z}\}$

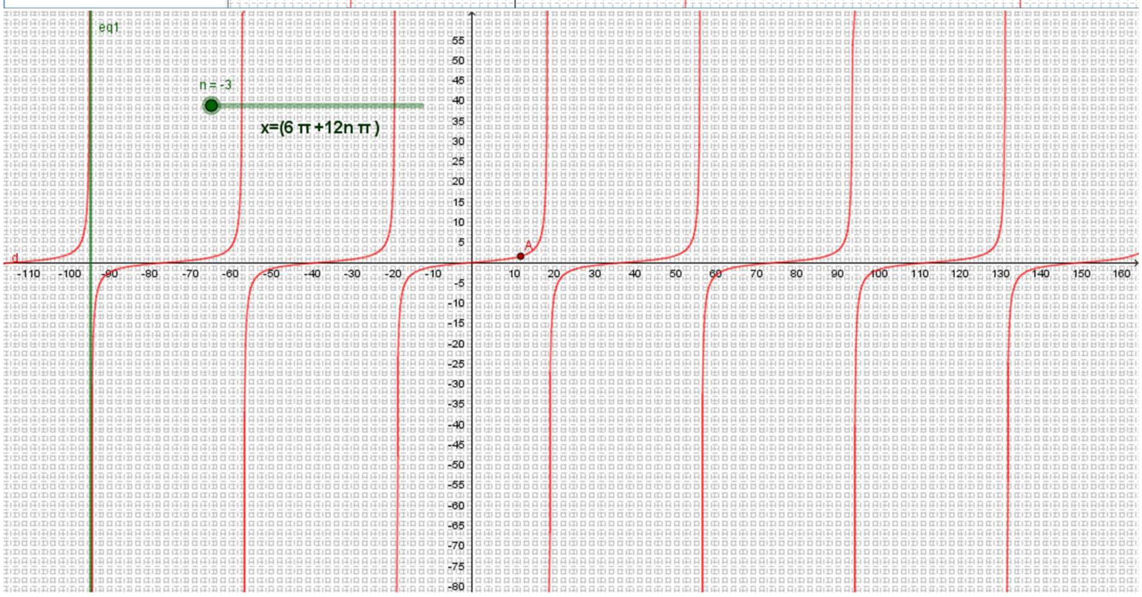
II) $\lim\limits_{x\to 12} tg\left(\frac{x}{12}\right) = \lim\limits_{x\to 12} tg\left(\frac{\cancel{12}}{\cancel{12}}\right) = tg\, 1\, rad$
$\cong 1,5574...$

$\lim\limits_{x\to +\infty} tg\left(\frac{x}{12}\right) \nexists$ (a função tg é descontínua em todo o domínio, variando seu limite entre $+\infty$ e $-\infty$)

$\lim\limits_{x\to -\infty} tg\left(\frac{x}{12}\right) \nexists$ (mesmo motivo acima)

III) assíntotas verticais em: $x = (6\pi + 12 \cdot n \cdot \pi)$
com $n \in \mathbb{Z}$





III) ... vertical

em x ...

com ...

e) $f(x) = e^{-x} + 12$

$f(x) = \frac{1}{e^{x}} + 12$

I) $Df(x) = \{x \in R\}$

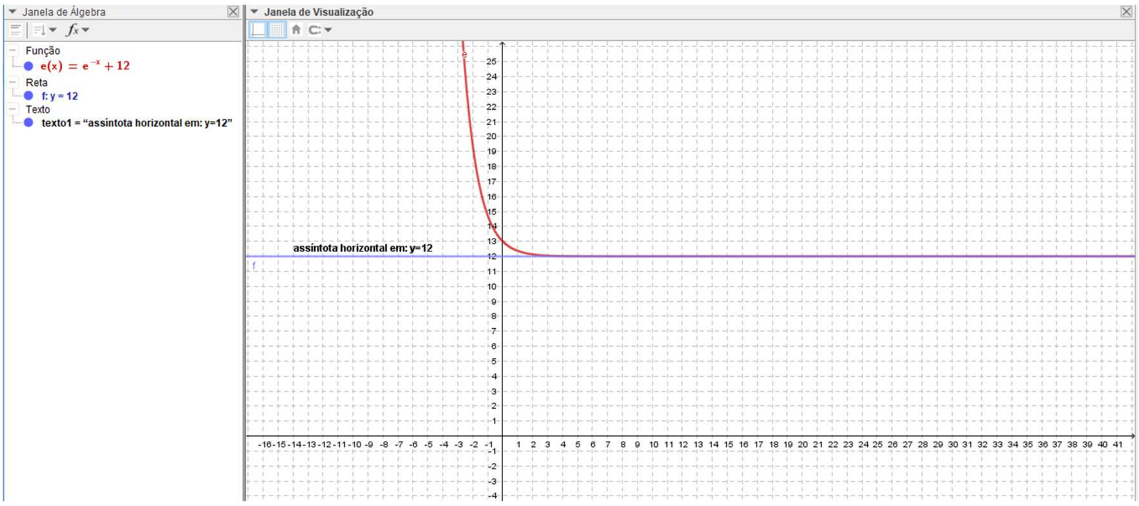
II) $\lim\limits_{x \to 12} \frac{1}{e^{12}} + 12 = 0{,}000006 + 12 = \text{"}12\text{"}$

$\lim\limits_{x \to +\infty} \frac{1}{e^{x}} + 12 = \text{"}12\text{"}$

$\lim\limits_{x \to -\infty} e^{-(-x)} + 12 \to +\infty$

III) HÁ ASSÍNTONTAS EM: Y = 12

V) É uma função contínua em R



f) $f(x) = \ln(x-12)$

I) $D\, f(x) = \{ x \in \mathbb{R}_+ \,/\, x > 12 \}$

II) $\lim\limits_{x \to 12} \ln(x-12) = \lim\limits_{x \to 12} \ln(\text{"}12\text{"} - 12) =$

$= \log_e \text{"}0\text{"} = Y \Rightarrow e^Y = \text{"}0\text{"} \to$ depende...

... limite lateral:

$\lim\limits_{x \to 12^+} \ln(\text{"}12\text{"} - 12) \Rightarrow \log_e \text{"}0^+\text{"} = Y \Rightarrow e^Y = \text{"}0^+\text{"}$

(quanto mais o 12 aproxima-se pela direita, mais o $Y \to -\infty$)

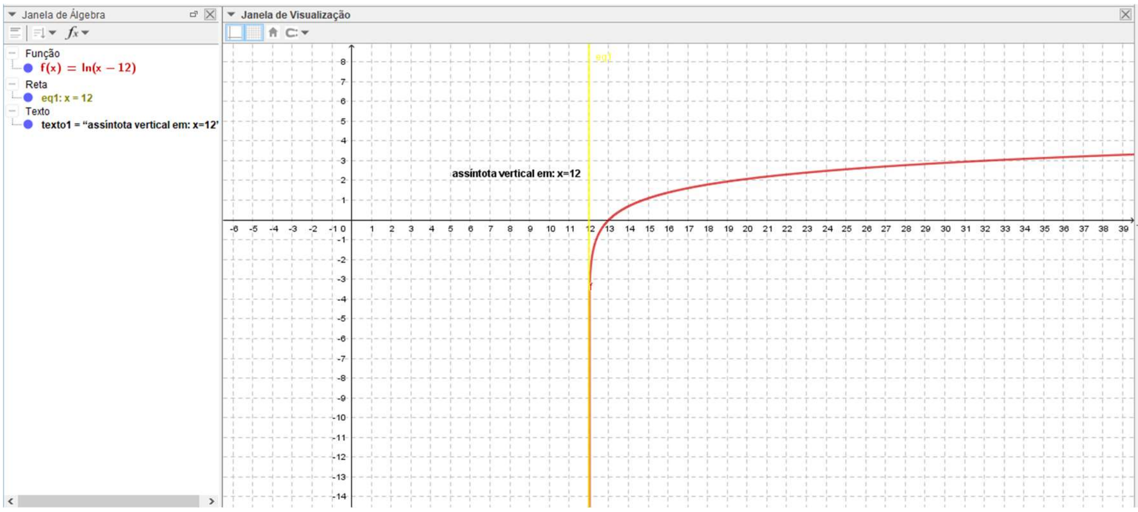
$\lim\limits_{x \to 12^-} \ln(\text{"}12\text{"} - 12) \Rightarrow \log_e \text{"}0^-\text{"} = Y \Rightarrow e^Y = \text{"}0^-\text{"}$

(quanto mais o 12 aproxima-se pela esquerda, então $f(x) = \ln(\text{"}12\text{"} - 12)\ \nexists$

$$\nexists \begin{cases} \lim\limits_{x \to +\infty} \ln(x-12) = \lim\limits_{x \to +\infty} \log_e x \Rightarrow e^Y = x \to +\infty \\ \lim\limits_{x \to -\infty} \ln(x-12) = \lim\limits_{x \to -\infty} \log_e x \Rightarrow e^Y = x \to \dfrac{1}{e^Y} = -x \\ 1/e^Y = -x\ \nexists \end{cases}$$

III) assíntota vertical em: $x = 12$

V) Descontínua: $]12, +\infty[$



g) $f(x) = \sqrt{-x+12}$

I) $Df(x) = \{x \in \mathbb{R} / x \leq 12\}$

II) $\lim_{x \to 12} \sqrt{-x+12} = \lim_{x \to 12} \sqrt{-“12”+12} = \sqrt{“0”} = “0”$

depende...

... limite lateral

$\lim_{x \to 12^+} \sqrt{-x+12} = \lim_{x \to 12} \sqrt{-12^+ + 12} = \sqrt{“0^-”} = \nexists$

$\lim_{x \to 12^-} \sqrt{-12^- + 12} = \sqrt{“0^+”} = “0^+”$

$\lim_{x \to +\infty} \sqrt{-x+12} = \lim_{x \to +\infty} \sqrt{-x} = \nexists$

$\lim_{x \to -\infty} \sqrt{-x+12} = \lim_{x \to -\infty} \sqrt{x} = \to +\infty$

III) NÃO HÁ ASSÍNTOTAS

b) $f(x) = \dfrac{sen(12x)}{x}$

I) 1) $f(x) = \{x \in \mathbb{R} \,/\, x \neq 0\}$

II) $\lim\limits_{x \to 12} \dfrac{sen(12x)}{x} = \lim\limits_{x \to 12} \dfrac{sen\,144}{12} \approx -0{,}0409\ldots$

$\lim\limits_{x \to +\infty} \dfrac{sen(12x)}{x} =$ "0" (ao dividirmos qualquer nº por outro que $\to +\infty$, este $\to 0$)

$\lim\limits_{x \to -\infty} \dfrac{sen(12x)}{x} =$ "0" (ao dividirmos qualquer nº por outro que $\to -\infty$, este $\to 0$)

III) assíntota em: $x = 0$.

V) Descontínua: $]-\infty, 0[$ e $]0, +\infty[$