~~5.1~~
5.2.1

$$p = \rho r T_K$$

$$\frac{p}{p_0} = \left(\frac{\rho}{\rho_0}\right)^{\gamma}$$

$$s = \frac{(\rho - \rho_0)}{\rho_0} = \frac{\rho}{\rho_0} - 1 \ll 1$$

$$\rho = (1 + s)\rho_0$$

$$\frac{p}{p_0} = \left(\frac{(1+s)\cancel{\rho_0}}{\cancel{\rho_0}}\right)^{\gamma} = (1+s)^{\gamma}$$

$$\boxed{\frac{p}{p_0} = 1 + \gamma s}$$

$$p = p_0 + \gamma s p_0$$

$$p - p_0 = \gamma s p_0 = B\left(\frac{\rho - \rho_0}{\rho_0}\right) = Bs$$

$$B = \gamma p_0$$

$$p_0 = \rho_0 r T_{K_0}$$

$$B = (\gamma \rho_0 r) T_K$$

$$B \propto T_K$$

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

~~5.4~~ 5.6.2) a) $c(P,T) = 1402.7 + 488\left(\frac{T}{100}\right) - 482\left(\frac{T}{100}\right)^2 + 135\left(\frac{T}{100}\right)^3$

$+ \left(15.9 + 2.8\left(\frac{T}{100}\right) + 2.4\left(\frac{T}{100}\right)^2\right)\frac{P_G}{100}$ BARS

$P_G = 0$

$c(P,T) = 1402.7 + 488(.3) - 482(.3)^2 + 135(.3)^3$

$= 1402.7 + 146.4 - 43.38 + 3.645$

$= \boxed{1509.4 \text{ m/s}}$

b) $c = 1402.7 + 4.88T - 4.82\times10^{-2}T^2 + 1.35\times10^{-1}T^3$

$\frac{dc}{dT} = 4.88 - 2(4.82\times10^{-2})T + 3(1.35\times10^{-1})T^2$

$= 4.88 - 2.892 + .3645 = \boxed{2.35 \text{ m/s/c}}$

5.5) a) $c^2 = \left(\frac{\partial P}{\partial \rho}\right)_s$ $\qquad P = \rho r T_k \Rightarrow c^2 = r\underline{T_k}$

$\frac{P}{P_0} = \frac{\rho}{\rho_0} \Rightarrow P = \frac{P_0}{\rho_0}\rho$

$\frac{\partial P}{\partial \rho} = \frac{P_0}{\rho_0} = c^2 \Rightarrow$ No, c Does Not Change with $P$, $P_0$

If $P_0 \uparrow$, $\rho_0 \downarrow$ & c Is Const

c) $c_T = \sqrt{\frac{P_0}{\rho_0}} = \sqrt{\frac{10^5 \text{ N/m}^2}{1.21 \text{ kg/m}^3}} = 287.5 \text{ m/s}$

$c = 343 \text{ m/s}$

~~5.6~~ $\vec{u} = \hat{\imath}\, U e^{j(\omega t - kx)}$

5.7.1

$$\frac{|(\vec{u}\cdot\vec{\nabla})\vec{u}|}{\left|\frac{d\vec{u}}{dt}\right|} = \frac{\left|\left(U e^{j(\omega t-kx)} \frac{\partial}{\partial x}\right) \cancel{\hat{\imath}} U e^{j(\omega t-kx)}\right|}{\left|\frac{\partial}{\partial t}\left(\cancel{\hat{\imath}}\, U e^{j(\omega t-kx)}\right)\right|}$$

$$= \frac{\left|U e^{j(\omega t-kx)} \cancel{U} \cancel{j} k \cancel{e^{j(\omega t-kx)}}\right|}{\left|\cancel{U} \cancel{j} \omega \cancel{e^{j(\omega t-kx)}}\right|} = \frac{U k}{\omega} \left|\cancel{e^{j(\omega t-kx)}}\right|$$

$$= \frac{U}{c} \qquad \text{QED}$$

5.7 $\quad \frac{U}{c} = \frac{(\vec{u}\cdot\vec{\nabla})\vec{u}}{\frac{du}{dt}}$

$\vec{u} = U e^{j(\omega t-kx)}$

$U \frac{\partial}{\partial x} \vec{u} = (-U j k)\, U e^{j(\omega t-kx)}$

$\frac{du}{dt} = j\omega U e^{j(\omega t-kx)}$

$$= \frac{-U j k \cancel{U} \cancel{e^{j(\omega t-kx)}}}{j\omega \cancel{U} \cancel{e^{j(\omega t-kx)}}}$$

$$= \frac{-U k}{\omega} = -U c$$

$$\frac{p}{\rho} = \frac{RT}{\eta}$$