Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 1 – IPSP

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Exercise Sheet 11 (WS 2013/14)

Date of Issue: Jan. 17^{th} 2014

Date of Submission: Jan. 24^{th} 2014

Submission Place: Marked mailbox next to room 302 (Linnestr. 5)
Submission Time: 11:00 a.m. at the submission day noted above

Please note: Write your name and matriculation number on EACH sheet of paper. Only submit the calculations and results for exercise 1-3.

If you need additional points to meet the criteria to participate in the exam, you can also submit exercise 4 and gain up to 10 extra points.

Exercises:

1. (a) Show that $A_0 \cos(\omega t + \delta)$ can be written as $A_s \sin(\omega t) + A_c \cos(\omega t)$, and determine A_s and A_c in terms of A_0 and δ. (b) Relate A_c and A_s to the initial position and velocity of a particle undergoing simple harmonic motion. (7 Points)

2. A winch cable has a cross-sectional area of 1.5 cm^2 and a length of 2.5 m. Young's modulus for the cable is 150 GN/m^2. A 950-kg engine block is hung from the end of the cable. (a) By what length does the cable stretch? (b) If we treat the cable as a simple spring, what is the oscillation frequency of the engine block at the end of the cable? (7 Points)

3. A harmonic wave on a string with a frequency of 80 Hz and an amplitude of 0.025 m travels in the $+x$ direction with a speed of 12 m/s. (a) Write a suitable wave function for this wave. (b) Find the maximum speed of a point on the string. (c) Find the maximum acceleration of a point on the string. (6 Points)

4. A pendulum that is used in your physics laboratory experiment has a length of 75 cm and a compact bob with a mass equal to 15 g. To start the bob oscillating, you place a fan next to it that blows a horizontal stream of air on the bob. With the fan on, the bob is in equilibrium when the pendulum is displaced by an angle of 5.0° from the vertical. The speed of the air from the fan is 7.0 m/s. You turn the fan off, and allow the pendulum to oscillate. (a) Assuming that the drag force due to the air is of the form bv, predict the decay time constant τ for this pendulum. (b) How long will it take for the pendulum's amplitude to reach 1.0°? (10 Extra Points)