?
$t = 0$

$$\frac{D}{Dt}\left[\int_{V_m(t)} \rho dV\right] = 0$$
(1)

$$\frac{DB}{Dt} = \frac{\partial B}{\partial t} + u.\nabla B$$
(2)

$$\frac{D}{Dt}\left[\int_{V_m(t)} B(x,t) dV\right] = \int_{V_m(t)} \left[\frac{\partial B}{\partial t} + \nabla.(Bu)\right] dV$$
(3)

$$\int_{V_m(t)} \left[\frac{\partial \rho}{\partial t} + \nabla.(\rho u)\right] dV = 0$$
(4)

$V_m(t)$

$$\frac{\partial \rho}{\partial t} + \nabla.(\rho u) = 0$$
(5)

$$\nabla.u = 0$$
(6)

$$rate of change of linear momentum in an inertial frame = the sum of forces acting on body$$
(7)

$$\frac{D}{Dt}\int_{V_m(t)} (\rho u) dV = sum of the forces acting on V_m(t)$$
(8)

$$\frac{D}{Dt}\int_{V_m(t)} (\rho u) dV = \int_{V_m(t)} \rho g dV + \int_{A_m(t)} t dA$$
(9)

$A_m(t)$
t
stress vector

$$\int_{V_m(t)} \left[\frac{\partial (\rho u)}{\partial t} + \nabla.(\rho uu)\right] dV = \int_{V_m(t)} \rho g dV + \int_{A_m(t)} t dA$$
(10)

t
$\mathbf{T}$

$$t = n.\mathbf{T}$$
(11)

$$\int_{A_m(t)} n.\mathbf{T} = \int_{V_m(t)} \nabla.\mathbf{T}$$
(12)

$$\int_{V_m(t)} \left[\frac{\partial (\rho u)}{\partial t} + \nabla.(\rho uu)\right] dV = \int_{V_m(t)} \rho g dV + \int_{V_m(t)} \nabla.\mathbf{T}$$
(13)

$$\int_{V_m(t)} \left[\frac{\partial (\rho u)}{\partial t} + \nabla.(\rho uu) - \rho g - \nabla.\mathbf{T}\right] dV = 0$$
(14)

$V_m(t)$

$$\frac{\partial (\rho u)}{\partial t} + \nabla.(\rho uu) = \rho g + \nabla.\mathbf{T}$$
(15)

$\mathbf{T}$

$$\mathbf{T} = -p\mathbf{I} + \tau$$
(16)

$$\frac{\partial (\rho u)}{\partial t} + \nabla.(\rho uu) = \nabla.(-p\mathbf{I} + \tau) + \rho g$$
(17)

$$\tau = 2\mu D$$
(18)

D
∇u

$$\tau = \mu(\nabla u + (\nabla u)^T)$$
(19)

$$\frac{\partial (\rho u)}{\partial t} + \nabla.(\rho uu) = -\nabla p + \nabla.(\mu(\nabla u + (\nabla u)^T)) + \rho g$$