THE CHINESE UNIVERSITY OF HONG KONG, SHENZHEN

PHY 1002

PHYSICS LABORATORY

Short Report: Centripetal Force

Author:
Chen Ang

Student Number:
118010009

Group Number:
Group 1

Experiment Date:
September 20, 2019

September 28, 2019

Contents

1 Data Analysis

1.1 F-m Relationship

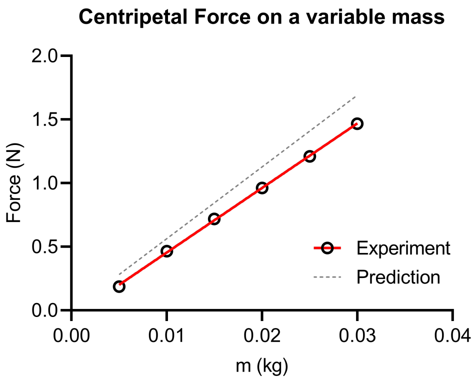

Figure 1: Force-mass graph at 10-cm radius in 2.4-m·s^{-1} tangential speed

With both tangential speed and radius of the trajectory held constant, the centripetal force acting on an object is proportional to the object's mass - that is,

$$F \propto m \text{ with } v, r \text{ fixed.}$$

1.2 F-v^2 Relationship

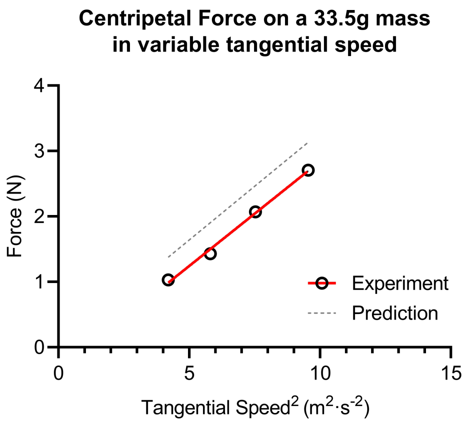

Figure 2: Force-speed^2 graph at 10-cm radius with a 33.5-g mass

With both mass and radius of the trajectory held constant, the centripetal force acting on an object is proportional to the object's tangential speed, but squared - that is,

$$F \propto v^2 \text{ with } m, r \text{ fixed.}$$

1.3 F-r Relationship

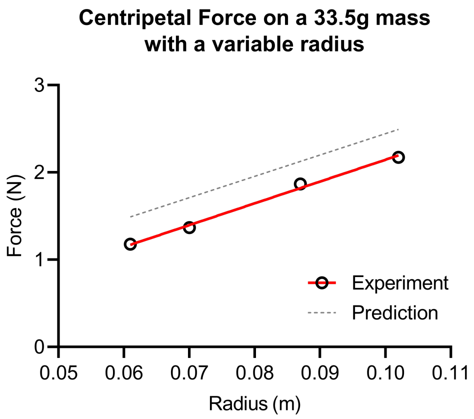

Figure 3: Force-radius graph at 27-rad·s^{-1} angular speed with a 33.5-g mass

With both mass and angular speed held constant, the centripetal force acting on an object is proportional to the radius of the trajectory - that is,

$$F \propto r \text{ with } m, \omega \text{ fixed.}$$

2 Discussion

The results obtained in the analysis strongly support the theory

$$F = mv^2/r.$$

However, it is noticed that, depsite a similar slope of the graph obtained from the experiment to that of the prediction, the magnitude of the centripetal force is always smaller than the prediction within all procedures, resulting in a downward shift of the graph. The uniformity of shift present in Figure 2 and 3 suggests the interference of *friction*. Specifically,

$$mv^2/r = F_{\text{pred}} = F_{\text{exp}} + F_{\text{fric}}$$

$$F_{\text{exp}} = F_{\text{pred}} - F_{\text{fric}},$$

explaining the uniform downward shift in Figure 2 and 3. The growing deviation in Figure 1 is also explained, as friction grows linearly in the normal force, which, in this experiment, grows linearly in the mass of the object.