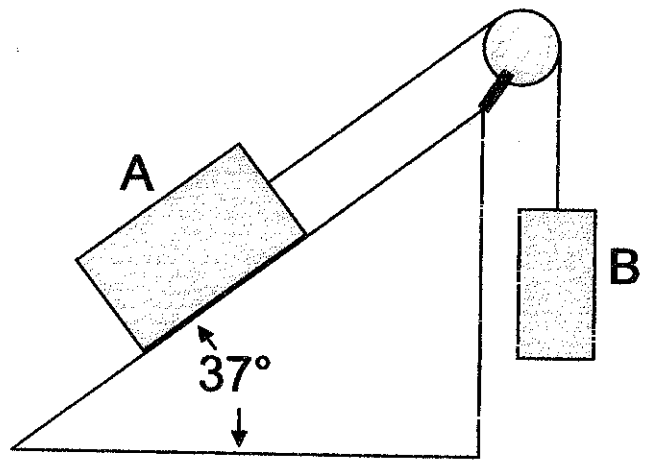
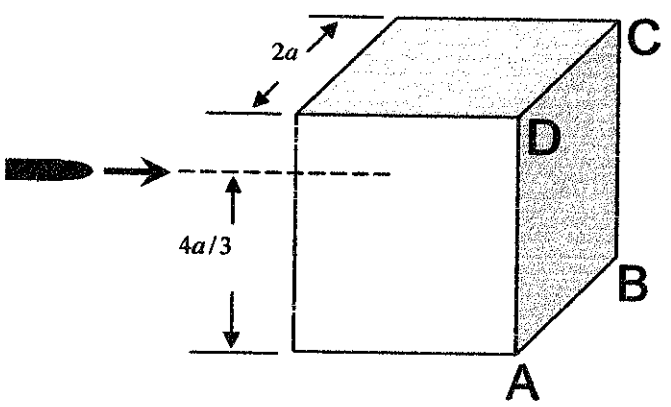
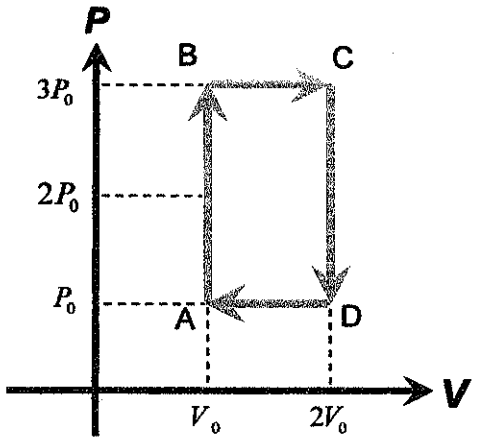
1. Tow blocks A and B are connected by a light rope over a pulley as shown. The pulley is frictionless, but the coefficient of friction between block A and the slope is 0.5 for static friction and 0.3 for kinetic friction. If the mass of block is 5 kg, what is the smallest mass B needed (a) to start block A sliding up the slope from rest. (b) to keep it moving if it has be started by an external push; (c) to prevent A from sliding down the slope? Take g = 10 m/s^2. (15 %)



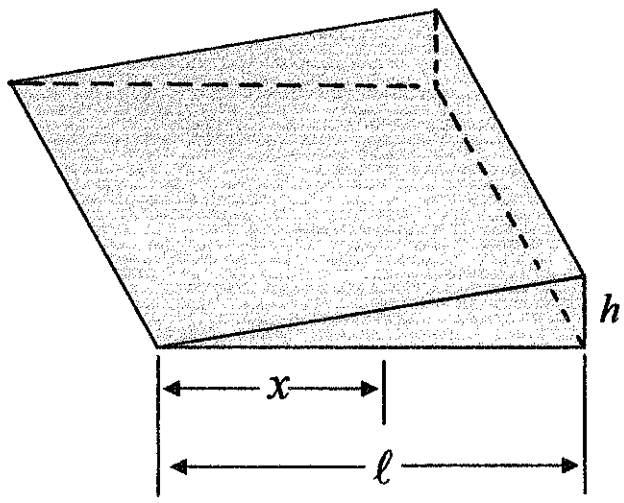
2. A solid cube of wood of side $2a$ and mass M is resting on a horizontal surface. The cube is constrained to rotate about an axis AB as shown. A bullet of mass m and speed v is shot at the face opposite to ABCD at a height of $4a/3$. The bullet becomes embedded in the cube. Find the minimum value of v required to tip the cube so that it falls on face ABCD. Assume m<<M. (10%)



3. A 1.00-mol sample of a monatomic ideal gas is taken through the cycle as shown. At point A, the pressure, volume, and temperature are P_0, V_0 and T_0, respectively. In terms of **R** (ideal gas constant) and T_0, find (a) the total energy entering the system by heat per cycle. (b) the total energy leaving the system by each per cycle, (c) the efficiency of an engine operating in this cycle, and (d) the efficiency of an engine operating in a Carnot cycle between the same temperature extremes. (15%)



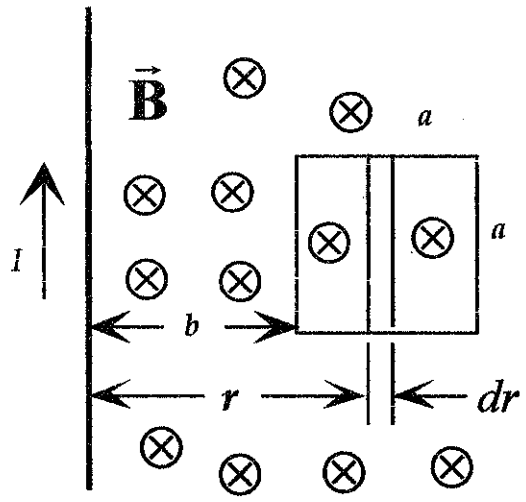
4. A piece of transparent material having an index of refraction n is cut into the shape of the wedge as shown below. The angle of the wedge is small. Monochromatic light of wavelength λ is normally incident from above, and viewed from above. Let h represent the height of the wedge and ℓ is its width. Calculate (a) the position of the first bright fringe and (b) the position of the first dark fringe counting from the sharp edge. (10%)



5. Two thin concentric (同心) spherical shells of radii r_1 and r_2 ($r_1<r_2$) contain uniform surface charge densities σ_1 and σ_2, respectively. Determine the electric field for (a) $0< r< r_1$ (b) $r_1< r< r_2$, and (c) $r> r_2$. (d) Under what conditions will E=0 for $r_1< r< r_2$? Neglect the thickness of the shells. (15 %)

6. A 0.5 μF and 0.8 μF capacitor are connected in series to a 9.0 V battery. Calculate (a) the potential difference across each capacitor and (b) the charge on each. (c) Repeat parts (a) and (b) assuming the two capacitors are in parallel. (10 %)

7. (a) Determine the magnetic flux through a square loop of side a if one side is parallel to, and a distance b from, a straight wire that carries I. (b) If the loop is pulled away from the wire at speed v, what emf is induced in it? (c)Does the incuce current flow clockwise or counterclockwise? (10 %)



8. (a) What is the rms current in a series RL circuit when a 60 Hz, 120 V rms ac voltage is applied, where R=965 ohm and L= 225 mH? (b) What is the phase angle between voltage and current? (c) What are the rms voltage readings across R and L? (15%)