EJERCICIOS DE APLICACIÓN. REGLA DE L´HÔPITAL.

1.- Calcula los siguientes límites:

a) $\lim_{x\to 0} \frac{sen^2 3x}{3x^2}$;

b) $\lim_{x\to 0} \frac{x^3 - x}{\sqrt{x+9} - 3}$

c) $\lim_{x\to 1} \frac{x^2 - 1}{Ln\, x}$

d) $\lim_{x\to 0} \frac{tg\, x}{x}$

e) $\lim_{x\to 0} \frac{e^{-x} - e^x}{3\, sen\, x}$

f) $\lim_{x\to 7} \frac{x^2 - 9x + 14}{Ln\left(x^2 - 6x - 6\right)}$

g) $\lim_{x\to +\infty} \frac{Ln\, x}{x}$

h) $\lim_{x\to +\infty} \frac{e^x}{Ln\, x}$

i) $\lim_{x\to 0} \left(\frac{1}{4x} - \frac{2}{xe^x}\right)$

j) $\lim_{x\to +\infty} \frac{x + \sqrt{x+1}}{3x}$

k) $\lim_{x\to 0} x\, Ln\, x$

l) $\lim_{x\to 0} (tg\, x)^x$

m) $\lim_{x\to +\infty} \left(1 + \frac{3}{x}\right)^{4x-5}$

n) $\lim_{x\to \infty} \sqrt[x]{x^2 + 2}$

ñ) $\lim_{x\to +\infty} \left(\frac{x+3}{x-2}\right)^{3x+1}$

o) $\lim_{x\to 2} \left[(x-2)Ln(x-2)\right]$

p) $\lim_{x\to 0} (\cos x + sen\, x)^{\frac{1}{x}}$

q) $\lim_{x\to 0} \frac{e^x - x - \cos x}{sen^2 x}$

r) $\lim_{x\to 0} \frac{e^{x^2} - 1}{\cos x - 1}$

s) $\lim_{x\to 0} \frac{e^x - e^{-x} - 2x}{x - sen\, x}$

t) $\lim_{x\to 0} \frac{x}{Ln(1+x)}$

u) $\lim_{x\to 0} \frac{x^2}{1 - \cos x}$

v) $\lim_{x\to 0} \frac{Ln\, x}{\cot g\, x}$

w) $\lim_{x\to 0} \left(e^x - x\right)^{\frac{1}{x}}$

aa) $\lim_{x\to 0} \frac{1 + x - e^x}{sen^2 x}$

ab) $\lim_{x\to 3} \frac{\sqrt{x^2 - 5} - 2}{x - 3}$

ac) $\lim_{x\to +\infty} \left(1 - \frac{1}{x^2}\right)^x$

ad) $\lim_{x\to 0} \frac{e^x sen\, x - x}{2x^2 + x^4}$

af) $\lim_{x\to 0} \frac{x - sen\, x}{tg\, x - sen\, x}$

ag) $\lim_{x\to 1} \left(\frac{1}{Ln\, x} - \frac{1}{x-1}\right)$

ah) $\lim_{x\to +\infty} (Ln\, x)^{e^{-x}}$

ai) $\lim_{x\to 0} (\cos 2x)^{\frac{1}{sen\, x^2}}$

aj) $\lim_{x\to 1/2} \frac{1 - tg\left(\frac{\pi}{2}x\right)}{Ln\, 4x^2}$

2.- Se considera la función $f(x) = \frac{x^2}{e^x}$. **Se pide calcular** $\lim_{x\to -\infty} f(x)$, $\lim_{x\to +\infty} f(x)$

3.- Determínese los valores de a y b para los cuales $\lim_{x\to 0} \frac{ax^2 + bx + 1 - \cos x}{sen\, x^2} = 1$

1. a) $\lim\limits_{x\to 0} \dfrac{sen^2 3x}{3x^2} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{\cancel{2} sen3x \cdot cos3x \cdot 3}{\cancel{6}x} =$

$= \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{3cos3x\,cos3x + 3sen3x(-sen3x)}{1} = \; = \dfrac{3}{1} = \underline{\underline{3}}$

b) $\lim\limits_{x\to 0} \dfrac{x^3 - x}{\sqrt{x+9} - 3} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{3x^2 - 1}{\dfrac{1}{2\sqrt{x+9}}} = \dfrac{-1}{\frac{1}{6}} = -6$

c) $\lim\limits_{x\to 1} \dfrac{x^2 - 1}{Lnx} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 1} \dfrac{2x}{\frac{1}{x}} = \dfrac{2}{1} = 1$

d) $\lim\limits_{x\to 0} \dfrac{tgx}{x} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{(1 + tg^2 x)}{1} = \dfrac{1}{1} = 1$

e) $\lim\limits_{x\to 0} \dfrac{e^{-x} - e^{x}}{3 \cdot senx} = \left[\dfrac{0}{0}\right] = \lim\limits_{x\to 0} \dfrac{-e^{-x} - e^{x}}{3\,cosx} = \dfrac{-2}{3}$

f) $\lim\limits_{x\to 7} \dfrac{x^2 - 9x + 14}{ln(x^2 - 6x - 6)} = \left[\dfrac{0}{0}\right] = \lim\limits_{x\to 7} \dfrac{2x - 9}{\dfrac{2x-6}{x^2-6x-6}} =$

$= \lim\limits_{x\to 7} \dfrac{(2x-9)(x^2 - 6x - 6)}{(2x-6)} = \dfrac{5 \cdot 1}{8} = \dfrac{5}{8}$

g) $\lim\limits_{x\to \infty} \dfrac{lnx}{x} = \left[\dfrac{\infty}{\infty}\right] \underset{L'H}{=} \lim\limits_{x\to \infty} \dfrac{1/x}{1} = \lim\limits_{x\to \infty} \dfrac{1}{x} = \dfrac{1}{\infty} = 0$

h) $\lim\limits_{x\to+\infty} \dfrac{e^x}{\ln x} = \left[\dfrac{\infty}{\infty}\right] \underset{L'H}{=} \lim\limits_{x\to+\infty} \dfrac{e^x}{1/x} = \lim\limits_{x\to+\infty} x e^x = \infty$

i) $\lim\limits_{x\to 0} \left(\dfrac{1}{4x} - \dfrac{2}{xe^x}\right) = (\infty - \infty) = \lim\limits_{x\to 0} \left(\dfrac{e^x - 8}{4xe^x}\right) =$

$= \dfrac{1-8}{0} = \dfrac{-7}{0} = -\infty.$

j) $\lim\limits_{x\to+\infty} \dfrac{x+\sqrt{x+1}}{3x} = \left[\dfrac{\infty}{\infty}\right] \underset{L'H}{=} \lim\limits_{x\to+\infty} \dfrac{1 + \frac{1}{2\sqrt{x+1}}}{3} = \dfrac{1}{3}$

k) $\lim\limits_{x\to 0} x\cdot \ln x = [0(-\infty)] = \lim\limits_{x\to 0} \dfrac{\ln x}{\frac{1}{x}} = \left[\dfrac{-\infty}{\infty}\right] \underset{L'H}{=}$

$= \lim\limits_{x\to 0} \dfrac{1/x}{-1/x^2} = \lim\limits_{x\to 0} -x = 0$

l) $\lim\limits_{x\to 0} (tg\,x)^x = [0^0] = e^0 = 1$

$\lim\limits_{x\to 0} \ln (tg\,x)^x = \lim\limits_{x\to 0} x\cdot \ln(tg\,x) = [0(-\infty)] =$

$\lim\limits_{x\to 0} \dfrac{\ln(tg\,x)}{\frac{1}{x}} = \left[\dfrac{-\infty}{\infty}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{\frac{1}{tg\,x}\cdot(1+tg^2x)}{-1/x^2} =$

$= \lim\limits_{x\to 0} \dfrac{x^2(1+tg^2x)}{-tg\,x} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{2x(1+tg^2x) + x^2\cdot 2tg\,x(1+tg^2x)}{-(1+tg^2x)} = 0$

m) $\lim\limits_{x\to+\infty}\left(1+\frac{3}{x}\right)^{4x-5} = [1^{\infty}] = e^{12}$

$\lim\limits_{x\to\infty} \ln\left(1+\frac{3}{x}\right)^{4x-5} = \lim\limits_{x\to\infty}(4x-5)\cdot\ln\left(1+\frac{3}{x}\right) = [\infty\cdot 0] =$

$= \lim\limits_{x\to\infty} \dfrac{\ln\left(1+\frac{3}{x}\right)}{\frac{1}{4x-5}} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to\infty} \dfrac{\frac{1}{\left(1+\frac{3}{x}\right)}\cdot\left(-\frac{3}{x^2}\right)}{\frac{-4}{(4x-5)^2}} =$

$= \lim\limits_{x\to\infty} \dfrac{3(4x-5)^2}{4\left(1+\frac{3}{x}\right)x^2} = \lim\limits_{x\to\infty} \dfrac{3(16x^2-40x+25)}{4\left(\frac{x+3}{\cancel{x}}\right)x^{\cancel{2}}} =$

$= \lim\limits_{x\to\infty} \dfrac{48x^2-120x+75}{4x^2+12x} = \frac{48}{4} = 12$

n) $\lim\limits_{x\to\infty} \sqrt[x]{x^2+2} = \lim\limits_{x\to\infty} (x^2+2)^{1/x} = [\infty^0] = e^0 = 1$

$\lim\limits_{x\to\infty} \ln(x^2+2)^{1/x} = \lim\limits_{x\to\infty} \frac{1}{x}\cdot\ln(x^2+2) = [0\cdot\infty] =$

$= \lim\limits_{x\to\infty} \dfrac{\ln(x^2+2)}{x} = \left[\frac{\infty}{\infty}\right] \underset{L'H}{=} \lim\limits_{x\to\infty} \dfrac{\frac{2x}{x^2+2}}{1} =$

$= \lim\limits_{x\to\infty} \dfrac{2x}{x^2+2} = 0$

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ξ) $\lim\limits_{x\to\infty}\left(\dfrac{x+3}{x-2}\right)^{3x+1} = [1^{\infty}] = e^{15}$

$\lim\limits_{x\to\infty} \ln\left(\dfrac{x+3}{x-2}\right)^{3x+1} = \lim\limits_{x\to\infty}(3x+1)\ln\left(\dfrac{x+3}{x-2}\right) = [\infty\cdot 0] =$

$\lim\limits_{x\to\infty} \dfrac{\ln\left(\frac{x+3}{x-2}\right)}{\frac{1}{3x+1}} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to\infty} \dfrac{\frac{1}{\frac{x+3}{\cancel{x-2}}}\cdot\frac{(x-2)-(x+3)}{(x-2)^{\cancel{2}}}}{\frac{-3}{(3x+1)^2}} =$

$= \lim\limits_{x\to\infty} \dfrac{\frac{-5}{(x+3)(x-2)}}{\frac{-3}{(3x+1)^2}} = \lim\limits_{x\to\infty} \dfrac{5(3x+1)^2}{3(x+3)(x-2)} =$

$= \lim\limits_{x\to\infty} \dfrac{45x^2+\dots}{3x^2+\dots} = \dfrac{45}{3} = 15$

ο) $\lim\limits_{x\to 2}\left[(x-2)\ln(x-2)\right] = [0(-\infty)] = \lim\limits_{x\to 2} \dfrac{\ln(x-2)}{\frac{1}{x-2}} = \left[\dfrac{-\infty}{\infty}\right]$:

$\underset{L'H}{=} \lim\limits_{x\to 2} \dfrac{\frac{1}{\cancel{x-2}}}{\frac{-1}{(x-2)^{\cancel{2}}}} = \lim\limits_{x\to 2} -(x-2) = 0$

p) $\lim_{x \to 0} (\cos x + \operatorname{sen} x)^{1/x} = [1^{\infty}] = e^{1}$

$\lim_{x \to 0} \ln(\cos x + \operatorname{sen} x)^{1/x} = \lim_{x \to 0} \frac{1}{x} \ln(\cos x + \operatorname{sen} x) = [\infty \cdot 0] =$

$= \lim_{x \to 0} \frac{\ln(\cos x + \operatorname{sen} x)}{x} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to 0} \frac{\frac{-\operatorname{sen} x + \cos x}{\cos x + \operatorname{sen} x}}{1}$

$= \lim_{x \to 0} \frac{-\operatorname{sen} x + \cos x}{\cos x + \operatorname{sen} x} = \frac{1}{1} = 1$

q) $\lim_{x \to 0} \frac{e^x - x - \cos x}{\operatorname{sen}^2 x} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to 0} \frac{e^x - 1 + \operatorname{sen} x}{2 \operatorname{sen} x \cdot \cos x}$

$= \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to 0} \frac{e^x + \cos x}{2\cos^2 x - 2\operatorname{sen}^2 x} = \frac{1+1}{2-0} = \frac{2}{2} = 1$

r) $\lim_{x \to 0} \frac{x^2}{1 - \cos x} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to 0} \frac{2x}{+\operatorname{sen} x} = \left[\frac{0}{0}\right] \underset{L'H}{=}$

$= \lim_{x \to 0} \frac{2}{\cos x} = \frac{2}{1} = 2$

s) $\lim_{x \to 0} \frac{e^x - e^{-x} - 2x}{x - \operatorname{sen} x} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to 0} \frac{e^x + e^{-x} - 2}{1 - \cos x} = \left[\frac{0}{0}\right] \underset{L'H}{=}$

$= \lim_{x \to 0} \frac{e^x - e^{-x}}{0 + \operatorname{sen} x} = \left[\frac{0}{0}\right] = \lim_{x \to 0} \frac{e^x + e^{-x}}{\cos x} = \frac{2}{1} = 1$

t) $\lim\limits_{x\to 0} \dfrac{x}{\ln(1+x)} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{1}{\frac{1}{1+x}} = 1$

u) $\lim\limits_{x\to 0} \dfrac{x^2}{1-\cos x} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{2x}{\operatorname{sen} x} = \left[\dfrac{0}{0}\right] =$

$= \lim\limits_{x\to 0} \dfrac{2}{\cos x} = \dfrac{2}{1} = 2.$

v) $\lim\limits_{x\to 0} \dfrac{\ln x}{\operatorname{cotg} x} = \left[\dfrac{-\infty}{\infty}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{1/x}{-1/\operatorname{sen}^2 x} = \lim\limits_{x\to 0} \dfrac{-\operatorname{sen}^2 x}{x} = \left[\dfrac{0}{0}\right]$

$= \lim\limits_{x\to 0} \dfrac{-2\operatorname{sen} x \cos x}{1} = \dfrac{0}{1} = 1$

w) $\lim\limits_{x\to 0} (e^x - x)^{1/x} = [1^\infty] = e^0 = 1$

$\lim\limits_{x\to 0} \ln(e^x - x)^{1/x} = \lim\limits_{x\to 0} \dfrac{1}{x} \cdot \ln(e^x - x) = [\infty \cdot 0] =$

$= \lim\limits_{x\to 0} \dfrac{\ln(e^x - x)}{x} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{\frac{e^x - 1}{e^x - x}}{1} =$

$= \lim\limits_{x\to 0} \dfrac{e^x - 1}{e^x - \cancel{x}} = \dfrac{1-1}{1-0} = \dfrac{0}{1} = 0$

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aa) $\lim\limits_{x\to 0} \dfrac{1+x-e^x}{sen^2 x} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{1-e^x}{2\, senx \cos x} = \left[\dfrac{0}{0}\right]$

$\underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{-e^x}{2\cos^2 x - 2 sen^2 x} = \dfrac{-1}{2}$

ab) $\lim\limits_{x\to 3} \dfrac{\sqrt{x^2-5}-2}{x-3} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 3} \dfrac{\frac{\cancel{2}x}{\cancel{2}\sqrt{x^2-5}}}{1} =$

$= \lim\limits_{x\to 3} \dfrac{x}{\sqrt{x^2-5}} = \dfrac{3}{2}$

ac) $\lim\limits_{x\to +\infty} \left(1+\dfrac{1}{x^2}\right)^x = [1^\infty] = e^0 = 1$

$\lim\limits_{x\to \infty} \ln\left(1-\dfrac{1}{x^2}\right)^x = \lim\limits_{x\to\infty} x \ln\left(1-\dfrac{1}{x^2}\right) = [\infty \cdot 0] =$

$= \lim\limits_{x\to\infty} \dfrac{\ln\left(1-\frac{1}{x^2}\right)}{\frac{1}{x}} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to\infty} \dfrac{\frac{1}{\left(1-\frac{1}{x^2}\right)} \cdot \frac{2}{x^3}}{-\frac{1}{x^2}} =$

$= \lim\limits_{x\to\infty} \dfrac{-2x^2}{\left(\frac{x^2-1}{\cancel{x^2}}\right)x^{\cancel{3}}} = \lim\limits_{x\to\infty} \dfrac{-2x}{x^2-1} = 0$

ad) $\lim\limits_{x\to 0} \dfrac{e^x \cdot senx - x}{2x^2+x^4} = \left[\dfrac{0}{0}\right] \underset{L'H}{=} \lim\limits_{x\to 0} \dfrac{e^x \cos x + e^x senx - 1}{4x+4x^3} = \left[\dfrac{0}{0}\right] \underset{L'H}{=}$

$= \lim\limits_{x\to 0} \dfrac{e^x \cos x \cancel{- e^x senx + e^x senx} + e^x \cos x}{4+12x^2} = \lim\limits_{x\to 0} \dfrac{2e^x \cos x}{4+12x^2} = \dfrac{2}{4} = \dfrac{1}{2}$

af) $\lim_{x \to 0} \frac{x - \operatorname{sen} x}{\operatorname{tg} x - \operatorname{sen} x} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to 0} \frac{1 - \cos x}{(1 + \operatorname{tg}^2 x) - \cos x} = \left[\frac{0}{0}\right]$

$\underset{L'H}{=} \lim_{x \to 0} \frac{0 + \operatorname{sen} x}{2 \operatorname{tg} x (1 + \operatorname{tg}^2 x) + \operatorname{sen} x} = \left[\frac{0}{0}\right] \underset{L'H}{=}$

$= \lim_{x \to 0} \frac{\cos x}{2(1 + \operatorname{tg}^2 x)^2 + 4 \operatorname{tg}^2 x (1 + \operatorname{tg}^2 x) + \cos x} = \frac{1}{2 + 1} = \frac{1}{3}$

ag) $\lim_{x \to 1} \left(\frac{1}{\ln x} - \frac{1}{x - 1} \right) = (\infty - \infty) =$

$\lim_{x \to 1} \frac{x - 1 - \ln x}{\ln x (x - 1)} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to 1} \frac{1 - \frac{1}{x}}{\frac{x - 1}{x} + \ln x} = \left[\frac{0}{0}\right] =$

$= \lim_{x \to 1} \frac{x - 1}{x - 1 + x \cdot \ln x} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to 1} \frac{1}{1 + \ln x + 1} = \frac{1}{2}$

ah) $\lim_{x \to \infty} (\ln x)^{e^{-x}} = [\infty^0] = e^{0} = 1$

$\lim_{x \to \infty} \ln (\ln x)^{e^{-x}} = \lim_{x \to \infty} e^{-x} \cdot \ln(\ln x) = [0 \cdot \infty] =$

$\lim_{x \to \infty} \frac{\ln(\ln x)}{e^x} = \left[\frac{\infty}{\infty}\right] \underset{L'H}{=} \lim_{x \to \infty} \frac{\frac{1}{\ln x} \cdot \frac{1}{x}}{e^x} =$

$= \lim_{x \to \infty} \frac{1}{x \cdot \ln x \cdot e^x} = \frac{1}{\infty} = 0$

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$$a i) \lim_{x \to 0} (\cos 2x)^{\frac{1}{\operatorname{sen} x^2}} = [1^\infty] = e^{-2}$$

$$\lim_{x \to 0} \ln (\cos 2x)^{\frac{1}{\operatorname{sen} x^2}} = \lim_{x \to 0} \frac{1}{\operatorname{sen} x^2} \cdot \ln(\cos 2x) =$$

$$= \lim_{x \to 0} \frac{\ln(\cos 2x)}{\operatorname{sen} x^2} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to 0} \frac{\frac{-2 \operatorname{sen} 2x}{\cos 2x}}{2x \cdot \cos x^2} =$$

$$= \lim_{x \to 0} \frac{-\operatorname{sen} 2x}{x \cos 2x \cdot \cos x^2} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to 0} \frac{-2 \cos 2x}{\cos 2x \cdot \cos x^2 + x(-2 \operatorname{sen} 2x) \cos x^2}$$

$$\overline{- 2x^2 \cos 2x \operatorname{sen} x^2} = \frac{-2}{1} = -2$$

$$a j) \lim_{x \to \frac{1}{2}} \frac{1 - \operatorname{tg}\left(\frac{\pi}{2} x\right)}{\ln 4x^2} = \left[\frac{0}{0}\right] \underset{L'H}{=} \lim_{x \to \frac{1}{2}} \frac{-\frac{\pi}{2}\left(1 + \operatorname{tg}^2\left(\frac{\pi}{2} x\right)\right)}{\frac{8x}{4x^2}} =$$

$$= \lim_{x \to \frac{1}{2}} -\frac{\pi}{4} x \left(1 + \operatorname{tg}^2\left(\frac{\pi}{2} x\right)\right) = -\frac{\pi}{8} \cdot 2 = -\frac{\pi}{4}$$

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2.- $\lim\limits_{x\to -\infty} \dfrac{x^2}{e^x} = \left[\dfrac{\infty}{0}\right] = \lim\limits_{x\to -\infty} x^2 \cdot \dfrac{1}{e^x} =$

$= \infty \dfrac{1}{e^{-\infty}} = \infty \cdot \dfrac{1}{0} = \infty \cdot \infty = \infty$

$\lim\limits_{x\to +\infty} \dfrac{x^2}{e^x} = \left[\dfrac{\infty}{\infty}\right] \underset{L'H}{=} \lim\limits_{x\to +\infty} \dfrac{2x}{e^x} = \left[\dfrac{\infty}{\infty}\right] \underset{L'H}{=}$

$= \lim\limits_{x\to +\infty} \dfrac{2}{e^x} = \dfrac{2}{\infty} = 0$

3.- $\lim\limits_{x\to 0} \dfrac{ax^2 + bx + 1 - \cos x}{\operatorname{sen} x^2} = \left[\dfrac{0}{0}\right] \underset{L'H}{=}$

$\lim\limits_{x\to 0} \dfrac{2ax + b + \operatorname{sen} x}{\cos x^2 \cdot 2x} = \dfrac{b}{0} \Rightarrow$ si $b = 0$ $\left[\dfrac{0}{0}\right] \underset{L'H}{=}$

$\lim\limits_{x\to 0} \dfrac{2a + \cos x}{-\operatorname{sen} x^2\, 4x^2 + 2\cos x^2} = \dfrac{2a+1}{2} = 1$

$2a + 1 = 2$

$\boxed{a = \dfrac{1}{2}}$