

Name: _____.

Mini-Exam I

CM 3110 17 September 2009

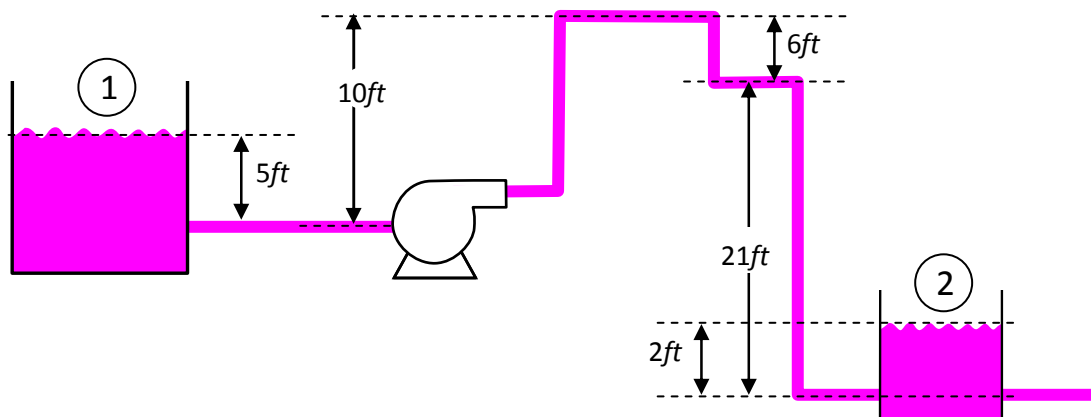
Note:
Significant figures count.
Please box your final answers.
Please be neat.

1. (50 points) For the apparatus shown in the figure below, we wish to use the mechanical energy balance to calculate the shaft work of the pump for 25°C water flowing at 0.38 lb_m/s . Friction may be neglected and the flow is turbulent. Please supply the following quantities:

- $P_1 =$
- $P_2 =$
- $v_1 =$
- $v_2 =$
- $z_1 =$
- $z_2 =$
- $F =$

How would you calculate shaft work from the quantities given in a-g above? You do not need to do the calculation or make the units match up, just fill in the right side of the equation below:

$$-W_{s,by} = W_{s,on} =$$



2. (50 points) A cross-shaped part rotates in a shaft as shown in the figure below. The open space in the device is filled with a lubricating oil with a viscosity of $3.2 \text{ Pa}\cdot\text{s}$. The shaft turns at 3.5 rpm (revolutions per minute), which corresponds to a velocity of the tip of 1.0 mm/s . The clearance gap is 0.50 mm , and we can assume that the gap is approximately constant (that is, neglect the effect of the curvature of the shaft housing).
- What is the shear stress in the gap (please give your answer in Pa)?
 - If the rotational speed doubles, what will the new shear stress be?

0.50 mm gap

