(d) $\lim_{x\to\pi} \dfrac{\operatorname{sen} x}{x-\pi} = -1$

Note que $\dfrac{\operatorname{sen}\pi}{\pi-\pi} = \dfrac{0}{0}$ gera uma indeterminação

mas, note que $\operatorname{sen}(x-\pi) = -\operatorname{sen} x$

De fato, $\operatorname{sen}(x-\pi) = \operatorname{sen}x \cdot \underbrace{\cos\pi}_{-1} - \underbrace{\operatorname{sen}\pi}_{0} \cdot \cos x = -\operatorname{sen} x$

Logo, $\dfrac{\operatorname{sen} x}{x-\pi} = \dfrac{-\operatorname{sen}(x-\pi)}{x-\pi} = -\dfrac{\operatorname{sen} u}{u}$ se $u = x-\pi$

Assim, $\lim\limits_{x\to\pi} \dfrac{\operatorname{sen} x}{x-\pi} = -\lim\limits_{u\to 0} \dfrac{\operatorname{sen} u}{u} = -1$ □