You are allowed to use a scientific calculator and one sheet of hand-written notes.

Check that your exam contains six questions.

Show all your work and clearly indicate your final answer.

When rounding is necessary, unless otherwise instructed, you may round your final answer to two digits after the decimal.

If you use a trial-and-error or guess-and-check method to solve a problem when another method is available, you will not receive full credit.

Give answers with appropriate units.

Raise your hand if you have a question.

You have 80 minutes to complete the exam.

Please put your name on your sheet of notes and turn it in with the exam.

GOOD LUCK!
1. (12 points) Compute the derivative. Do not simplify.

(a) \( y = \sin(\tan(3x)) \)

(b) \( y = \sqrt{e^{4x} + \cos^2(x)} \)

(c) \( y = (\sin^{-1} x)^x \)
2. (8 points)

(a) Find all points of intersection of $x^2 + xy + y^2 = 1$ with the line $y = x$.

(b) True or False? At the intersection points you found in part (a), the tangent line to $x^2 + xy + y^2 = 1$ is perpendicular to the line $y = x$. Justify your answer.

ANSWER: (circle one) TRUE FALSE
3. (8 points)

(a) Find the linearization $L(x)$ of the function

$$f(x) = \sin(2x) + \cos(4x)$$

at $x = 0$.

(b) Use your linearization to approximate $\sin(0.2) + \cos(0.4)$. 
4. (10 points) A spherical iron ball 10 centimeters in diameter is coated with a layer of ice of uniform thickness. If the ice melts at a rate of 6 cm³/minute, how fast is the thickness of the ice decreasing when there are \( \frac{872\pi}{3} \) cm³ of ice present? (NOTE: The volume of a sphere with radius \( r \) is \( V = \frac{4}{3}\pi r^3 \).)
5. (5 points) Let \( h(x) = f \left( \frac{g(x)}{x^2 + 1} \right) \).

If \( f(1) = 3, \ f(2) = 5, \ f'(1) = 7, \ f'(2) = 11, \ g(1) = 2, \) and \( g'(1) = 4 \), what is \( h'(1) \)?
6. (7 points) Let $y = e^{rx}$, where $r$ is a constant. For which values of $r$ is the following statement true?

$$2y'' + 7y' - 4y = 0$$