For full credit show all of your work (legibly!), unless otherwise specified. Answers may include all arithmetic operations, trigonometric functions, inverse trigonometric functions, and natural logarithms. Algebraic simplification of answers is unnecessary.

The problems are in no particular order, and it is suggested that you look at all of them before beginning to answer any.

1. **(8 points)** The *cissoid of Diocles* is a curve satisfying the equation $x(x^2 + y^2) = 4y^2$.

   (a) **(6 points)** Find a formula for $\frac{dy}{dx}$ on this curve.

   (b) **(2 points)** Find the equation of the tangent line to the curve at $(2, -2)$.

2. **(6 points)** Calculate $\frac{d}{dx}\cos(x^2e^x)$.

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3. **(8 points)** Amy is standing motionless 50 meters east of a north-south road with a radar gun, while Bob, who is 120 meters to the north, is driving south. The radar gun reports how quickly the *distance between Amy and Bob* is changing (which may not be Bob's actual speed).

   (a) **(6 points)** If Bob is driving south at 30 meters per second, what will the radar report as the rate of change of the distance between Bob and Amy?

   (b) **(2 points)** Conversely, if the radar reported a change-rate of 25 meters per second, what would Bob's actual speed be?

4. **(5 points)** Find an equation of the tangent line to the curve $y = e^x(x^2 - 3x + 1)$ at $(0, 1)$.

5. **(6 points)** If $f(x) = \frac{\arctan 3x}{\sqrt{x^4+2}}$, then find $f'(x)$.

6. **(6 points)** Answer the following derivative-related questions.

   (a) **(2 points)** Find $\frac{d}{dx}\left((e^x + 2x)\arcsin x\right)$.

   (b) **(4 points)** If $y = \tan\sqrt{\sec x}$, find $\frac{dy}{dx}$.

   (c) **(2 points)** If $g(t) = \frac{\ln x}{\sqrt[3]{x}}$, find $g'(t)$.

7. **(4 points)** Estimate the following values using appropriate linear approximations.

   (a) **(2 points)** $(-1.993)^4$.

   (b) **(2 points)** $\sqrt{25.07}$.

8. **(4 points)** Find the absolute maxima and minima of the function $f(x) = 2x^3 - 5x^2 + 4x + 2$ on the interval $[0, 3]$.