Instructions. Be sure to show your work and explain your reasoning where necessary for full credit. There are two problems, and Problem 1 has four parts!!! be sure to flip over your paper!!!

**Theorem** (The Intermediate Value Theorem (IVT)). Suppose that $f$ is continuous on the closed interval $[a, b]$ and let $N$ be any number between $f(a)$ and $f(b)$, where $f(a) \neq f(b)$. Then there exists a number $c$ in $(a, b)$ such that $f(c) = N$.

Pictured is the graph of $f(x) = \sin(x)$ on the interval $[0, 7]$ (may be helpful for Problem 1).

**Problem 1** (6 points total)

(a) Let $f(x) = x^7 - 3x + 4$. Is there a number in the interval $[-2, -1]$ such that $f(x) = 0$? Explain why or why not (Note $(-2)^7 = -128$).

For Problem (1) parts (b)-(d), let $g(x) = \frac{1}{\sin(x)}$.

(c) Are there values of $x$ where $g(x)$ is discontinuous in the interval $[1, 2]$? If yes, say why. If not, say why not. You don’t need to specify the points.
(d) Are there values of $x$ where $g(x)$ is discontinuous in the interval $[2, 4]$? If yes, say how many and why. If not, say why not. You don’t need to specify the points.

(d) Recall that $\sin \left(\frac{\pi}{2}\right) = 1$, $\sin \left(\frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$, and $\sqrt{2} \approx 1.414$. Is there a number $c$ in the interval $\left[\frac{\pi}{4}, \frac{\pi}{2}\right]$ such that $g(c) = 1.2$? Explain why or why not.

Problem 2 (4 points)

Find the limit, and circle your answer when you find the number:

$$\lim_{x \to \infty} \sqrt{4x^2 + x - 2x}$$