

Due by: November 18 – *Late work will not be accepted.*

Show all of your work in the spaces provided.

You may work in groups of up to 3 people – 3 names on one paper.

Parametric Equations

1. (11 points) A baseball player hits a ball. The horizontal and vertical positions, in meters, are given by the set of parametric equations, where t is the time, in seconds, after the ball is hit:

$$h(t) = 54.5t$$
$$v(t) = -9.8t^2 + 28t + 1.2$$

- a. Using the equations and the Pythagorean Theorem, find the initial velocity of the ball.

- b. Find the angle (in degrees) of the ball as it was hit.

c. When will the ball reach its highest point? How high is this point?

d. When does the ball hit the ground?

e. How far does the ball travel?

f. Find the velocity of the ball as it hits the ground.

Related Rates and Optimization

2. (6 points) A hot air balloon is perfectly spherical and has 85 cubic meters of hot air in it. It will lift off when it has 210 cubic meters of hot air. Hot air is being pumped in at a rate of 10 cubic meters per minute, but loses 1 cubic meter of hot air every 2 minutes.
- When will the balloon take off?
 - How fast is the diameter of the balloon growing when it takes off?
 - How fast is the surface area of the balloon growing when it takes off?
 - How fast is the circumference growing when it takes off?

3. (3 points) The balloon takes off from a mountain and its path is modeled by:

$$y = -0.000025x^2 + 0.5x + 250,$$

where x is the horizontal position and y is the vertical position, both in meters.

- a. How high in the air does the balloon get?

- b. How far does the balloon travel before it lands?