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

Sheet 9 / November 12, 2019 Discussion of the Exercises: **19.11.2019/20.11.2019**

Exercise 41.

On a massless thread of length $l = 15$ m hangs a punctiform mass $m = 8$ kg. We consider an undamped oscillation with a displacement of 5°. The direction of the oscillation is along the x-coordinate, the height difference of the pendulum is given with the y-coordinate.

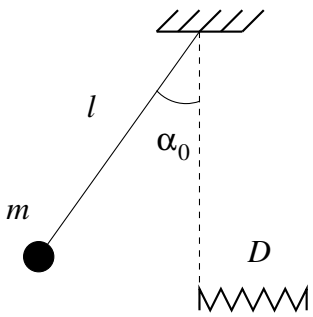
(a) What frequency does the pendulum have?
(b) What is the oscillating period of the pendulum?
(c) Which distance in x-direction crosses the mass during a period?
(d) What is the $x(t)$ equation of the vibration? (For $t = 0$, the pendulum should start at the maximum value of x.)
(e) What is the speed in x-direction 5 s after the start?
(f) What is the restoring force at the reversal points?

Exercise 42.

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 43.

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?



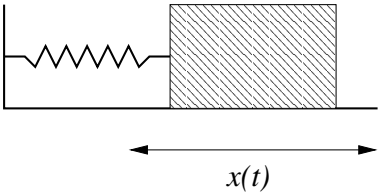
Exercise 44.

A wooden cuboid with height h and a base area A floats in water. It is briefly submerged in the water and then released. Subsequently, it starts to oscillate 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.

Exercise 45.

A wooden brick is attached to a spring and swings back and forth above a rough surface, see figure. After 5 periods of oscillation, the spring deflection is half the size as at the beginning. Each oscillation has a duration of 3 s. How big is the damping constant δ?



Solutions

Exercise 41. (a) 0.13 Hz

(b) 7.8 s

(c) 5.23 m

(e) 0.84 m/s

(f) 6.84 N

Exercise 42. 0.459 m

Exercise 43. (a) 0.32 s

Exercise 45. 0.0462 s^{-1}