5. (20 pts) Let $g(x) = \arctan x^2$.

    (a) Find a Maclaurin series for $g(x)$.

    (b) Use your answer for part (a) to find a Maclaurin series for $x^3 g(x)$. Simplify your answer.

    (c) What is the sum of the series found in part (b)?

6. (14 pts) Consider the parametric curve $x = e^{t/2}$, $y = 1 + e^{2t}$.

    (a) Find an equation of the line with slope 4 that is tangent to the curve.

    (b) Eliminate the parameter to find a Cartesian equation of the curve. Simplify your answer.

7. (14 pts) Consider the curve $x^2 = 16(1 + y^2)$.

    (a) Find the vertices and asymptotes of the curve.

    (b) Find a polar representation $r = f(\theta)$ for the curve.

8. (20 pts) Consider the polar curves $r = 2 + \sin(2\theta)$ and
$r = 2 + \cos(2\theta)$ in the 1st and 2nd quadrants, shown at right.

    (a) Find the (x, y) coordinates for the point that corresponds to
$r = 2 + \sin(2\theta)$, $\theta = \frac{\pi}{6}$. Simplify your answer.

    (b) Set up (but <u>do not evaluate</u>) integrals to find the following quantities.

        i. Length of the curve $r = 2 + \sin(2\theta)$.

        ii. Area of the region inside $r = 2 + \sin(2\theta)$ and outside
$r = 2 + \cos(2\theta)$. *Hint:* For the bounds, consider
$\tan(2\theta)$.