1. Find the derivatives, dy/dx, of the following functions (10 points):
   a. \( y = x \ln(x^2) \)
   b. \( y = \sec(x)\tan(x) \)
2. Find the derivatives, dy/dx, of the following functions. Fully rationalize and simply answers to a single fraction. It may be helpful to simply first. (10 points)

a. \[ y = \frac{\sqrt[3]{x^5}}{(4x^3)^{-1/2}} \cdot \frac{1}{2x^2} \]

b. \[ y = \frac{x + e}{\sqrt{x^2 + e^2}} \]
3. Find the derivatives, dy/dx, of the following functions and simplify (18 points):

a. \( y = \arcsin(\sqrt{3x}) \)

b. \( y = \frac{1}{[(\sin kx)(\cos kx)]^2} \) where \( k \) is an unknown constant

b. \( y = [\sin(3x)]^x \) for \( 0 < x < \pi/2 \)
4. The picture below shows the graph of the hyperbola \(x^2 - 2y^2 = 1\). Find the coordinates of the point(s) on the curve where the slope is 1. (12 points)
5. Given the function \( f(x) = e^{-x} \), find the equation of the tangent line to the curve at the point where \( x = 1 \). Graph the original function and the tangent line together below. Label x and y intercepts with their coordinates. \((11 \text{ points})\)

6. Consider the function \( f(x) = x^2 - 4ax + 3a^2 \) (where ‘a’ is an unknown constant). Find the \((x,y)\) coordinates on \( f(x) \) where the slope is zero. Answer will be in terms of ‘a’. \((3 \text{ points})\)
7. Find the equation of the tangent line to the curve $y = \sqrt[3]{x^5}$ at the point on the curve were $x=8$. Place your answer in $y=mx+b$ form. (10 points)

8. A circle is slowly increasing in size. At the moment when its radius has increased to 5 cm, its area is increasing at a rate of 10 cm$^2$/min. At this moment, how fast is its circumference increasing? (10 points)
9. Given the right triangle pictured to the right. Suppose that \( a = 5 \) feet and \( c = 13 \) feet. Suppose side ‘a’ begins stretching to the right at a rate of 3 ft/min. As this happens, side ‘b’ remains constant and side ‘c’ stretches with it. Find the rate at which the measure of angle \( \theta \) is changing at the moment when side ‘a’ has stretched to 12 feet in length. \( \text{(10 points)} \)

10. Find \( \frac{d^{100}}{dx^{100}} y \) if \( y = 2xe^x \) \( \text{(6 points)} \)