Math 126 Exam 2 Quick Review

13.3: Measurement on 3D Curves

1. Arc Length $= \int_a^b \sqrt{(x'(t))^2 + (y'(t))^2 + (z'(t))^2}\, dt$,

   $\kappa(t) = \frac{|\mathbf{r}'(t) \times \mathbf{r}''(t)|}{|\mathbf{r}'(t)|^3}$,

   $\mathbf{T} = \frac{\mathbf{r}'(t)}{|\mathbf{r}'(t)|}$, $\mathbf{N} = \frac{\mathbf{T}'(t)}{|\mathbf{T}'(t)|}$, $\mathbf{B} = \mathbf{T} \times \mathbf{N}$.
2. tangent line, normal plane, oscullating plane.

13.4: Velocity and Acceleration

1. If $\mathbf{r}(t)$ represents position at time t, then $\mathbf{v}(t) = \mathbf{r}'(t)$ is velocity, $|\mathbf{v}(t)|$ is speed, and $\mathbf{a}(t) = \mathbf{r}''(t)$ is acceleration. Be able to go from position to acceleration and acceleration to position.
2. $a_T = \frac{\mathbf{r}'(t) \cdot \mathbf{r}''(t)}{|\mathbf{r}'(t)|}$, $a_N = \frac{|\mathbf{r}'(t) \times \mathbf{r}''(t)|}{|\mathbf{r}'(t)|}$

14.1, 14.3, 14.4: Multivariable functions, Partials

1. Sketch a domain and sketch level curves.
2. Compute partial derivatives and understand what they represent.
3. Find a tangent plane, a linearization, and the total differential:
   $z - z_0 = f_x(x_0, y_0)(x - x_0) + f_y(x_0, y_0)(y - y_0)$.

14.7: Critical points and max/min

1. Find critical points ($f_x = 0$ and $f_y = 0$, then combine and solve).
2. Classify critical points (second derivative test). $D = f_{xx}f_{yy} - f_{xy}^2$. If $D > 0$ and $f_{xx} > 0$, then local min. If $D > 0$ and $f_{xx} < 0$, then local max. If $D < 0$, then saddle point.

Find the absolute max/min over a region.

1. Find critical points.
2. Find the critical points on each boundary.
3. Evaluate the original function at all critical points inside and on the boundary and all the endpoints.

15.1, 15.2, 15.3: Double Integrals.

1. Break up a rectanglular domain into rows and columns and approximate the volume with rectangular boxes.

2. Find inequalities to describe the region (Top/Bottom or Right/Left). Set up an iterated integrals.

3. To reverse the order, first draw the region.

15.4: Using Polar Coordinates.

1. Find polar inequalities to describe the region. Replace $x^2 + y^2 = r^2$, $x = r\cos(\theta)$, $y = r\sin(\theta)$, and $dA = r dr d\theta$.

15.5: Center of mass.

1. If $\rho(x, y) =$ density at each point on a plate, then $\iint\limits_D \rho(x, y)\, dA$ is the total mass of the plate.

2. $\bar{x} = \dfrac{\iint\limits_D x\rho(x, y)\, dA}{\iint\limits_D \rho(x, y)\, dA}$ and $\bar{y} = \dfrac{\iint\limits_D y\rho(x, y)\, dA}{\iint\limits_D \rho(x, y)\, dA}$