Exam 1 Equation Sheet

$$\delta_{ij} = \begin{cases} 1 & \text{if } i = j \\ 0 & \text{otherwise} \end{cases}$$

$$\delta_{ij} a_j = a_i$$
$$\delta_{ij} a_{ij} = a_{ii}$$

$$\epsilon_{ijk} = \begin{cases} 1 & \text{if } ijk \text{ is an even permutation of 1,2,3} \\ -1 & \text{if } ijk \text{ is an odd permutation of 1,2,3} \\ 0 & \text{otherwise} \end{cases}$$

$$Q_{ij} = \cos(x_i', x_j)$$

$$v_i' = Q_{im} v_m$$
$$\sigma_{ij}' = Q_{im} Q_{jn} \sigma_{mn}$$

$$\text{div}(v_i) = \text{tr}(\nabla v_i)$$

$$\nabla v_i = \begin{bmatrix} v_{r,r} & \frac{1}{r}(v_{r,\theta} - v_\theta) & v_{r,z} \\ v_{\theta,r} & \frac{1}{r}(v_{\theta,\theta} + v_r) & v_{\theta,z} \\ v_{z,r} & \frac{v_{z,\theta}}{r} & v_{z,z} \end{bmatrix}$$

$$\nabla v_i = \begin{bmatrix} v_{r,r} & \frac{v_{r,\theta} - v_\theta}{r} & \frac{v_{r,\phi}}{r\sin\theta} - \frac{v_\phi}{r} \\ v_{\theta,r} & \frac{v_{\theta,\theta} + v_r}{r} & \frac{v_{\theta,\phi}}{r\sin\theta} - \frac{v_\phi \cot\theta}{r} \\ v_{\phi,r} & \frac{v_{\phi,\theta}}{r} & \frac{v_{\phi,\phi}}{r\sin\theta} + \frac{v_r + v_\theta \cot\theta}{r} \end{bmatrix}$$

$$\frac{D\Theta(X_i, t)}{Dt} = \left(\frac{\partial \hat{\Theta}}{\partial t}\right)_{X_i - fixed}$$

$$\frac{D\Theta(x_i, t)}{Dt} = \left(\frac{D\tilde{\Theta}}{Dt}\right)_{X_i - fixed} = \left(\frac{\partial \tilde{\Theta}}{\partial x_i}\right)\frac{\partial x_i}{\partial t} + \left(\frac{\partial \tilde{\Theta}}{\partial t}\right)_{x_i - fixed}$$

$$F_{ij} = x_{i,j} = \delta_{ij} + u_{i,j} = R_{im} U_{mj} = V_{im} R_{mj}$$

$$C_{ij} = F_{mi} F_{mj}$$

$$\rho v_{i,i} + \frac{D}{Dt}\rho = 0$$