

This test is closed-book and closed-notes. No calculator is allowed for this test. For full credit show all of your work (legibly!), unless otherwise specified. Algebraic simplification of final answers will not be necessary.

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

1. **(15 points)** Find the following derivatives:

(a) **(5 points)** For  $y = \frac{x^7 - x^3}{2+x}$ , evaluate  $\frac{dy}{dx}$ .

(b) **(5 points)** For  $f(x) = (x^5 - 3\sqrt{x})(2x^3 + 4x - 7)$ , evaluate  $f'(x)$ .

(c) **(5 points)** Evaluate  $\frac{d}{dt} \left(4t - 3 + \frac{5}{t}\right)^5$ .

2. **(20 points)** Perform the following differentiations:

(a) **(10 points)**  $\frac{d}{dt} \left( \frac{t^2-2}{t^3+4t} (3t^2 + 2t - 4) \right)$ .

(b) **(10 points)**  $\frac{d}{dx} \left( \frac{4x-3}{x^3-2x} \right)^3$ .

3. **(5 points)** Use differentials to find a rational approximation of  $\sqrt{3.97}$ .

4. **(15 points)** Answer the following questions about the ellipse determined by the equation  $2x^2 - 4xy + 5y^2 - 4x + 3y = 12$ .

(a) **(10 points)** Find an expression for  $\frac{dy}{dx}$  in terms of  $x$  and  $y$ .

(b) **(5 points)** Find the equation of the tangent line to this ellipse at the point  $(-1, -2)$ .