1. [9 points] While assembling a large fan as a holiday gift, you discover the following lovely diagram in the instruction manual. The propeller and base of the fan are illustrated by the polar curve $r = 2 + \sin(3\theta)$ and the circle $r = 2$, respectively.

![Polar Curve Diagram]

a. [5 points] Write down, but do not evaluate, an integral that gives the arc length of the part of the propeller outside the circle in the first quadrant.

\[ \text{Solution: } \int_{0}^{\pi/3} \sqrt{(2 + \sin(3\theta))^2 + (3 \cos(3\theta))^2} \, d\theta, \]

or alternatively

\[ \int_{0}^{\pi/3} \sqrt{(3 \cos(3\theta) \cos(\theta) - (2 + \sin(3\theta)) \sin(\theta))^2 + (3 \cos(3\theta) \sin(\theta) + (2 + \sin(3\theta)) \cos(\theta))^2} \, d\theta. \]

b. [4 points] Write down the Cartesian equation of the tangent line to the propeller at the point $(x, y) = (2, 0)$.

\[ \text{Solution: } y = \frac{2}{3}(x - 2). \]