6. [10 points] Let $g(x)$ be the function defined by

$$g(x) \;=\; x\sin(\pi x) + \frac{1}{\pi}\cos(\pi x).$$

The derivative of $g(x)$ is

$$g'(x) \;=\; \pi x\cos(\pi x).$$

As a reminder, $1 = \cos(0) = \sin(\frac{\pi}{2})$, and $-1 = \sin(-\frac{\pi}{2}) = \cos(\pi) = \cos(-\pi)$.

a. [3 points] Find all critical points of the function $g(x)$ that are in the interval $[-\frac{1}{2}, 1]$.

Answer: $x =$ _____

b. [5 points] Find all x-values where the global extrema of $g(x)$ occur on the interval $[-\frac{1}{2}, 1]$. Be sure to show your work and justify your answers.

Answer: The maximum occurs at $x =$ _____

Answer: The minimum occurs at $x =$ _____

c. [2 points] Find a formula for the linear approximation $L(x)$ of the function $g(x)$ at the point $\big(-2, \frac{1}{\pi}\big)$.

Answer: $L(x) =$ _____