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).

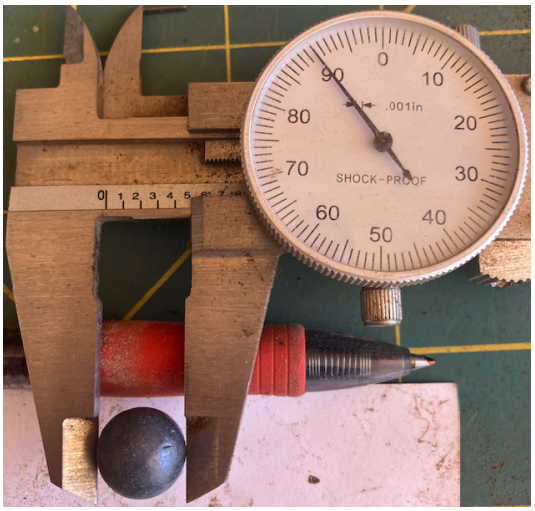


Figure 1: Sphere in dial-caliper instrument reading diameter in inches

Figure 2: Sphere on scale reading mass in grams

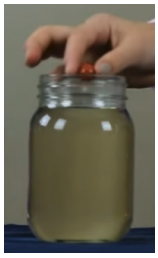
Determine:

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

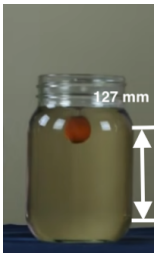
Show work here

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

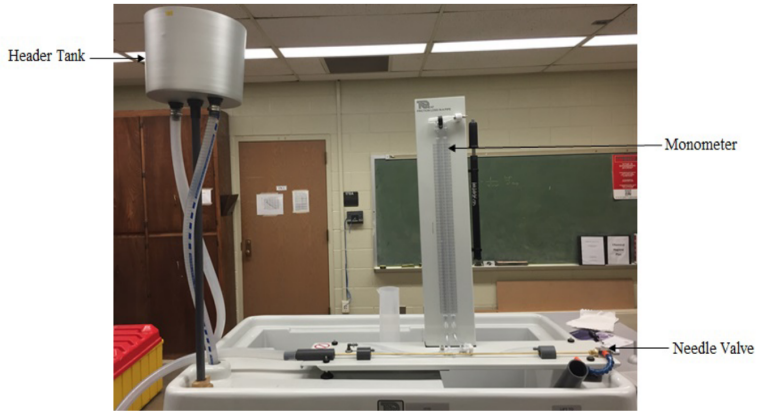


Figure 1: Experimental Setup of Friction Loss in a Pipe

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

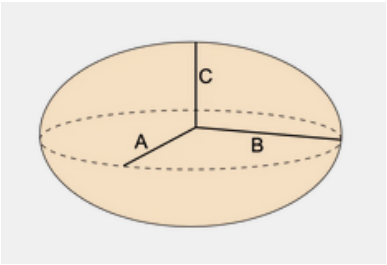
Show work here

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.