HW2.

1. In the simulation of a standing wave, why does vx have double wave vector of vy?

2. Experiment with the timestep dt in the code, what does dt/dx have to be for stability?

3. Put in an option for a Gaussian initial velocity (vpert*exp(-((x(i)-0.5)/w0)^2):
   a) Why there are left and right going packets?
   b) If the perturbation velocity is only in the x direction (vx), show that you get the sound wave solution with the correct sound speed (omega/k = V_sound);
   c) How does the choice of w0 affect the conservation of energy? Why?

4. Put in a hard-wall perfect conductor boundary condition, simulate the motion of a traveling Alfvenic gaussian wave packet (vy perturbation only). Show that
   a) you get the sound wave solution with the correct Alfvén speed;
   b) the gaussian wave packet reflects off the boundary;
   c) Energy is conserved.

5. Put in a constant By0 term in the equations, and simulate the fast mode wave (small amplitude vx sinoidal perturbation), show that you get the write wave period based on V_fast^2 = V_alfven^2 + V_sound^2

6. What happens if you simulate the Alfvén wave (vy sinoidal perturbation) for a long time with beta = 0? why? Explain it quantitatively.

7. [Optional, extra credit 20%] Implement the one-step Adams-Bashforth time stepping method and simulate a traveling Alfvén wave packet.