# Week 13 — Exam Review

## MATH:113, Recitations 304 and 305

### Implicit Differentiation, Related Rates

Names: _____

For each of the following, find $\frac{\mathrm{d}y}{\mathrm{d}x}$ first by solving directly for $y$ and differentiating directly; then, use implicit differentiation to find $\frac{\mathrm{d}y}{\mathrm{d}x}$. Check that the derivatives you get are the same.

$x/y^3 = 1$ $\qquad$ $x^2 + y^3 = 4$ $\qquad$ $x^2 + y^2 = 2$

Implicitly determine the derivatives $\frac{\mathrm{d}y}{\mathrm{d}x}$ for each of the following expressions. If a point is provided, evaluate $\frac{\mathrm{d}y}{\mathrm{d}x}$ at that point.

$e^x - \cos(y) = x$ $\qquad$ $\tan(x^2y^4) = 3x + y^2$ *(warning: very gross)*

$x^2 + y^2 = 4$ at $(0, 2)$ $\qquad$ $y^4 + 3xy + x = 2$ at $(2, 0)$

Complete the following related rates problems.

1. The length of one edge of a cube is increasing at a rate of $8^{cm}/_{s}$. How quickly is the volume of the cube growing when this edge is 6cm long?

2. A dinghy carrying a horse (a *horse boat*, patent Dwight Schrute) is pulled toward a dock by a rope. The dock is 6 feet higher than the top of the boat.

   (a) If we pull in the rope at 2 $^{ft}/_{s}$, how quickly is the boat approaching the dock if 10 feet of rope are out?

   (b) How quickly is the *angle from the rope to the boat* changing when 10 feet of rope are out?

   ***This question is directly from your practice exam, save for a small change. Make sure you're comfortable with the concepts, setup, and computation strategies used in this problem.***

3. Air is escaping from a perfectly (and impossibly) spherical balloon at a rate of 2 $^{m^3}/_{min}$. When the radius of the balloon is 1m, how quickly is the *surface area* of the balloon shrinking?