

**Problem 1**

Show that the Jacobian of the transformation from spherical coordinates to rectangular coordinates ( $x = \rho \sin(\phi) \cos(\theta)$ ,  $y = \rho \sin(\phi) \sin(\theta)$ ,  $z = \rho \cos(\phi)$ ) is  $\rho^2 \sin(\phi)$ .

## Problem 2

Find the volume of the ellipsoid

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$$

for constants  $a, b, c > 0$  by making the transformation  $x = au$ ,  $y = bv$ ,  $z = cw$  where  $u, v, w$  are the new variables. (Hint/Shortcut: If you encounter an integral giving the volume of a sphere, you may use the formula  $V = \frac{4}{3}\pi r^3$ .)