MA 302: Exam 1 Review **Name:**______________________________

(1) Derivatives:
   (a) Understand and be able to calculate the derivative as a matrix
   (b) Understand the definition of C^1 and of differentiable
   (c) Be able to find the equation for the affine approximation to a function at a point
   (d) Know and be able to use the chain rule

(2) Parameterized Curves
   (a) Know parameterizations for common curves (circles, straight lines, graphs of functions)
   (b) Understand and be able to use tangent space coordinates to find the parameterizations of complicated curves (epicycles, cycloids, etc.)
   (c) Understand what the derivative of a parameterized curve measures
   (d) Be able to reparameterize a curve with an orientation preserving or reversing change of coordinates function.
   (e) Understand the difference between intrinsic and extrinsic properties of curves
   (f) Be able to write down an integral representing the length of a parameterized curve.

(3) The geometry of parameterized curves
   (a) Be able (in practice and principle) to reparameterize a curve by arclength.
   (b) Be able to prove that the unit tangent vector **T** is intrinsic to oriented curves
   (c) Be able to calculate the moving frame **T**, **N**, and **B** (although **B** won't be on the exam.)
   (d) Be able to calculate curvature $\kappa(t)$.
   (e) Understand the idea of tangential and normal components to acceleration.
   (f) Be able to prove that in a 2-body system consisting of a planet and a sun, the planet's orbit will lie in a plane.

(4) Line Integrals

(a) Know that if f is a scalar field and if $\mathbf{x}\colon [a,b] \to \mathbb{R}^n$ is a path then
$$\int_{\mathbf{x}} f\,ds = \int_a^b f(\mathbf{x}(t))||\mathbf{x}'(t)||\,dt.$$

(b) Know that if $\mathbf{F}$ is a vector field and if $\mathbf{x}\colon [a,b] \to \mathbb{R}^n$ is a path then
$$\int_{\mathbf{x}} \mathbf{F}(\mathbf{x}(t)) \cdot \mathbf{x}'(t)\,dt.$$

(c) Understand what the path integral of a vector field measures (work, circulation, etc.) and why.

(5) Vector Fields

(a) Be able to draw a picture of a given vector field
(b) Know the concept of "flow line" and be able to work simple examples
(c) Understand what curl measures and be able to calculate it.
(d) Know what a conservative/gradient field is and be able to find potential functions for simple examples
(e) Know how the basic idea for why conservative vector fields don't have closed up flow lines
(f) Be able to prove that the line integral of a conservative field over an equipotential curve is 0.
(g) Be able to prove that conservative vector fields have path independent line integrals.