Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 1 – IPSP

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Exercise Sheet 2 (WS 2011/12)

Date of Issue: Oct. 21st 2011

Date of Submission: Oct. 28th 2011

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, exercise 4+5 will be discussed during the instruction classes.

Exercises:

1. Sketch a v-versus-t curve for each of the following conditions: (a) Acceleration is zero and constant while velocity is not zero. (b) Acceleration is constant but not zero. (c) Velocity and acceleration are both positive. (d) Velocity and acceleration are both negative. (e) Velocity is positive and acceleration is negative. (f) Velocity is negative and acceleration is positive. (g) Velocity is momentarily zero but the acceleration is not zero. (7 Points)

2. Two cars are traveling along a straight road. Car A maintains a constant speed of 80 km/h and car B maintains a constant speed of 110 km/h. At $t = 0$, car B is 45 km behind car A. (a) How much farther will car A travel before car B overtakes it? (b) How much ahead of A will B be 30 s after it overtakes A? (7 Points)

3. A submarine can use sonar (sound traveling through water) to determine its distance from other objects. The time between the emission of a sound pulse (a "ping") and the detection of its echo can be used to determine such distances. Alternatively, by measuring the time between successive echo receptions of a regularly timed set of pings, the submarine's speed may be determined by comparing the time between echoes to the time between pings. Assume you are the sonar operator in a submarine traveling at a constant velocity underwater. Your boat is in the eastern Mediterranean Sea, where the speed of sound is known to be 1522 m/s. If you send out pings every 2.000 s, and your apparatus receives echoes reflected from an undersea cliff every 1.980 s, how fast is your submarine traveling? (6 Points)

4. A particle moves along the x axis with velocity $v_x = (8.0\,m/s^2)t - 7.0\,m/s$. (a) Find the average acceleration for two different one-second intervals, one beginning at $t = 3.0\,s$ and the other beginning at $t = 4.0\,s$. (b) Sketch v_x versus t over the interval $0 < t < 10\,s$. (c) How do the instantaneous accelerations at the middle of each of the two time intervals specified in Part (a) compare to the average accelerations found in Part (a)? Explain.

5. A ball is launched directly upward from ground level with an initial speed of 20 m/s. (Air resistance is negligible.) (a) How long is the ball in the air? (b) What is the greatest height reached by the ball? (c) How many seconds after launch is the ball 15 m above the release point?