

1. (10%) A cylindrical wooden rod is loaded with lead at one end so that it floats upright in water with the length of the submerged portion l as in Fig. 1. The rod is set into vertical oscillation. Please express the period of oscillation in terms of l and the free-fall acceleration g .

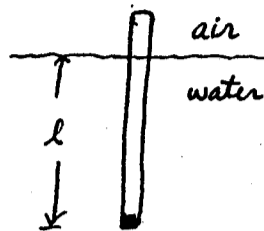


Fig. 1

2. (10%) A mole of an ideal gas is initially at a state a with $P_a = 5 \times 10^4 \text{ N/m}^2$ and $V_a = 0.083 \text{ m}^3$. If the gas is changed quasistatically along the process from a through b to c in the P - V diagram as in Fig. 2. Find

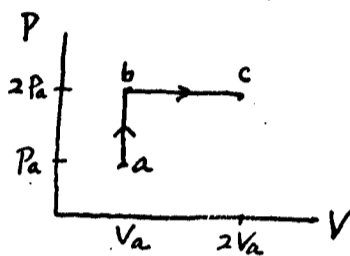


Fig. 2

- (a) the heat the gas absorbs,
 (b) the work the gas does, and
 (c) the change of internal energy of the gas.

$$(C_v = \frac{3}{2} R, \quad R = 8.3 \text{ J/mol}\cdot\text{K} \approx 2.0 \text{ Cal/mol}\cdot\text{K})$$

3. (10%) What is the electric field due to an infinite straight line of charge with constant charge per length λ ?

4. (10%) Two long, parallel wires are separated by a distance of 0.40 m as shown in Fig. 3. Find the magnitude of the force exerted by each wire on a 0.2 m length of the other. Is the force attractive or repulsive ?

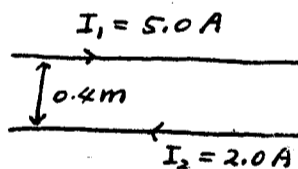


Fig. 3

5. (10%) An electron ($m = 9.11 \times 10^{-31} \text{ kg}$) is confined between two impenetrable walls which are $1.0 \times 10^{-9} \text{ m}$ apart. Find the energy of the lowest state.