CE 3105 – Fluid Mechanics Laboratory Final Exam

- Please read through the entire exam before you begin - notice there are blank pages to show your work, so make it legible and follow a logical problem solving protocol.
- Write your name on **each** sheet before beginning to work the exam.

Question 1

What are the names of your laboratory team members:

1. TEAM MEMBER 0 (YOU): _____
2. TEAM MEMBER 1: _____
3. TEAM MEMBER 2: _____
4. TEAM MEMBER 3: _____
5. TEAM MEMBER 4: _____
6. TEAM MEMBER 5: _____

Question 2

Before each laboratory you received a safety briefing. What were three safety reminders before each laboratory?

1. REMINDER 1: _____
2. REMINDER 2: _____
3. REMINDER 3: _____

Question 3

A metal sphere measured using a dial-caliper (in inches) is pictured. The same sphere is weighed using a digital scale (in grams).

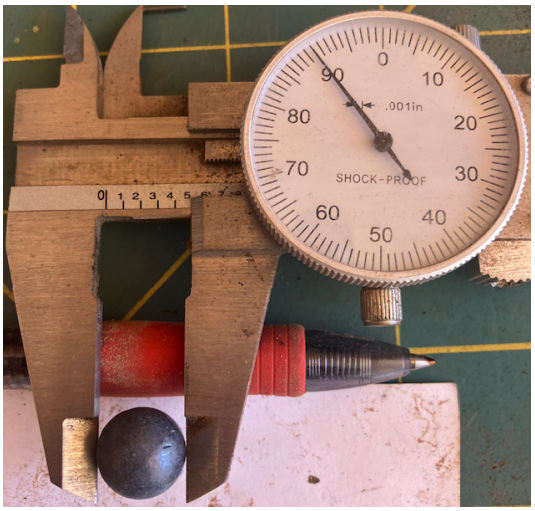


Figure 1: Sphere in dial-caliper instrument reading diameter in inches

Figure 2: Sphere on scale reading mass in grams

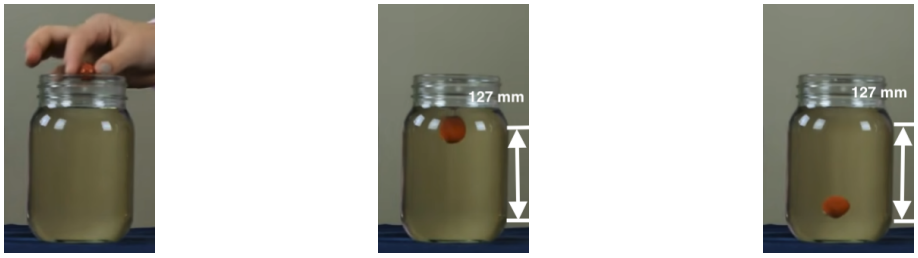
Determine:

1. The volume of the sphere in cubic meters.
2. The density of the sphere in $\frac{kg}{m^3}$

Show work here

Question 4

The sphere (color coated for visibility) is used to estimate viscosity for an unknown liquid as depicted in the photographs below. A 50 ml sample of the light amber liquid has a mass of 71.5 grams at 20°C. The time required for the sphere to traverse 127 mm was observed to be 3.9 seconds. Determine:



(a) Dropping sphere (b) Time = 0 sec. (c) Time = 3.9 sec.

Figure 3: Spherical object for viscosity measurement by Stokes Law (Laboratory 1)

1. The density of the unknown liquid (in $\frac{g}{ml}$)
2. The viscosity of the unknown liquid (in Pa·s)

Show work here

Question 5

The following discharge data and head change were obtained using the apparatus in the photograph below:

Table 1: Pipe head loss apparatus (Laboratory 4)

Volume (mL)	Time (s)	Δh (m)
122	8.36	1.34
138	6.67	2.56
180	7.9	3.09
205	8.03	3.98
217	8.26	3.92

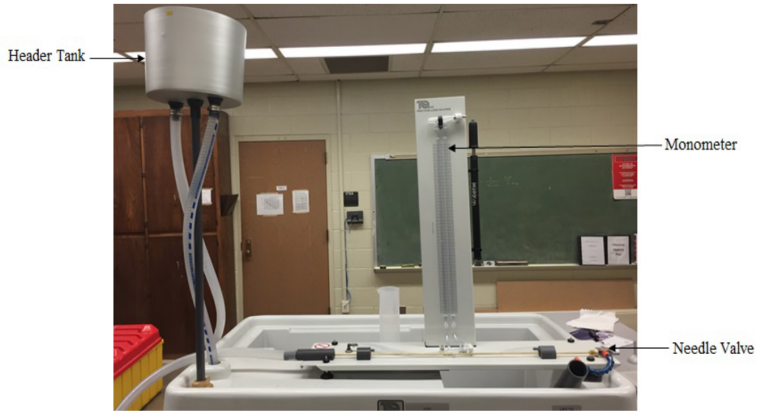


Figure 1: Experimental Setup of Friction Loss in a Pipe

Figure 4: Pipe head loss apparatus (Laboratory 4)

Determine:

1. The discharge rate for each of the 5 measurements.
2. The flow velocity in the 508 mm long, 3-mm diameter, brass tube for each of the 5 measurements.
3. The Reynolds number for each of the 5 measurements.
4. The Darcy-Weisbach friction factor for each of the 5 measurements.
5. The flow regime (laminar, transitional, or turbulent) in each experiment?
6. Plot (sketch) the friction factor versus Reynolds number for these data.

Show work here

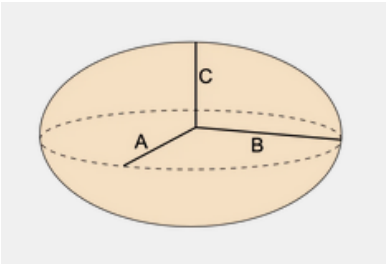
Show work here

Question 6

A small piece of volcanic ejecta from Amboy Crater is at the front of the classroom

The mass of the object is 23.93 grams. The porosity of typical pumice is η = 64–85% by volume `https://en.wikipedia.org/wiki/Pumice`

The ellipsoid method to approximate volume uses 3 measurements A,B, and C, called semi-axes.



$V = \frac{4}{3} * \pi * A * B * C$

The porosity of typical pumice is η = 64–85% by volume. The porosity can be used to approximate the solids volume from the expression:

$V_{total} \cdot (1 - \eta) \approx V_{solids}$

Determine:

1. An estimate of the volume of the irregular shaped object (in milliliters).
2. An estimate of the solids volume, based on a porosity of 64%
3. If the object will float in air.
4. If the object will float in water.
5. If the object will float in glycerine.
6. Write an experimental procedure to obtain definitive answers to the three previous (will it float in ...) questions.

Show work here

Show work here