

INSTRUCTIONS: Books, notes, flying monkeys and electronic devices are not permitted. Write your (1) name, (2) instructor's name, and (3) recitation section on the front of your bluebook. Also make a scoring table, with places for 5 problems, plus a total score. Work all 5 **problems**. Start each problem on a **new page**. Show your work. **BOX** in your answers. A correct answer with incorrect or no supporting work may receive no credit, while an incorrect answer with relevant work may receive partial credit.

1. (20 points)

- a) Find df/dt , if $f(t) = \frac{1}{6}(1 + \cos^2(7t))^3$
- b) Find d^2z/dy^2 for the function $6z^3y + 4y = 1$.

2. (15 points)

- a) I am building a cubic box and I want each side to be 10 inches. If each measurement could be off by 0.1 inch, what is the approximate error in the volume?
- b) Use linearization to find approximately the value of $\sin 3$.

3. (25 points) A 4-m length of wire is available for making a circle and a square.

- a) How should the wire be distributed between the two shapes to maximize the sum of the enclosed areas?
- b) What is the maximum area. Be sure to show that it is a maximum.

4. (20 points)

- a) Graph the function: $f(x) = x^2(2x^2 - 9)$. Be sure to identify (and label on the graph) any maxima, minima or inflection points and any asymptotes.
- b) Identify the interval(s) on which $f(x)$ is increasing and/or decreasing
- c) Identify the interval(s) on which $f(x)$ is concave up and/or concave down

5. (20 points) Sand is flowing from a conical structure (see picture) at a rate of $50 \text{ m}^3 / \text{min}$ into a train car. If the radius of the base is 5 meters and the height of the structure is 6 meters, then

- a. How fast is the height changing at the moment when the height is 4 meters?
- b. How fast is the radius changing at the same moment?

Note: $V = \frac{\pi}{3} r^2 h$

