

Problem 1

(a)

Rewrite Eq. (2.30) of Ch. 2,

$$dx = \frac{\partial x}{\partial q_1} dq_1 + \frac{\partial x}{\partial q_2} dq_2 + \frac{\partial x}{\partial q_3} dq_3$$

and similar for differentiation of y and z with respect to the coordinates q_1 , q_2 , and q_3 as a single matrix equation

$$|d\mathbf{x}\rangle = \mathbf{J}|d\mathbf{q}\rangle$$

where the matrix \mathbf{J} is a matrix of derivatives known as the Jacobian matrix. Show that

$$\langle d\mathbf{x}|d\mathbf{x}\rangle = \langle d\mathbf{q}|\mathbf{G}|d\mathbf{q}\rangle$$

with the metric matrix \mathbf{G} having elements g_{ij} given by Eq. (2.32).

(b)

Show that

$$|\mathbf{J}|dq_1 dq_2 dq_3 = dx dy dz$$

with $|\mathbf{J}|$ the usual Jacobian determinant.

Problems from W&A Ch. 3:

W&A 3.3.1

W&A 3.3.2

W&A 3.3.9

W&A 3.3.10

W&A 3.4.1

W&A 3.4.5

W&A 3.4.6