HW#6 SP07

#1.

An idealized velocity field is given by the formula

$\mathbf{V} = 4tx\mathbf{i} - 2t^2y\mathbf{j} + 4xz\mathbf{k}$

Is this flow field steady or unsteady? Is it two- or three- dimensional? At the point (x, y, z) = (-1, 1, 0), compute *(a)* The acceleration vector and *(b)* any unit vector normal to the acceleration.

#2.

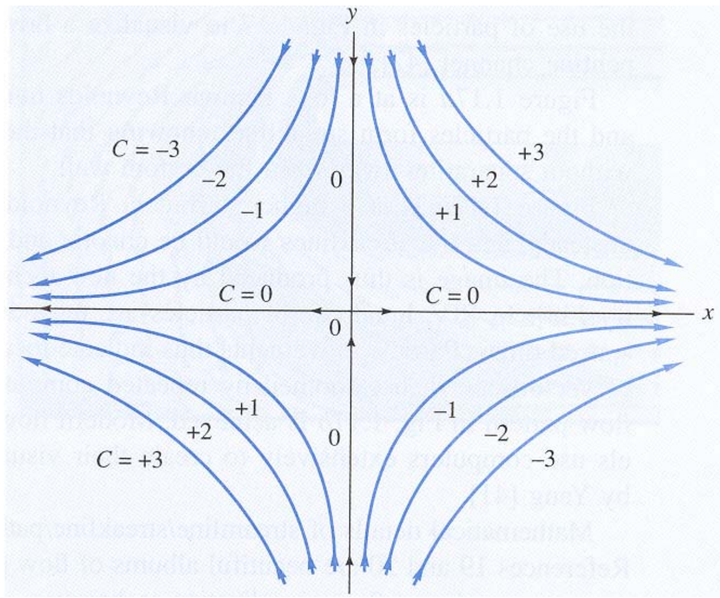
The temperature ***T***, in a long tunnel is known to vary approximately as $T = T_0 - \alpha e^{-x/L} \sin(2\pi t/\tau)$, where T_0, α, L and τ are constants, and x is measured from the entrance. A particle moves into the tunnel with a constant speed, U. Obtain an expression for the rate of change of temperature experienced by the particle. What are the dimensions of this expression?

#3.

The velocity field near a stagnation point (see Fig.) may be written in form $u = \frac{U_0 x}{L}$, $v = -\frac{U_0 y}{L}$ U_o and L are constants.

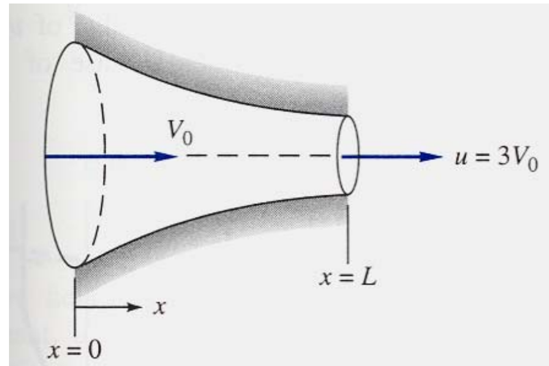
(a) Show that the acceleration vector is purely radial.

(b) For the particular case L = 1.5 m, if the acceleration at (x, y) = (1 m, 1 m) is 25 m/s^2, what is the value of U_0 ?



#4.

Assume that the flow in the converging nozzle shown has the form $\mathbf{V} = V_0[1+(2x)/L]\mathbf{i}$. Compute *(a)* the fluid acceleration at $x = L$ and *(b)* the time required for a fluid particle to travel from $x = 0$ to $x = L$.



#5.

A velocity field is given by $u = V \cos \theta$, $v = V \sin \theta$, and $w = 0$, where V and θ are constants. Derive a formula for the streamlines of this flow.

#6.

A steady, two-dimensional velocity field is given by $u = 0.5 + 0.8\,x$, $v = 1.5 – 0.8\,y$, where *x and y* coordinates are in meters and the magnitude of velocity is in m/s. Derive a formula for the streamlines of this flow and sketch them in the right half of flow ($x > 0$).