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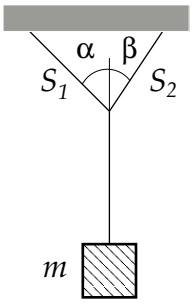
Exercises and Complements for the Introduction to Physics I for Students of Biology, Pharmacy and Geoscience

Sheet 3 / September 25, 2019 Discussion of the Exercises: **08.10.2019/09.10.2019**

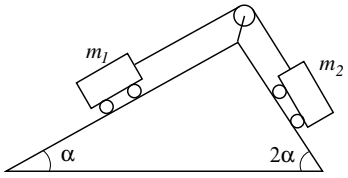
Exercise 11.



A mass $m = 0.5$ kg is hanging on thin wires, see figure. The angle α is 45° and $\beta = 60°$. How big are the absolute values of the forces F_1 and F_2 in the different parts of the wire S_1 and S_2?

Exercise 12.

Two wagons are connected via a rope and they should move without friction. $m_1 = m_2 = 100$ kg, $\alpha = 20°$ and assume that the rope has no mass. Calculate:



(a) the acceleration of the wagons.
(b) the velocity v after 10 s (the initial velocity is 0).

Exercise 13.
In 1638 Galileo Galilei published that all bodies would have the same fall time, if there was no resistance of the air. So, the fall time of a body depends on the fall height, but not on its mass. As part of the Apollo 15 mission in 1971, David Scott was able to demonstrate this phenomenon on the moon ($g_{Moon} = 1.62$ m/s^2) with a hammer and a falcon feather.

(a) Deduce with a formula, that the fall time in vacuum depends only on the drop height and the gravitational acceleration g.
(b) What is the fall time of a feather dropped on the moon from a height of 1 m?
(c) What is the final speed of the feather immediately before the impact?

Exercise 14.

A communication satellite without an engine should be placed always at the same position above the Earth's surface.

(a) How big does the distance to the Earth's surface has to be?
(b) Is it possible that this satellite is always positioned, for example, above Basel? Explain!

Exercise 15.
Using angular momentum conservation, calculate how much time a rotation of the earth would need, if the earth suddenly shrank to 60% of its diameter (while mass remained constant).

Solutions:

Exercise 11. 4.4 N and 3.6 N

Exercise 12. (a) 1.48 m/s^2, (b) 14.8 m/s

Exercise 13. (b) 1.1 s, (c) 1.8 m/s

Exercise 14. 36000 km

Exercise 15. 8.64 h