Honors Calculus: Related Rates and Extrema Test Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Show all work. Please circle your answers.**

*Solve each related rate problem.*

1. Air is being pumped into a spherical balloon at a rate of 3 cm3 per minute. Determine the rate at which the radius is increasing when the surface area of the balloon is cm2. (
2. A pebble is thrown in a pond and causes concentric circular ripples. The outermost ripple has a radius that is increasing at a rate of 4 in/sec . At what rate is the total area of the rippling water changing when the radius is 10 in? ()
3. At a rock quarry, gravel is falling off a conveyer belt onto a conical (cone-shaped) pile below at a constant rate of 10 cubic feet per minute. The pile is shaped such that the diameter is 4 times as wide as the pile’s height. When the pile is 12 feet high, how fast is the height of the pile growing? ( )

*For each function below, find all critical numbers.*



*For each function, find the x-values for the relative maximums and relative minimums, if any. Justify your answer.*

*For each function, fund the x-values for which the function has an absolute maximum and absolute minimum on the specified interval.*

8.

9. ]

10. Find the equation of the line tangent to at

*Bonus:* A hot-air balloon rising vertically from level ground in Albuquerque, New Mexico is being recorded by a video camera placed 500ft from the liftoff point. The camera is adjusting its angle at a rate of 15º per second. When the angle of the camera is 45º, how fast is the balloon rising? *Hint: Convert from degrees to radians*.