**Carleton University**

**Laboratory Report**

**Course #:** PHYS1003-A **Experiment #: 04**

**Atwood’s Machine**

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**Station #:** 14

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Purpose

The purpose of this lab is to determine the gravitational constant.

Theory

𝐼𝛼=𝑇2𝑟−𝑇1𝑟−𝛤

I is the rotational inertia of the pulley, T1 and T2 are the two tensions from the masses, with T2 being the larger force, r being the radius of the pulley, and 𝛤 is the frictional torque.

Apparatus

* Mass with iron insert
* Mass
* 10 washers
* Scale (0.02g)
* Meter stick
* Vernier Caliper (0.05cm)
* Timer (0.02s)

Observations

See attached tables and graph

Calculations

𝜎𝛥𝑚=sqrt (𝜎𝑀2+4𝜎𝑚12+4𝑁2𝜎𝑚𝑤2)

𝒔𝒍𝒐𝒑𝒆=𝒈𝟐𝒉𝑴+𝑰𝒓𝟐

𝒊𝒏𝒕𝒆𝒓𝒄𝒆𝒑𝒕=−𝜞𝟐𝒉𝒓𝑴+𝑰𝒓𝟐

Net torque = 𝐼𝛼=𝑇2𝑟−𝑇1𝑟−𝛤

Linear acceleration = radius \* angular acceleration

Results

Discussion

Is the sign of 𝛤 correct? Explain.

𝛤 is always opposite in direction to the rotation.

How does this experiment compare with one where you would calculate g from the time it takes for an object to fall on the floor (think about your reaction time)?

There would be less error from human reaction time, as the weights fall slower. It takes more preparation though.

Does friction play a part of the error in the measurement of g? Why?

The coefficient of kinetic friction between the rotating pulley and the string should be very small. Prior knowledge of wheels shows that rolling friction is normally very low.

What about air resistance? Is it a significant source of error? Why?

Air resistance should not be a big factor, as the surface area and speeds were both small compared to the forces.

What is the effect of the weight of the string? And of its elasticity?

The effect of the weight of the string would be partially counteracted by the weight of the string on the other side. The elasticity would slightly affect the time it takes.

Why did you measure the radius of the pulley by measuring the distance between the strings instead of measuring it directly from the pulley?

It is hard to measure the radius from exactly the centre of the pulley. The distance between the strings should be the diameter of the pulley.