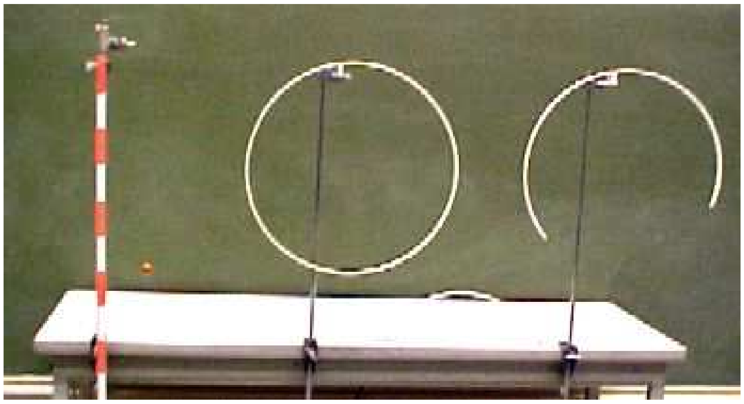
Physical pendulum (3)
Oscillating ring

Aim: To show a particular example of a compound pendulum.

Subjects: 3A15 (Physical Pendula)

Diagram:



Equipment:

- 2 large (steel) rings, ϕ=600 with knife-edge suspension. These rings can be divided into 2/3 and 1/3.
- mathematical pendulum, l=600
- meterstick

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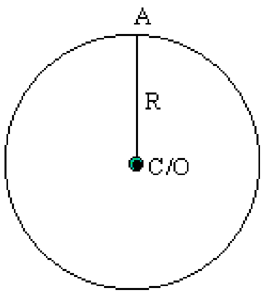
Presentation: One complete ring swings in its plane at the knife-edge on its periphery. A simple pendulum whose length is equal to the diameter of the ring is suspended beside it so the equality of periods can be observed.
A second 2/3-ring is made swinging. It can be observed that the ring has still the same period!
Again the same period is measured when 1/3-ring is swinging

Explanation:

- For a physical pendulum, the period *T* is given by $T = \frac{2\pi}{\sqrt{g}}\sqrt{\frac{I_A}{ms}}$.

  If the pendulum is a complete ring, then $s=R$ (see Figure 1), $I_A=I_C+mR^2$ and



Figuur 1

$I_C=mR^2$. Then $T = \frac{2\pi}{\sqrt{g}}\sqrt{2R}$, so $l_r=2R$.

So a complete ring has the same period as a mathematical pendulum of length 2R.

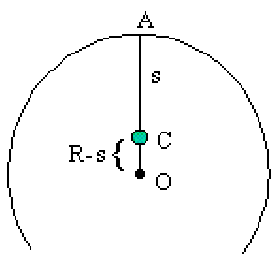


Figure 2

Physical pendulum (3)
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- If the pendulum is part of a complete ring, $I_O = mR^2$ (Figure 2). Also $I_O = I_C + m(R-s)^2$ (C is the center of mass) and $I_A = I_C + ms^2$. It follows that $I_A = 2mRs$ and $T = \frac{2\pi}{\sqrt{g}}\sqrt{2R}$. So again $l_r = 2R$.

Sources:

- Ehrlich, R., Why Toast Lands Jelly-Side Down: Zen and the Art of Physics Demonstrations, pag. 126-127
- Roest, R., Inleiding Mechanica, pag. 169-170
- Sutton, Richard Manliffe, Demonstration experiments in Physics, pag. 88