**Name :\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_**

**Jello Jiggliness**

**Purpose:** To determine the storage modulus for Jello.

**Background:** There are many ways to categorize materials. Once such way is as an elastic solid or as a fluid. An elastic solid responds to an applied force by stretching and when the force is removed the solid returns to its original size and shape. When a fluid experiences a shearing force over a period of time it flows with some degree of ease and when that force is remove the fluid simply stops. Most materials however are a combination of solid and fluid called viscoelastic. When forces are applied to these materials they stretch but when the forces are removed they go back to their original shape but it takes longer. We’re going to use this fact to quantify the “jiggliness” of Jello.

$$G^{'}\left(w\right)=\left(\frac{w^{2}I}{b}\right)\left(1+\frac{∆^{2}}{4π^{2}}\right)$$

$$G^{''}\left(w\right)=\left(\frac{w^{2}I}{b}\right)\left(\frac{∆}{π}\right)$$

G′ (w) is called the storage modulus. It is a way of quantifying how solid something is. The higher this number the stiffer the material is. Similarly, G′′ (w) is called the loss modulus. It is a way of quantifying how fluid something is.

**Procedure:**

1. Begin by measuring the dimensions of your sample and using this to calculate the form factor (b).

Radius (R) = \_\_\_\_\_\_\_\_\_ m

Height (h) = \_\_\_\_\_\_\_\_\_ m

b = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ m3

1. Next, sandwich your sample between the rotating plate of your sensor and the piece of glass beneath it. It is important that your sample is making contact with both surfaces but be careful not to squish your sample.
2. Let’s chat for a minute about rotating things. If you were to apply a torque to your rotating disk without the Jello being present the disk would simply rotating until friction between the disk’s parts brought it to rest. With the presence of the Jello however the disk will not be able to rotate freely. It will oscillate back and forth similar to a spring or a pendulum. Record these oscillations and sketch an image of the displacement versus time graph in the space below.
3. Use the graph generated by your sensor to make the following measurements and calculations.

Period of oscillation (T) = \_\_\_\_\_\_\_\_\_ s

Angular frequency (w) = \_\_\_\_\_\_\_\_\_\_ Hz

Amplitude of 1st crest (Ao) = \_\_\_\_\_\_\_ rad

Amplitude of 2nd crest (A1) = \_\_\_\_\_\_\_ rad

 Logarithmic Decrement (Δ) = \_\_\_\_\_\_\_\_

1. The last measurements and calculations you’ll need to make relate to the moment of inertia of the rotating metal disks. I have already measured the mass of each disk for you.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Mass (kg)** | **Radius (m)** | **I (kgm2)** |
| **Top Disk** |  |  |  |
| **Middle Disk** |  |  |  |
| **Bottom Disk** |  |  |  |

Total Moment of Inertia (I) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ kgm2

1. Now you have all you need to calculate the storage modulus for your Jello. You can also calculate the loss modulus. Use the space below to show your calculations.
2. An examination of dimensional analysis should result in units of kg\*m-1\*s-2. This combination is better known as a pascal (Pa). Pascals or kilopascals (kPa) are standard units for measurements of pressure and stress.

**Post-Lab Questions:**

1. What did you calculate for G′ and G′′ respectively?
2. Based on your results are Jello Jigglers more like a solid or more like a fluid? Explain.
3. How do your results compare with other in the class? What is one possible cause of any variations?
4. If you were to perform this experiment what is one thing you would add, change, or adjust? Explain your reasoning and what you hope to gain from this adjustment.