

Pre-Semester 2010 - Physics Course - Extra TutorialSTÉPHANE NGO DINH
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1. Pendulum

A pendulum of length $l = 80$ cm with a bob of mass $m = 0.6$ kg is released from rest at initial angle of θ_0 with the vertical. At the bottom of the swing, the speed of the bob is $v_b = 2.8$ m/s.

- What was the initial angle θ_0 of the pendulum?
- What angle θ' does the pendulum make with the vertical when the speed of the bob is $v' = 1.4$ m/s?

2. Loop

Consider a bob of mass m gliding “down” a frictionless slide which contains a loop of radius R . The ball starts at rest at a height $h \geq 2R$ above the bottom of the loop.

- Compute the ball's speed v_{top} at the top of the loop.
- What is the path which the bob describes in the case $h = 2R$?
- What is the minimal height h_{min} from which the bob needs to start in order to make it through the loop?

3. Spring

A block of mass m is dropped onto the top of a vertical spring whose force constant is k . The block is released from a height h above the top of the spring.

- What is the maximum kinetic energy $E_{\text{kin,max}}$ of the block?
- What is the maximum compression s_{max} of the spring?
- At what compression s is the block's kinetic energy half its maximum value?

4. 2D Collision

A particle with mass m_1 has initial speed v_0 . It collides with a second particle with mass m_2 that is at rest, and is deflected through an angle θ_1 . Its speed after the collision is v . The second particle recoils, and its velocity makes an angle θ_2 with the initial direction of the first particle.

- Show that

$$\tan \theta_2 = -\frac{v \sin \theta_1}{v_0 - v \cos \theta_1}.$$

- Show that if the collision is elastic and $m_1 = m_2$, then $v = v_0 \cos \theta_1$.