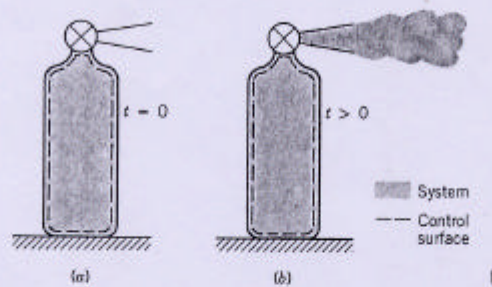
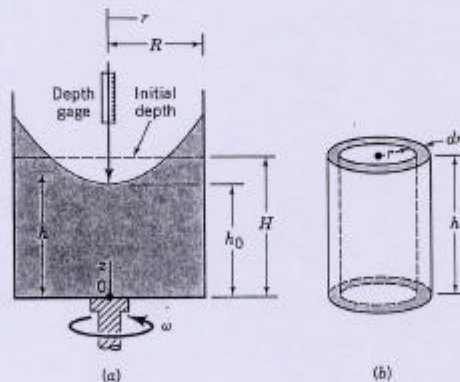


## Fluid Mechanics Part I

1. (10%) (a) Fluid flows from the fire extinguisher tank shown below. Discuss the difference between  $dB_{sys}/dt$  and  $dB_{CV}/dt$  if  $B$  represents mass.
- (10%) (b) Let the extensive property of interest be the system mass, and write the appropriate form of the Reynolds transport theorem for this flow.



2. (8%) (a) What is the Bernoulli equation?
- (12%) (b) Under what assumptions is the Bernoulli equation derived? Briefly discuss the result of the improper use of the equation.
3. (10%) It has been suggested that the angular velocity,  $\omega$ , of a rotating body or shaft can be measured by attaching an open cylinder of liquid (as shown below), and measuring with some type of depth gage the change in the fluid level,  $H - h_0$ , caused by the rotation of the fluid. Determine the relationship between this change in fluid level and the angular velocity.



**Fluid Mechanics Qualify Exam (10/5/2004) II**

1. The velocity components in a steady, incompressible, two-dimensional flow field are

$$U = 2y$$

$$V = 4x$$

Determine the corresponding stream function and show on a sketch several streamlines. Indicate the direction of flow along the streamlines.

(15%)

2. Assume the drag,  $D$ , acting on a spherical particle that falls very slowly through a viscous fluid is a function of the particle diameter,  $d$ , the particle velocity,  $V$ , and the fluid viscosity,  $\mu$ . Determine, with the aid of dimensional analysis, how the drag depends on the particle velocity. (10%)
3. Please describe the difference of the mechanism and structure of the laminar flow shear stress and turbulent flow shear stress. (10%)
4. Please derive equation for the volume flow rate of the fully developed laminar flow in a cylindrical tube. (15%)