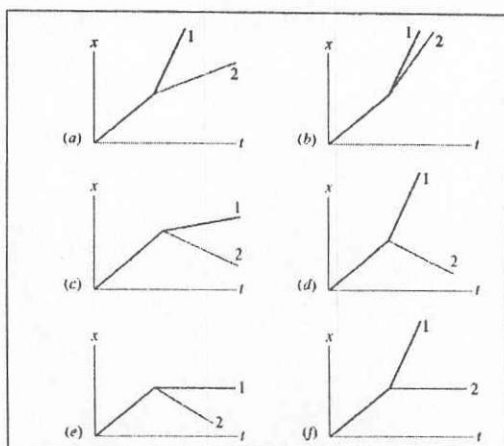1. A disk that is moving on a frictionless floor along the x axis separates into two parts. (1) Which of the graphs in the figure could possibly give the position versus time for the disk and the two parts? (2) Which of the numbered lines indicate the trailing part? (3) Rank the possible graphs according to the relative speed between the parts, greatest first. (12%)


2. The figure shows four situations in which four different dark liquids and a gray liquid are in a U-tube. The gray liquid is of the same density. (1) Which is physically impossible? (2) Rank the density of the dark liquids, greatest first. (8%)
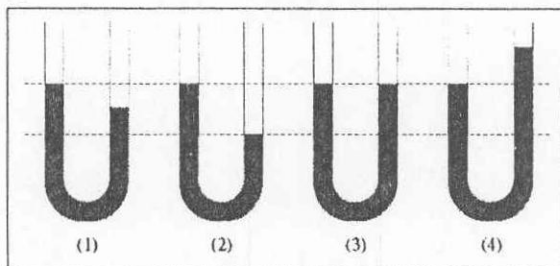
3. In Fig. (a), three isothermal processes are shown for the same gas and for the same change in volume (V_i to V_j) but at different temperatures. Rank the processes according to (1) the work done by the gas, (2) the change in the internal energy of the gas, and (3) the energy transferred as heat to the gas, greatest first. In Fig. (b), three isothermal processes are shown along a single isotherm, for the same change ΔV in volume. Rank the processes according to (4) the work done by the gas, (5) the change in the internal energy of the gas, and (6) the energy transferred as heat to the gas, greatest first. (12%)
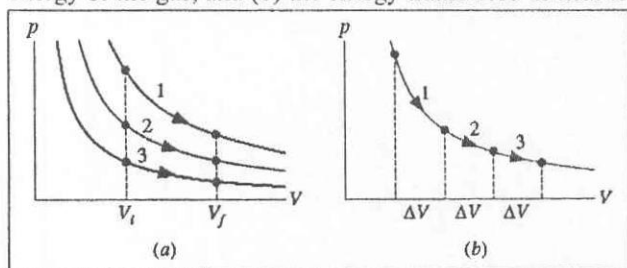

4. The switch in the circuit of the left figure has been closed on a for a very long time when it is then thrown to b. The resulting current through the inductor is indicated in the right figure for four sets of values for the R and L: (1) R_0 and L_0, (2) $2R_0$ and L_0, (3) R_0 and $2L_0$, (4) $2R_0$ and $2L_0$. Which set goes with which curve? (8%)
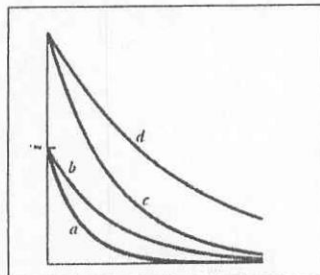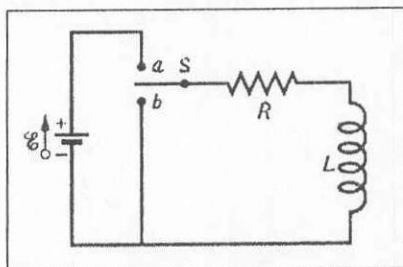
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5. The particle of mass m in the figure slides down the frictionless surface through height h and collides with the uniform vertical rod (of mass M and length d), sticking to it. The rod pivots about point O through the angle θ before momentarily stopping. Find θ. (15%)
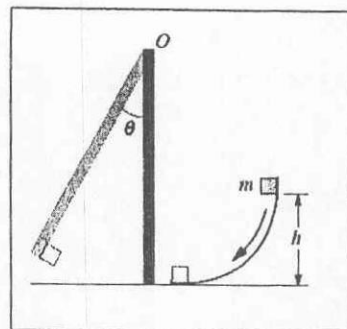
6. One mole of an ideal gas is used as the working substance of an engine that operates on the cycle shown in the Figure. BC and DA are reversible adiabatic processes. (a) Is the gas monatomic, diatomic, or polyatomic? (10%) (b) What is the efficiency of the engine? (10%)
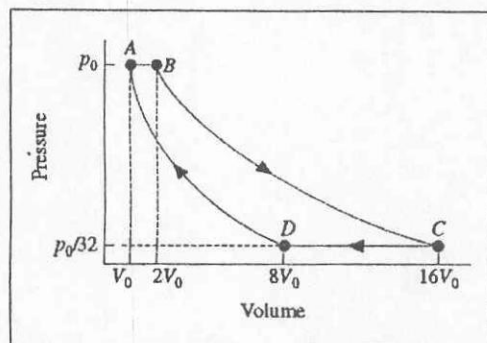
7. A beam of partially polarized light can be considered to be a mixture of polarized and unpolarized light. Suppose we send such a beam through a polarizing filter and then rotate the filter through 360° while keeping it perpendicular to the beam. If the transmitted intensity varies by a factor of 5.0 during the rotation, what fraction of the intensity of the original beam is associated with the beam's polarized light? (15%)

8. What is the capacitance of the capacitor, of plate area A, shown in the figure? κ_1, κ_2 and κ_3 are the dielectric constant of the materials indicated. (10%)

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