remember: these problems are very hard! you should use any resources available to you, including online graphing tools like desmos and geogebra, and calculators like wolfram alpha or your graphing calculator. only bother trying these if you really feel like you have a handle on the material, these will be difficult to solve if you aren't used to the equations. try these questions on a separate document, and then look at the solutions available here

chloe choi is standing at the origin on a dock with insignificant width that follows the graph of the equation $r = 2\sin\theta + \cos 2\theta$.

a) what is the total amount of water encircled by this dock (i.e. the area completely enclosed within any section of this graph)?

b) her mother, mr. proulx, has fallen into the water at the point $(0, \frac{3}{4})$. chloe has a lifesaver that she can throw to save her mother. how close can she get to her mother (i.e. what is the closest point on the graph to this point)?

c) chloe can run one unit per second, and chloe's mom can only float for 2.5 more seconds. if chloe wants to be as close as she possibly can before throwing the lifesaver, will chloe be able to save him?