PHYS 2425 - Practice Final Problems

Possibly Useful Information: $g = 9.80 m/s^2$, $G = 6.67\times10^{-11}\ N\cdot m^2/kg^2$, $1atm = 1.013\times10^5 Pa$,
$0°C = 273K$, $\alpha_{alum} = 23\times10^{-6}/C°$, $\rho_{alum} = 2700\ kg/m^3$, $1\ m^3 = 1000$ liter
For water: $c = 4186\ J/(kg\cdot C°)$, $c_{ice} = 2090\ J/(kg\cdot C°)$, $L_f = 3.33\times10^5\ J/kg$, $L_v = 2.26\times10^6\ J/kg$

Problem 1

(a) How long does it take for a pulse to travel the length of a 20m long aluminum wire with a 3mm diameter under a tension of 80N? The density (mass/volume) of aluminum is 2700 kg/m^3.

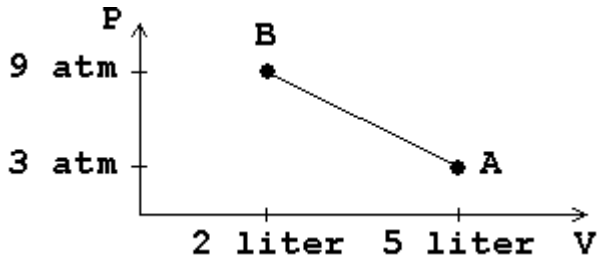
(b) A liquid fills an aluminum container to the brim. When the temperature of both the liquid and aluminum is increased from 20°C to 100°C, 2% of the liquid spills out. What is the coefficient of volume expansion of the liquid?

(c) A wave of the form: $y(x,t) = 0.05m \cos[\ (2\ m^{-1})\ x\ +\ (500\ s^{-1})\ t\ ]$ travels down a string with a linear density of $3\times10^{-4} kg/m$. What are the wavelength and frequency of the wave and average power transmitted down the string?

(d) Planet X has 4 times the earth's mass and orbits the sun every 27 years. What is the radius of its orbit in AU, where 1 AU is the earth-sun distance?

Problem 2

(a) 1500 J of heat flows out of gas as it is compressed from point A to point B in the PV-diagram as shown. What is the change in the internal energy of the gas?



(b) An astronaut stands on the surface of a spherical asteroid with a 400 m radius and a 5×10^{12} kg mass. What is the gravitational acceleration on the surface and with what speed must he jump to fully escape the gravity of the asteroid?

Problem 3

(a) A heat engine takes 2300 J of heat from a boiling water and vents 2000 J of heat to the environment at 20°C. What is the efficiency of this heat engine?

(b) What is the maximum efficiency of the heat engine in part (a)?