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MATH 253

Paper Homework 2

Fall 2009

Section 501,503

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:

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