Centripetal force

Aim: To show an example of centripetal force.

Subjects: 1D50 (Central Forces)

Diagram:

Equipment:

- Conical beaker, 2 liter, filled with water.
- Rubber stop.
- Ping-pong ball tied to rubber stop (see Diagram).

Safety:

- The conical beaker filled with water is quite heavy ($m \approx 2kg$). Hold it firmly!

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Presentation: Hold the conical beaker filled with water upside-down in your hands. The ping-pong ball stands vertically above the rubber stop. Make yourself turn in a circle and while turning observe the ping-pong ball (see Figure 1).

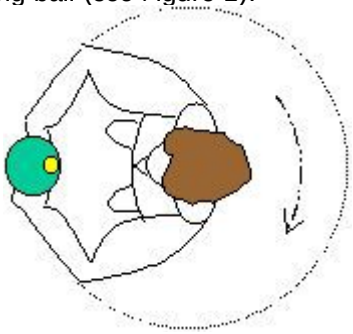

Figure 1

The ping-pong ball is displaced towards you.

Explanation: The ping-pong ball being completely immersed in water experiences an upward thrust F_u that is larger than its weight mg. The net force (F_u-mg) is directed upwards. The tension T in the string prevents that the ping-pong ball floats upwards (see Figure 2a).

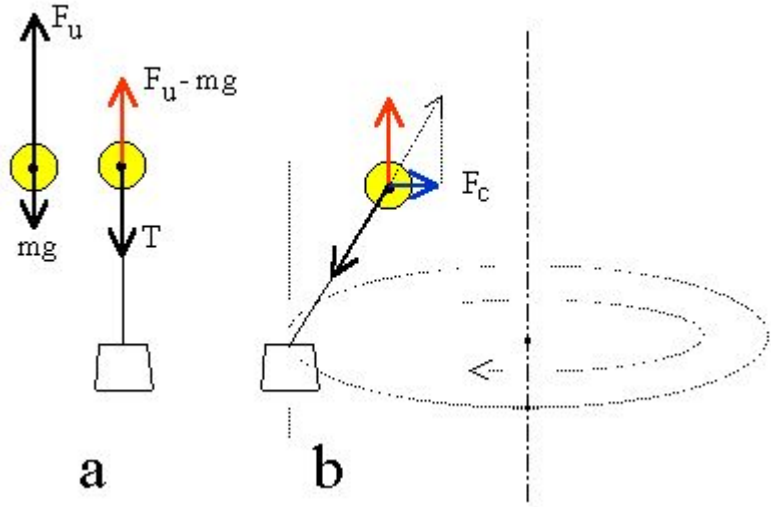

Figure 2

When turning around in circles the ping-pong ball is forced to move in a circle. A centripetal force is needed for that. Figure 2b shows the new situation of equilibrium: the net upward force and tension are compensated by a centripetal force F_c.. Any other position of the ping-pong ball is not a situation of equilibrium (drawing a free body diagram of the forces will show this).

Remarks:

- When an air-bubble is trapped in the conical beaker filled with water, this bubble will behave in the same way as the ping-pong ball does.
- When you move the system from left to right, the acceleration on the left side and the deceleration on the right side can be observed. In general: the system can be used as an acceleration-meter.

In case of errors, please contact: E.Balsma@tudelft.nl

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Sources:

- Ehrlich, Robert, Turning the World Inside Out and 174 Other Simple Physics Demonstrations, pag. 31-32.