

REMEMBER!

PLEASE, start each problem at the top of a new side of a page!

ALSO, please LABEL (or underline or box in) your answers.

FINALLY, *SHOW ALL WORK* to justify your answers!

1. (10) Given the parabola $y = (2x - 1)^2$,
 - (a) Find the equation of the line tangent to the parabola at $x = 2$.
 - (b) Find the equation of the line normal to the parabola at the same point. (Remember that a *normal* line is perpendicular to the *tangent* line.)
2. (24) Find $\frac{dy}{dx}$ for each of the following.
 - (a) $y = (5x^2 - 3x)(3x^5 - 2x^2 + 1)$
 - (b) $y = \frac{2x^4}{3x^2 + 1}$
 - (c) $y = 4(2 - \frac{3\pi}{7})^{12}$
 - (d) $y = (x^2 + 2)^2 e^{2x}$
3. (13) Generalization lies at the very center of mathematics. That is, given a specific result, the mathematician wants to generalize to more cases. Using rules you already know, derive a “nice” formula (i.e., a formula in which only u , v , w , u' , v' , and w' [possibly raised to some positive power] appear WITHOUT any parentheses) for the following. (Note that this is merely a generalization for the derivative of a product and a quotient of functions of x .) *Show all stages of the derivation for full credit!*
$$\frac{d}{dx} \left(\frac{u}{vw} \right)$$
4. (15) What are the first, second, and twelfth derivatives of $y = (3x^3 + 2)^3$?
5. (12) Find $\frac{dy}{dx}$ for each of the following.
 - (a) $y = \tan x \sin 3x^2$
 - (b) $y = \frac{\sin 3x}{\cos 4x^2}$
6. (10) Find $\frac{dy}{dx}$ given $y = \sin^2(2 \cos 3x^2)$.
7. (16) A baseball is thrown up into the air and the altitude is described by $s(t) = 64t - 16t^2$.
 - (a) How fast is the ball going at 3 seconds after it is thrown?
 - (b) How long does it take to reach half-way to its highest point?