Provide a clear and organized presentation. Show all of your work, give exact values only, and completely simplify all answers. Justify all claims of extrema.

1.   (10 pts) If $f(x) = 3\sin x$, determine the value of x that satisfies the conclusion of

the *Mean Value Theorem* for f over the interval $\left[0, \dfrac{\pi}{2}\right]$

2.   (10 pts) If $f'(x) = 90x^3 + 27x^2 - 4x - 1$, determine the critical numbers for f.

3. (20 pts) Let $f(x) = x + x^{2/3}$. Clearly sketch the graph of $y = f(x)$ and label in your graph all intercepts, local extrema, and inflection points.

4. (20 pts) Let $f(x) = \cos x + \cos 2x$ over $[-\pi, \pi]$. Clearly sketch the graph of $y = f(x)$ over its indicated domain and label in your graph all intercepts and local extrema.

5.   (20 pts) A window is constructed in the shape of a rectangle surmounted by an isosceles right triangle as depicted in the following picture. If its perimeter is fixed at 15 ft, then determine the dimensions that will maximize the amount of light that can enter the window.
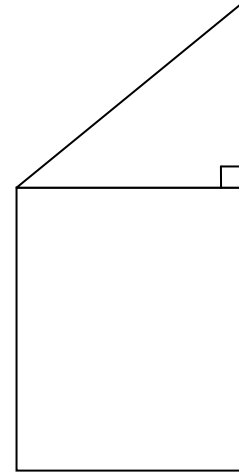
6.   (20 pts) I have a 3 foot wide hallway that meets a 4 foot wide hallway at a right angle. My cat *Pythagoras* attempts to push on the carpet a stick along one hallway and around the corner to continue down the subsequent hallway. What is the longest length of such a stick that he can get around this corner?

4'