Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 1 – IPSP

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Exercise Sheet 5 (WS 2011/12)

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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 will be discussed during the instruction classes.

Exercises:

1. A force F_x acts on a particle that has a mass of 1.5 kg. The force is related to the position x of the particle by the formula $F_x = Cx^3$, where $C = 0.50$ if x is in meters and F_x is in newtons. (a) What are the SI units of C? (b) Find the work done by this force as the particle moves from $x = 3.0$ m to $x = 1.5$ m. (c) At $x = 3.0$ m, the force points opposite the direction of the particle's velocity (speed is 12.0 m/s). What is its speed at $x = 1.5$ m? (8 Points)

2. A particle of mass m moves from rest at $t = 0$ under the influence of a single constant force $\vec{F}$. Show that the power delivered by the force at any time t is $P = F^2 t/m$. (5 Points)

3. A 2.40-kg block is dropped onto a spring and platform (Figure 1) of negligible mass. The block is released a distance of 5.00 m above the platform. When the block is momentary at rest, the spring is compressed by 25.0 cm. Find the speed of the block when the compression of the spring is only 15.0 cm. (7 Points)

4. When a particle moves in a circle that is centered at the origin and the magnitude of its position vector $\vec{r}$ is constant. (a) Differentiate $\vec{r} \cdot \vec{r} = r^2 =$ constant with respect to time to show that $\vec{v} \cdot \vec{r} = 0$, and therefore $\vec{v} \perp \vec{r}$. (b) Differentiate $\vec{v} \cdot \vec{r} = 0$ with respect to time and show that $\vec{a} \cdot \vec{r} + v^2 = 0$, and therefore $a_r = -v^2/r$. (c) Differentiate $\vec{v} \cdot \vec{v} = v^2$ with respect to time to show that $\vec{a} \cdot \vec{v} = dv/dt$, and therefore $a_t = dv/dt$.

Figure 1: Exercise 3