Karlsruhe Institute of Technology - International Department GmbH

Pre-Semester 2010 - Physics Course - Extra Tutorial

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Sheet 2
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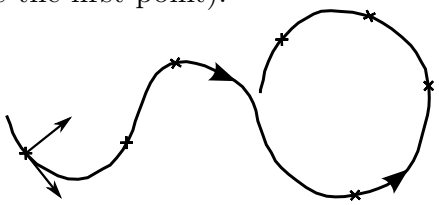
1. Newton's axioms

(a) State Newtons's first axiom (the principle of inertia)!
Hence, is there a force acting on a body which performs a circular motion?

(b) State Newtons's second axiom (the principle of action)!
Consider a particle which moves along the path given below, with velocity $|\vec{v}(t)| = const.$ Sketch the direction of the velocities and forces which act in the marked points (see as an example the first point).



(c) State Newton's third axiom (*actio=reactio*)!
Imagine an apple (with mass $m = 200\,\mathrm{g}$) falling from a tree. What is the gravitational force with which it attracts the earth (mass $M = 6 \cdot 10^{24}\,\mathrm{kg}$)? What is, hence, the acceleration with which the earth falls towards the apple?

2. Miscellaneous

(a) A bullet of mass $1.8 \cdot 10^{-3}\,\mathrm{kg}$ moving at $500\,\mathrm{m/s}$ impacts a large fixed block of wood and travels 6 cm before coming to rest. Assuming that the acceleration of the bullet is constant, find the force exerted by the wood on the bullet.

(b) To drag a 75-kg log along the ground at constant velocity, you have to pull on it with a horizontal force of 250 N.

(i) What is the resistive force exerted by the ground?

(ii) What horizontal force must you exert if you want to give the log an acceleration of $2\,\mathrm{m/s^2}$?

3. Hook's Law

A vertical spring of force constant $600\,\mathrm{N/m}$ has one end attached to the ceiling and the other to a 12-kg block resting on a horizontal surface so that the spring exerts an upward force on the block. The spring stretches by 10 cm.

(i) What force does the spring exert on the block?

(ii) What is the force that the surface exerts on the block?

4. Centripetal Force

A 0.20-kg-stone attached to a 0.8-m string is rotated in the horizontal plane. The string makes an angle of 20° with the horizontal. Determine the speed of the stone and the tension of the string.