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MATH 251 Paper Homework 3 Spring 2010

Sections 200,511 P. Yasskin

1. Find the Jacobian for hyperbolic coordinates. The position vector is given by

$$\vec{R}(u,v) = \left(\frac{u^2 - v^2}{2}, uv\right)$$

a. Find the coordinate tangent vectors:

$$\vec{e}_u = \frac{\partial \vec{R}}{\partial u} =$$

$$\vec{e}_v = \frac{\partial \vec{R}}{\partial v} =$$

b. Compute the Jacobian determinant:

$$\frac{\partial(x,y)}{\partial(u,v)} =$$

c. Compute the Jacobian factor:

$$J = \left| \frac{\partial(x,y)}{\partial(u,v)} \right| =$$

2. Find the Jacobian for spherical coordinates. The position vector is given by

$$\vec{R}(\rho,\theta,\varphi) = (\rho\sin\varphi\cos\theta, \rho\sin\varphi\sin\theta, \rho\cos\varphi)$$

a. Find the coordinate tangent vectors:

$$\vec{e}_\rho = \frac{\partial\vec{R}}{\partial\rho} =$$

$$\vec{e}_\theta = \frac{\partial\vec{R}}{\partial\theta} =$$

$$\vec{e}_\varphi = \frac{\partial\vec{R}}{\partial\varphi} =$$

b. Compute the Jacobian determinant:

$$\frac{\partial(x,y,z)}{\partial(\rho,\theta,\varphi)} =$$

c. Compute the Jacobian factor:

$$J = \left|\frac{\partial(x,y,z)}{\partial(\rho,\theta,\varphi)}\right| =$$