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Exercises and Complements for the Introduction to Physics I

for Students

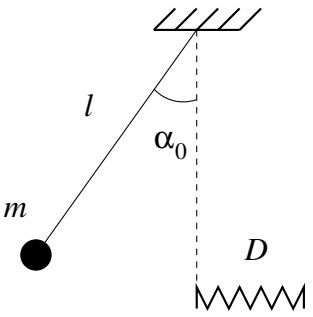
of Biology, Pharmacy and Geoscience

Sheet 9 / November 7, 2017 Discussion of the Exercises: **21.11.2017/22.11.2017**

Exercise 36.
In former times the bell of a church was not electrically driven. This bell can weigh several tons and to made it ring, manual work was necessary. In order to make the bell swing someone pulls on a rope which is connected to the bell. Explain why it is also possible for the little daughter of the bell ringer to make the bell swing.

Exercise 37.
After running for 12 h a mechanical pendulum clock is 30 min slow. The pendulum is originally 0.5 m long. To which length l does the pendulum need to be adjusted so that the clock runs exactly?

Exercise 38.
A sphere (mass $m = 400$ g) attached to a wire (length $l = 0.2$ m) swings against a massless spring (spring constant $D = 19.6$ N/m) and gets elastically pushed back by the spring (see figure). The maximum angle of deflection α_0 is 10°.



(a) How long are the sphere and the spring in contact?
(b) Does the contact time depend on α?

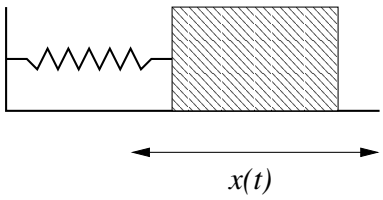
Exercise 39.
A wooden cuboid with height h and a base area A floats in water. It gets pushed once at the beginning and due to this it oscillates up and down.

(a) Demonstrate that the motion is a harmonic oscillation.
(b) Derive a term for the period T of oscillation.
(c) Is the result of (b) also valid for a wooden sphere? Justify your answer.

Additional Exercise (for students which are looking for a challenge - not relevant for the exam).
A wooden brick is attached to a spring and swings back and forth above a rough surface, see figure. The spring deflection after 5 periods of oscillation is half as big as at the beginning. Each oscillation

lasts 3 sec.

(a) How big is the damping δ?
(b) According to the script, the motion of the brick can be described by the following equation: $x(t) = x_0 \exp(-\delta t) \sin(\omega t)$. Since $\exp(-\delta t)$ never becomes zero, the amplitude of the oscillation is exponentially reducing but the brick will never stop moving. In reality the brick stops after a few oscillations. Why?
(c) Is the oscillation made faster or slower by putting soap on the surface?



Solutions

Exercise 37. 0.459 m

Exercise 38. (a) 0.32 sec

Additional Exercise (a) 0.0462 s^{-1}