

40 pts.

Problem 1.

Suppose that we want to hit a target 5000 feet away with a cannon that has a muzzle speed of 500 feet per second. Find the two angles at which we can fire the cannon to hit the target. What is the time of flight for the larger of the two angles? Give numerical answers accurate to two decimal places.

40 pts.

Problem 2.

A particle moves in 3-dimensional space with the position vector

$$\mathbf{R}(t) = t^2\mathbf{i} + t\mathbf{j} + \frac{t^3}{3}\mathbf{k}.$$

Find the curvature κ , the tangential component of acceleration A_T , and the normal component of acceleration A_N .

40 pts.

Problem 3. Consider the function $f(x, y) = 3x^2 + y - x^3y^4$. Find the partial derivatives $f_x, f_y, f_{xx}, f_{xy}, f_{yx}$ and f_{yy} by hand computation.

40 pts.

Problem 4.

A right circular cylinder is measured to have a height of 5 feet and a radius of 10 feet. The maximum error in these measurements is ± 0.2 feet. Use increments to estimate the maximum possible error in the calculated volume of the cylinder. What is the maximum possible percentage error in the calculated volume of the cylinder?

40 pts.

Problem 5.

Let $z = f(x, y) = xy + xy^3$, where $x = t^3$ and $y = 1 + 2t$. Find dz/dt in the following two ways.

- A. Express z explicitly as a function of t and differentiate.
 - B. Use the Chain Rule for partial derivatives, expressing your answer as a function of t .
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Problem 6.

Consider the function

$$f(x, y) = xy - x^2y.$$

- A. Find the directional derivative of f at the point $P(2, 1)$ in the direction of the vector $4\mathbf{i} - 3\mathbf{j}$.
 - B. In what direction should you go from P to get the greatest rate of change in f ? What is this maximum rate of change?
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EXAM

Exam 1

Math 2350-04, Spring 2008

Feb. 20, 2008

- Write all of your answers on separate sheets of paper. You can keep the exam questions when you leave. You may leave when finished.
- You **must** show enough work to justify your answers. Unless otherwise instructed, give exact answers, not approximations (e.g., $\sqrt{2}$, not 1.414).
- This exam has 6 problems. There are **240 points total**.

Good luck!