HW#5 Due 2023/12/04

1.Derive the equation of state.

$$\frac{\partial P}{\partial t} = -\bar{u} \cdot \nabla P - \gamma P \nabla \cdot \bar{u}$$

Hint: starting from $\frac{d}{dt} ln(P\rho^{-\gamma}) = 0$ and combining with continuity equation.

2.Derive

$$\begin{bmatrix} \omega^2 - V_A^2 k_\parallel^2 - (C_s^2 + V_A^2) k_\perp^2 & 0 & -C_s^2 k_\parallel k_\perp \\ 0 & \omega^2 - V_A^2 k_\parallel^2 & 0 \\ -C_s^2 k_\parallel k_\perp & 0 & \omega^2 - C_s^2 k_\parallel^2 \end{bmatrix} \begin{pmatrix} u_{1x} \\ u_{1y} \\ u_{1z} \end{pmatrix} = 0$$

from the linearized MHD equations in the $(\omega, \bar{k})$ domain by setting the background magnetic field in the z direction and wave vector on the xz plane. V_A is the Alfvén speed and C_S is the sound speed.