Name: ____ Date: ___________________

Viscosity Activity Worksheet

1. **Describe the fluid you are working with using every day descriptive vocabulary.** (For example: "I am looking at honey. It is yellow(ish) and clear(ish). It is pretty thick and moves slowly. It feels sticky.")

2. **Calculate the <u>density</u> of the fluid using these steps:**
   - Weigh the empty graduated cylinder. Record its mass in grams.

     $M_{cylinder}$=___________ [g]

   - Fill the cylinder with fluid, and record the volume in cm^3. Note: 1 cm^3=1 ml.

     Vol_{fluid}=________ [cm^3]

   - Weigh the full graduated cylinder. Subtract the mass of the empty graduated cylinder and record the mass of the fluid.

     M_{fluid}=___________ [g]

   - The density of the fluid is the mass over the volume. Calculate the density of the fluid.

$$\rho_f = \frac{Mass\,of\,Fluid\,[g]}{Volume\,of\,Fluid\,[cm^3]}$$

ρ_f= __________ [g/cm^3]

3. **Measure the <u>density</u> of the sphere using these steps:**

- Measure the radius of the sphere. Record as r [cm].

r_s = __________ [cm]

- Calculate the volume of the sphere. Either use the equation:
  or place the sphere in a graduated cylinder filled with water and record its displacement.

Vol_s = __________ [cm^3]

- Weigh the sphere. Record its mass.

M_s = __________ [g]

- Calculate the density of the sphere by dividing its mass by its volume.

ρ_s= __________ [g/cm^3]

4. **Measure the <u>terminal velocity</u> of the sphere falling through the fluid using these steps:**

- With your stopwatch ready, drop the ball into the fluid.

  If the fluid is not very viscous, the ball will fall through it very fast, *so be ready!*

  If the fluid is thick enough, then the ball will reach a constant speed.
  This is the *terminal velocity*, the point at which the drag on the sphere by the fluid is equal to the force of gravity.

- Measure how fast the ball falls a distance. Record the distance, and the time.

distance = __________ [cm]

time = ____________ [s]

- Calculate the velocity, which is the distance divided by the time.

V_s = __________ [cm/s]

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5.

6. **Using this equation, derived from Stokes' law, calculate the viscosity of your fluid.** Gravity is 981 cm/s^2. *Be very careful* to show your units and how they cancel out. Your final answer should be in units of [g/(cm s)].

$$\mu = \left(\frac{2}{9}\right) * \frac{r^2 * g(\rho_s - \rho_f)}{V_s}$$

μ= ________ [g/(cm s)]

7. **Viscosities are usually recorded in [Pa s]. To convert from [g/(cm s)] to [Pa s], simply divide by 10:**

=________ [Pa s]

8. **Using the internet, look up the viscosities of some common household fluids. Be sure to include units. Do any of the answers surprise you?**

Fluid	Viscosity	Fluid	Viscosity
Example: blood	3 x 10-3 to 4 x10-3 [Pa s]		

Note: In searching the internet, you may find viscosities in a variety of units. Some may be in Poise [P] or Centipoise [cP]. 1 [cP]=.001 [Pa s]. The viscosity of water is 1 [cP]. Other fluids may have viscosity in Stokes [St], which is the ratio of the viscosity to the density of the fluid. To convert from Stokes, multiply it by the fluid's density, or find another source! *Hint:* Search for "dynamic viscosity."