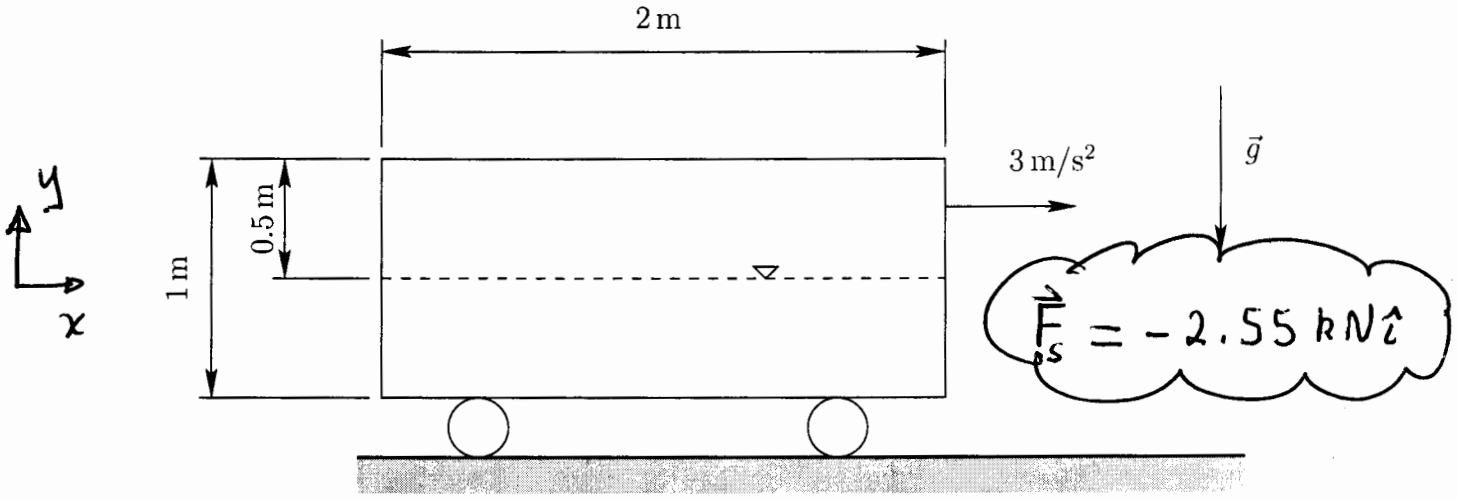
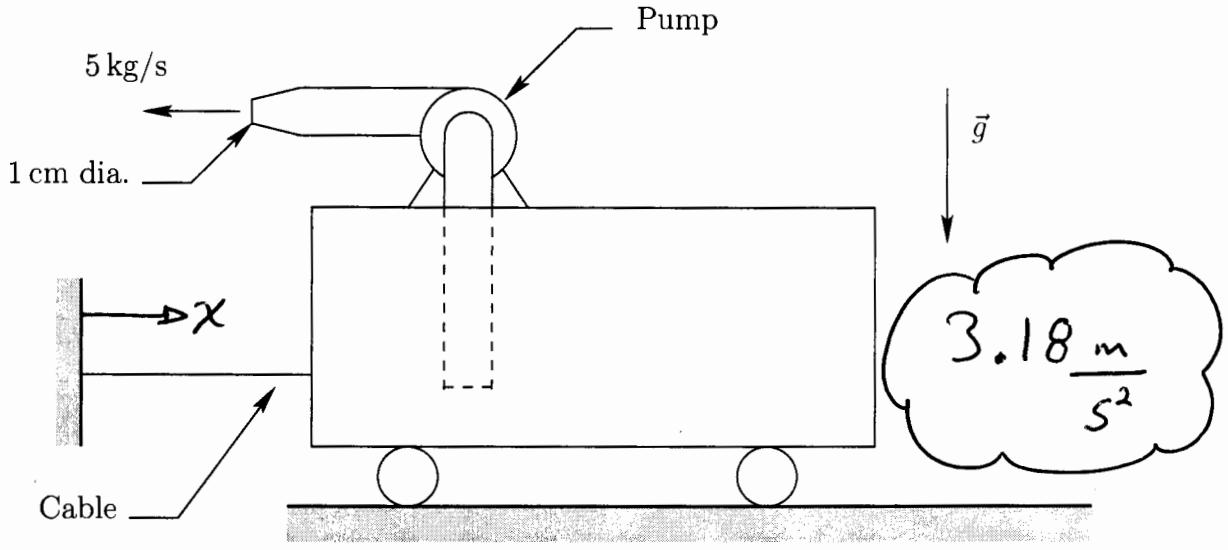
ME 215.3 2003 Final

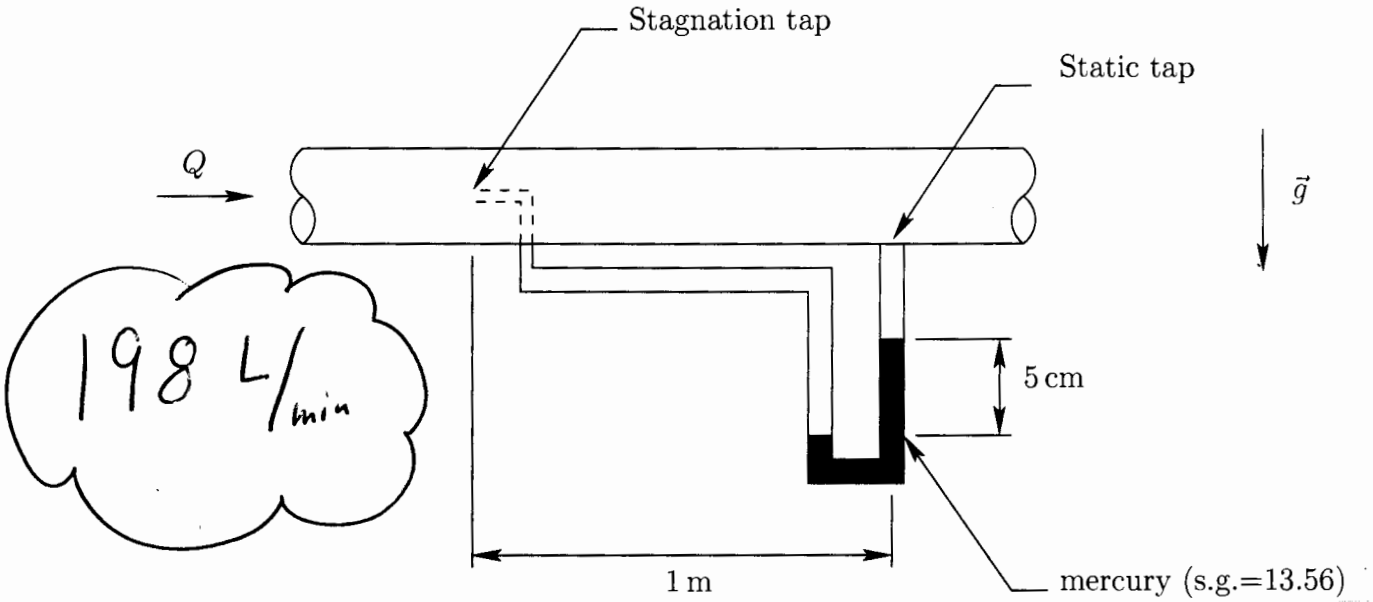
(20) 2. An open–top cart half full of water ($\rho = 1000\,\text{kg/m}^3$) is shown at rest in the figure below. The cart begins to accelerate to the right at a constant $3\,\text{m/s}^2$. After some time, the fluid reaches a hydrostatic state. Determine the net hydrostatic force on the rear, vertical end of the cart. The cart is 0.8 m wide.



(20) 3. A tank on wheels contains water ($\rho = 1000\,\text{kg/m}^3$) and is held in place by a cable as shown below. A pump mounted on top of the tank draws water from the tank and discharges the water through a horizontal, 1 cm diameter nozzle at a mass flow rate of 5 kg/s. The cable breaks and the cart begins to move. At some instant in time later, the total mass of the tank, pump assembly, and the water remaining in the tank is 100 kg and the velocity of the system is 20 m/s. Determine the acceleration of the system at this instant in time. The flow rate supplied by the pump remains constant.



(20) 4. Water ($\rho = 1000\,\text{kg/m}^3$, $\mu = 0.001\,\text{Pa}\cdot\text{s}$) flows through a horizontal section of 4 cm diameter pipe. The pipe has a roughness of 0.2 mm. A stagnation pressure tap and a static pressure tap are mounted 1 m apart as shown. The pressure difference between these two taps is measured with a mercury (s.g.=13.56) manometer which shows a displacement of 5 cm. The manometer tubes are otherwise full of water. What is the volume flow rate of the water?



198 L/min

(20) 5. A crude model of flow over a symmetric aerofoil is produced by combining a freestream (U_∞)with two doublets (λ_1 and λ_2). The two doublets are separated by a distance a in the freestream direction. Describe a procedure to determine the length L and maximum thickness T of the resulting aerofoil.