The Final Exam is Friday, December 11 at 12:30 pm in KC 100.

1. a. Find the parametric equations of the line of intersection of the planes $2x - y + z = 5$ and $x + y - z = 1$.

b. Find the angle between the planes.

2. Reparameterize the curve $r(t) = e^{2t} \cos 2t \mathbf{i} + 2 \mathbf{j} + e^{2t} \sin 2t \mathbf{k}$ with respect to arclength measured from the point where $t = 0$ in the direction of increasing $t$.

3. Find the limit, if it exists, or show that it does not.
$$\lim_{(x,y,z) \to (0,0,0)} \frac{x^2 + y^2 - z^2}{x^2 + y^2 + z^2}$$

4. Find an equation of the tangent plane to the surface $z = e^{-x^2 - y^2}$ at $(x, y) = (1, 1)$.

5. Find and classify the critical points of the function $f(x, y) = 4xy - 2x^4 - y^2$. 
6. A box with a rectangular base is to be used as a shipping crate with a volume of 12 m$^3$. The material for the bottom of the box costs twice as much per square meter than the material for the four sides and the top. Find the dimensions of the box that minimize the cost.

7. Evaluate the triple integral $\int_0^a \int_0^{\sqrt{a^2-x^2}} \int_0^{\sqrt{a^2-x^2-y^2}} \frac{z^3}{\sqrt{x^2+y^2}} \, dz \, dy \, dx$.

8. Evaluate the double integral $\int_0^3 \int_{x^2/3}^4 x \cos(y^4) \, dy \, dx$.

9. Evaluate the line integral $\int_C xy \, dx + (x + y) \, dy$, where $C$ is the part of the curve $y = x^2$ from $(-1, 1)$ to $(2, 4)$.

10. a. Show that the vector field $\mathbf{F}(x, y, z) = e^y \mathbf{i} + xe^y \mathbf{j} + (z + 1)e^z \mathbf{k}$ is conservative.

b. Evaluate the line integral $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $C$ is given by $\mathbf{r}(t) = t \mathbf{i} + t^2 \mathbf{j} + t^3 \mathbf{k}$ for $0 \leq t \leq 1$. 