**Viscosity Activity Worksheet Answers**

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.”)

Answers to questions 1-6 will vary, depending on the fluids and equipment used.

1. **Calculate the density of the fluid using these steps:**
	* Weigh the empty graduated cylinder. Record its mass in grams.

Mcylinder=\_\_\_\_\_\_\_\_\_\_ [g]

* + Fill the cylinder with fluid, and record the volume in cm3. Note: 1 cm3=1 ml.

Volfluid=\_\_\_\_\_\_\_\_\_\_ [cm3]

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

Mfluid=\_\_\_\_\_\_\_\_\_\_ [g]

* + The density of the fluid is the mass over the volume. Calculate the density of the fluid.



= \_\_\_\_\_\_\_\_\_ [g/cm3]

1. **Measure the density of the sphere using these steps:**
	* Measure the radius of the sphere. Record as r [cm].

rs = \_\_\_\_\_\_\_\_\_\_ [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.

Vols = \_\_\_\_\_\_\_\_\_\_ [cm3]

* + Weigh the sphere. Record its mass.

Ms = \_\_\_\_\_\_\_\_\_\_ [g]

* + Calculate the density of the sphere by dividing its mass by its volume.



= \_\_\_\_\_\_\_\_\_\_ [g/cm3]

1. **Measure the terminal velocity 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.

Vs = \_\_\_\_\_\_\_\_\_\_ [cm/s]

1. **Using this equation, derived from Stokes’ law, calculate the viscosity of your fluid.** Gravity is 981 cm/s2. *Be very careful* to show your units and how they cancel out.
Your final answer should be in units of [g/(cm s)].

$$μ= \left(\frac{2}{9}\right)\*\frac{r^{2}\*g\left(ρ\_{s}-ρ\_{f}\right)}{V\_{s}}$$

= \_\_\_\_\_\_\_\_\_\_ [g/(cm s)]

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



=\_\_\_\_\_\_\_\_\_\_ [Pa s]

1. **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]** |  | **castor oil** | **0.25 to 0.5** |
| **SAE 30 motor oil** | **0.25 to 0.5 [Pa S]** |  | **ketchup** | **50 to 70 [Pa S]** |
| **maple syrup** | **0.15 to 0.2 [Pa S]** |  | **shortening or lard** | **1,000 to 2,000 [Pa S]** |
| **milk** | **2 x 10-3 to 5 x10-3****[Pa S]** |  | **honey** | **2 to 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.”