

ASEN 5227
Aerospace Math 1
Fall 2004

Homework 4

Assigned 16 SEP, Due 28 SEP

1. Prove the following identities:

a.
$$\frac{d}{dt}[\mathbf{abc}] = \left[\frac{d\mathbf{a}}{dt} \mathbf{bc} \right] + \left[\mathbf{a} \frac{d\mathbf{b}}{dt} \mathbf{c} \right] + \left[\mathbf{ab} \frac{d\mathbf{c}}{dt} \right].$$

b.
$$\frac{d}{dt} \left[\mathbf{a} \frac{d\mathbf{a}}{dt} \frac{d^2\mathbf{a}}{dt^2} \right] = \left[\mathbf{a} \frac{d\mathbf{a}}{dt} \frac{d^3\mathbf{a}}{dt^3} \right].$$

2. If x_i are rectangular Cartesian coordinates and θ^i are the parabolic curvilinear coordinates defined by the transformation

$$\begin{aligned}x_1 &= \theta^1 \theta^2 \cos \theta^3 \\x_2 &= \theta^1 \theta^2 \sin \theta^3 \\x_3 &= \frac{1}{2} [(\theta^1)^2 - (\theta^2)^2]\end{aligned}$$

- a. The covariant base vectors \mathbf{e}_i .
 - b. The components of the fundamental metric g_{ij} .
 - c. The reciprocal base vectors.
 - d. The arclength ds .
 - e. The physical components of a vector.
 - f. The scale factors.
3. If \mathbf{a} and \mathbf{b} are two vectors in a curvilinear coordinate system, find the cosine of the angle between \mathbf{a} and \mathbf{b} in terms of the components of \mathbf{a} and \mathbf{b} , and the fundamental metric g_{ij} .