The final exam will cover topics from the entire quarter. Review both midterms and all of the practice for those exams. In addition be sure you understand how to solve problems like the following.

1. Change the Cartesian integral into an equivalent polar integral and evaluate the polar integral \[ \int_{-\sqrt{5}}^{\sqrt{5}} \int_{-\sqrt{25-x^2}}^{\sqrt{25-x^2}} (x^2 + y^2) \, dy \, dx \].

2. Evaluate the double integral: \[ \iint_D \sin(x^2 + y^2) \, dA \], where \( D \) is the part of the unit circle that lies in the first quadrant.

3. Set up the integral, but do not evaluate, to find the volume of the solid bounded by the planes \( 2x + y + z = 4, \quad z = -6, \quad y - x = 4, \quad \text{and} \quad y = 0 \).

4. Evaluate the integral: \[ \int_0^1 \int_0^1 e^{-xy} \, dy \, dx \].

5. Sketch the region over which we are integrating and evaluate the integral: \[ \int_0^1 \int_{3y}^{e} e^x \, dx \, dy \].

6. Calculate the iterated integral \[ \int_1^4 \int_2^1 \left( \frac{x}{y} + \frac{y}{x} \right) \, dy \, dx \] and completely simplify your answer.

7. Find the volume of the solid lying under the elliptic paraboloid \( \frac{x^2}{4} + \frac{y^2}{9} = z \) and above the rectangle \( R = [-1,1] \times [-2,2] \).

8. Sketch the region of integration and change the order of integration, \[ \int_0^{\ln x} \int_0^1 f(x,y) \, dy \, dx \].

9. Evaluate the integral in polar coordinates. \[ \iint_R \cos(x^2 + y^2) \, dA \], where \( R \) is the region that lies to the left of the \( y \)-axis within the circle \( x^2 + y^2 = 9 \).

10. Evaluate the iterated integral, \[ \int_0^1 \int_0^z 6xz \, dy \, dx \] .

11. Evaluate the iterated integral, \[ \int_0^1 \int_0^{\sqrt{1-x^2}} ze^y \, dx \, dy \] .

12. If the density is \( \rho = 1 \) the center of mass of the thin plate in the \( xy \)-plane bounded by \( y = \cos x \) and \( y = 0 \) lies on the \( y \)-axis. Find \( \bar{y} \), the \( y \) coordinate of the center of mass.