

Pre-Semester 2010 - Physics Course - Extra Tutorial

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Sheet 7
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1. Double pendulum

Two strings with the same length l are attached to the same hinge. To one of the strings a point mass m_1 is affixed, to the other string a heavier point mass m_2 ($m_2 > m_1$) is affixed. Initially, both point masses are at rest. While m_2 is in its equilibrium (vertical) position, m_1 is deflected by the *small* angle $\alpha_0 < 0$ (to the left). At time $t = 0$ it is released and starts moving towards m_2 .

- (a) State the equation of motion for the angle $\alpha(t)$ that the first rope (with m_1) makes with the vertical. Approximate it for small α and solve it (before the collision takes place)!
- (b) At which time t_1 does m_1 reach m_2 ? What is the velocity v_1 of m_1 shortly before the collision?
- (c) Assume that the collision is elastic and that momentum is conserved. What is the velocity v_2' of m_2 shortly after the collision?
- (d) State the equation of motion for the angle $\beta(t)$ that the second rope (with m_2) makes with the vertical. Approximate it for small β and solve it (for times $t \geq t_1$, after the collision has taken place).
- (e) What is the maximal deflection β_0 of m_2 ? Is it larger or smaller than $|\alpha_0|$?
- (f) When and where will the two masses collide the next time?