Practical 6 Centripetal force – whirling bung

Purpose

The aim of this experiment is to verify the equation for centripetal force using a whirling bung.

Safety

Do not swing the bungs round too fast and avoid collisions between bungs and people!
Keep away from windows.
Wear eye protection.

You will need:

- Rubber bung with a hole through it
- Length of string (about 1.5 m)
- Washers or 10 g slotted masses and hanger
- Stopwatch or stop clock
- Metre ruler
- Short length of glass tube with the ends burred over (or a short metal tube)
- Access to a balance
- Eye protection

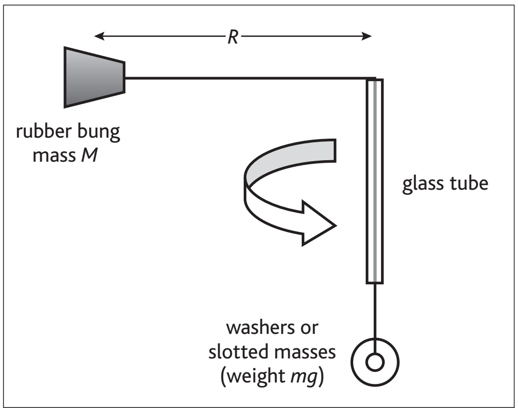

Figure 1: Whirling bung arrangement

Experimental instructions

Tie the piece of string to a rubber bung and then thread it through a short length (10 cm) of glass tube. Fix a small weight (such as a few washers with a mass a little greater than the mass of the bung) to the lower end of the string.

Whirl the bung round in a horizontal circle (radius approximately 80 cm) while holding the glass tube so that the radius of the bung's orbit is constant. (A mark on the string will help you see if the radius of the orbit remains the same.)

Measure the mass of the bung (M), the total mass of the washers (m), the radius of the orbit (R) and the time for ten orbits ($10 \times T$).

Repeat the experiment with different numbers of washers, different orbit radii and bungs of different masses.

Analysis and conclusions

Calculate the period of the orbit (T), the velocity of the bung in the orbit $\left(v = \dfrac{2\pi R}{T}\right)$ and then work out the centripetal force $\left(F = \dfrac{Mv^2}{R}\right)$.

Compare this value with the weight of the washers (mg).

(The centripetal force should be equal to the weight of the washers. This will only be the case if the system is frictionless.)

Plot a graph of m against v^2.

Comment on the most important sources of error in your experiment and how they might be reduced.