Conical pendulum

Aim: To show that the period of motion of a conical pendulum changes only noticebly at large angles.

Subjects: 1D50 (Central Forces)

Diagram:

Equipment:

- Ball suspended to a thread.
- Clamping material.
- Large paper circle, diam. = 70cm.
- Small paper circle, diam. = 15cm.
- Stopwatch with large display.
- Small ball suspended to a thread

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

Delft University of Technology

Conical pendulum

Presentation:

1. Set up the conical pendulum as shown in the Diagram. Place the small paper circle under the pendulum and make the pendulum swing conically along the circumference of the paper circle. Measure the time needed for 10 periods. Repeat this procedure, but now with the large paper circle.
   In our set-up, the times measured are 18.2 and 17.5sec respectively.
2. Take the small simple pendulum by hand and make it swing conically. Gradually speed it up. At very large angles the increase in the angular speed is noticed easily.

Explanation:

Theory tells us that the period (T) of a conical pendulum is given by $T = 2\pi\sqrt{\frac{l\cos\varphi}{g}}$ (see Figure1).

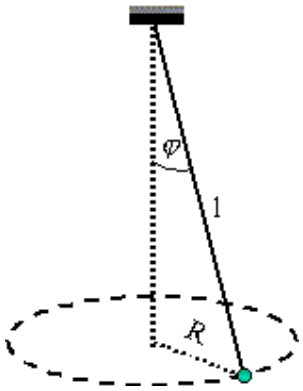

Figure 1

So $T \propto \sqrt{\cos\varphi}$

The table in Figure2 shows that from 0° to 30°, $\sqrt{\cos\varphi}$ only changes 7%, while from 60° to 89° this change is about 82%. So only at large angles T changes noticeably.

φ (°)	$\sqrt{\cos\varphi}$
0	1
15	0,98
30	0,93
45	0,84
60	0,71
75	0,51
80	0,42
85	0,30
89	0,13

Figure 2

Conical pendulum

Remarks:

- When the pendulum is suspended vertically and not swinging, we have marked this central position on the table. The paper circles have a hole in their center so that it is easy to position the paper circles in the right place (hole and mark coincide).
- Making the pendulum swing along the circumference of the paper circle needs some practice. Launch the suspended ball tangentially and give it a speed so that it just reaches a deflection equal to *R* of the paper circle (see Figure3).

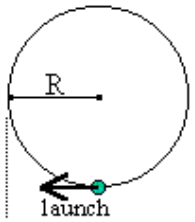

Figure 3

Sources:

- Mansfield, M and O'Sullivan, C., Understanding physics, pag. 70
- Roest, R., Inleiding Mechanica, pag. 55-56
- Young, H.D. and Freeman, R.A., University Physics, pag. 141-142