

Pencil and Paper homework Number 11

This homework concerns L'Hospital's Rule.

1) Find the following limits

a) $\lim_{x \rightarrow 0} \frac{\sin 5x}{3x}$

b) $\lim_{x \rightarrow 0} \frac{\cos 5x - 1}{x^2}$

c) $\lim_{x \rightarrow 0} \frac{e^{2x} - 1}{x}$

d) $\lim_{x \rightarrow 0} \frac{\sin^2 x - x^2}{x^2}$

e) $\lim_{x \rightarrow 0} \frac{\sin x - \tan x}{x^3}$

f) $\lim_{x \rightarrow 1} \frac{x^2 - 3x + 2}{x^2 - 1}$

g) $\lim_{x \rightarrow \frac{\pi}{2}} \frac{\sin x}{x - \frac{\pi}{2}}$

h) $\lim_{x \rightarrow 0} \frac{\tan 3x}{\ln(1+x)}$

i) $\lim_{x \rightarrow 0} \frac{\sin(x^2)}{(\sin x)^2}$

j) $\lim_{x \rightarrow 0} \frac{\sec x}{\cos x}$ Careful!

k) $\lim_{x \rightarrow \frac{\pi}{2}} (\sec x - \tan x)$

2) Do the following limits using the log trick.

a) $\lim_{x \rightarrow 0} (1 - 2x)^{\frac{1}{x}}$

b) $\lim_{x \rightarrow 0^+} (\sin x)^{(e^x - 1)}$

c) $\lim_{x \rightarrow 0} (\tan x)^{\tan 2x}$

3) Here's an example from Quantum Mechanics: Feynman wants

$$\lim_{\omega \rightarrow 0} \frac{\hbar\omega}{e^{\frac{\hbar\omega}{kT}} - 1}$$