

1. (20) Use the method of Lagrange multipliers to find the points on the ellipse $x^2 + 4y^2 = 8$ which minimize $f(x, y) = xy$.

2. i) (20) Evaluate the integral $\int_0^1 \int_y^1 e^{x^2} dx dy$.

ii) (10) Express the integral of i) above in polar form but do not evaluate.

3. (10) Evaluate the integral $\int_1^e \int_1^e \int_1^e \frac{1}{xyz} dx dy dz$.

4. (20) Set up, but do not evaluate, a triple integral for the volume of the solid bounded above by $z = 4 - y^2$, below by $y + z = 2$, and on the sides by $x = 0$ and $x = 3$. Be sure to carefully sketch the region of integration.

5. (20) Express the integral $\int_0^2 \int_{z^2}^4 \int_{-\sqrt{z^2-y}}^{\sqrt{z^2-y}} x^2 e^z dx dy dz$. Be sure to carefully sketch the region of integration.