

Instructions: Show all work. Use exact answers unless otherwise asked to round.

1. Evaluate the integrals. Describe or sketch the volume defined by the integral.

a. $\int_0^1 \int_0^2 \int_0^{\sqrt{1-z^2}} \frac{z}{y+1} dx dy dz$

b. $\int_0^{2\pi} \int_0^{\pi/2} \int_1^3 \rho^3 \cos \phi \sin \phi \cos \theta d\rho d\phi d\theta$

2. Change the integral $\int_{-2}^2 \int_{-\sqrt{4-x^2}}^{\sqrt{4-x^2}} \int_{\sqrt{x^2+y^2}}^2 xz dz dx dy$ to cylindrical coordinates and evaluate it. Sketch or describe the region of integration.

3. Change the integral $\int_{-2}^2 \int_{-\sqrt{4-x^2}}^{\sqrt{4-x^2}} \int_{\sqrt{x^2+y^2}}^{\sqrt{8-x^2-y^2}} xz dz dx dy$ to spherical coordinates and evaluate it. Sketch or describe the region of integration.