KIT - International Department GmbH

Pre-Semester Physics - Exercises Summer 2010

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1. Exercise:

A body of unknown mass is attached to an ideal spring with force constant $D = 120\,\frac{\mathrm{N}}{\mathrm{m}}$. It is found to vibrate with a frequency of $f = 0.6\,\mathrm{Hz}$. At $t = 0$ the particle is at rest at $x_0 = 10\,\mathrm{cm}$.

(a) What is the period T?

(b) Determine the mass m of the body.

(c) Find the velocity v where the spring is neither contracted nor elongated.

(d) Sketch $x(t)$.

(e) How would the diagram change if the mass would move in water?

2. Exercise:

A point mass m is hanging on a string with length ℓ and can move frictionless through air. At $t = 0$ the point mass is at an angle $\phi(0) = \phi_0$ to the vertical.

(a) State the equation of motion.

(b) What is the general solution $\phi(t)$ for small angles?

(c) Determine the period T of the oscillation.

(d) Find the tension force F_T in the string.

(e) With what frequency Ω should the center of rotation oscillate to get the maximum amplitude?

3. Exercise:

Consider again a point mass m_p which is now put at one end of a rod with mass m_r and length ℓ while the other end is fixed. Initially the rod is at an angle $\phi(0) = \phi_0$ to the vertical. Neglect any friction.

(a) What is the total moment of inertia Θ for this kind of rotation?

(b) Determine the resulting moment of torque $|\vec{M}|$ for the system.

(c) State the equation of motion.

(d) Find the period of oscillation T in the case of small angles.

(e) What is the reduced length of the pendulum?