These problems are samples of final-like problems.

These problems do not constitute a comprehensive review for the final.

1. Let the curve C be the helix parameterized by $\vec{r}(t) = \langle \cos t, \sin t, t \rangle$ for $0 \leq t \leq 2\pi$ and let $f(x, y, z) = x^2 + y^2 + z^2$. Evaluate the line integral $\int_C f(x, y, z)\, ds$.

2. Evaluate the line integral $\int_C x^2 y\, dx + (x - 2y)\, dy$ where C is the part of the parabola $y = x^2$ from $(0, 0)$ to $(1, 1)$.

3. Evaluate the line integral $\int_C \left(2y + \sqrt{1 + x^5}\right) dx + \left(5x - e^{y^2}\right) dy$ where C is the circle $x^2 + y^2 = 4$ oriented counterclockwise.

4. Find the equation of the plane that contains the points $(0, 1, 2)$, $(-1, 2, 3)$, and $(-4, -1, 2)$. Demonstrate (i.e., check) that your answer is correct.

5. Express $\vec{v} = 3\vec{\imath} + 5\vec{\jmath} + \vec{k}$ as the sum of a vector parallel to $\vec{w} = \vec{\imath} + 2\vec{\jmath} - \vec{k}$ and a vector perpendicular to $\vec{w}$. Demonstrate (i.e., check) that your answer is correct.

6. Find the volume between $z = 2 - x^2 - y^2$ and $z = x^2 + y^2 - 2$. (Draw a meaningful picture.)

7. Compute $\int_0^1 \int_0^{\sqrt{1-x^2}} e^{x^2+y^2}\, dy\, dx$.

8. Find the directional derivative of $f(x, y, z) = x^3 - xy^2 - z$ at the point $P = (1, 1, 0)$, in the direction of $\vec{v} = 2\vec{\imath} - 3\vec{\jmath} + 6\vec{k}$.

9. Find all points (x, y) where a local maximum, local minimum, or saddle point occurs for the function $f(x, y) = xy - x^2 - y^2 - 2x - 2y + 4$.

10. Find the area of the region bounded by $y + x^2 = 2$ and $y + x = 0$. (Draw a meaningful picture.)