

PHYS 2425 - Practice Final Problems

Possibly Useful Information: $g = 9.80\text{m/s}^2$, $G = 6.67 \times 10^{-11} \text{N}\cdot\text{m}^2/\text{kg}^2$, $1\text{atm} = 1.013 \times 10^5\text{Pa}$,
 $0^\circ\text{C} = 273\text{K}$, $\alpha_{\text{alum}} = 23 \times 10^{-6}/\text{C}^\circ$, $\rho_{\text{alum}} = 2700 \text{kg/m}^3$, $1 \text{m}^3 = 1000 \text{liter}$
For water: $c = 4186 \text{J}/(\text{kg}\cdot\text{C}^\circ)$, $c_{\text{ice}} = 2090 \text{J}/(\text{kg}\cdot\text{C}^\circ)$, $L_f = 3.33 \times 10^5 \text{J/kg}$, $L_v = 2.26 \times 10^6 \text{J/kg}$

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 2700kg/m^3 .

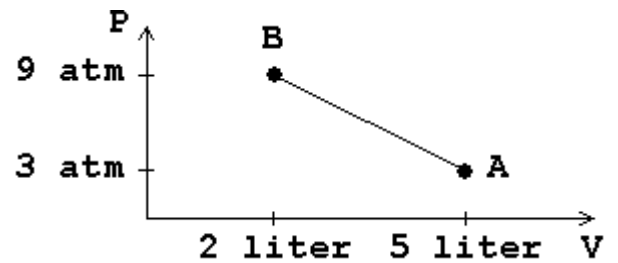
(b) A liquid fills an aluminum container to the brim. When the temperature of both the liquid and aluminum is increased from 20°C to 100°C , 2% of the liquid spills out. What is the coefficient of volume expansion of the liquid?

(c) A wave of the form: $y(x,t) = 0.05\text{m} \cos[(2 \text{m}^{-1}) x + (500 \text{s}^{-1}) t]$ travels down a string with a linear density of $3 \times 10^{-4} \text{kg/m}$. 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)?