

FYSP101 PHYSICS I

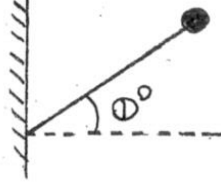
FINAL EXAM March 6, 2009

Use: $g = 9.8 \text{ m/s}^2$

1. Jill drops a stone down from a sheer cliff of height 10 m. At the same instant Tom throws a baseball straight up from the foot of the cliff at initial speed $v_0 = 8 \text{ m/s}$. You can neglect the air resistance.

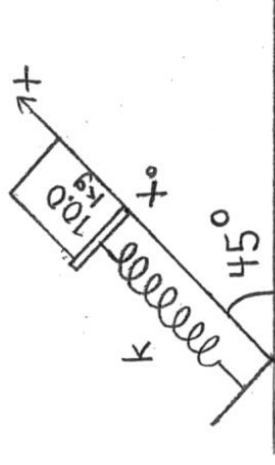
- (a) How much time after the drop of the stone has elapsed when the stone and the ball hit each other?
- (b) At which height the stone and the ball hit each other?
- (c) Also Mary from the neighborhood wants to do the collision experiment with Jill. Mary throws the ball at speed $v_0 = 5 \text{ m/s}$ towards the dropping stone. What will happen?

2. A 5.0-kg metal sphere swings at the end of a string of length 1.0 m in the Earth's gravitational field. The sphere starts its swing at rest at an angle $\theta_0 = 30^\circ$, as shown in the adjacent figure. You can neglect the air resistance.



- (a) What is the speed of the sphere at $\theta = 0^\circ$?
- (b) How much work does the tension of the string do during the transition $\theta = 30^\circ \rightarrow 0^\circ$?
- (c) Determine the tension of the string at $\theta = 0^\circ$.

3. A harmonic spring of force constant k is placed on an inclined frictionless plane as shown in the figure. The first-year physics students performed the following experiments with the spring.



- (a) The students measured the value of k by letting a 10.0-kg block compress the spring very slowly. The measured maximum compression was 20.0 cm. What was the value of the force constant?
 - (b) In their next experiment the students placed the 10.0-kg block at point x_0 , as shown in the figure. The point x_0 corresponds to the contact with uncompressed spring. The students now released the block and let it slide down the plane. Determine the maximum compression of the spring.
 - (c) Find the maximum compression of the spring if in (b) the kinetic friction between the block and the plane was $\mu = 0.2$.
4. A block of mass M collides at speed $v_0 = 5.0 \text{ m/s}$ elastically with a block of mass m , at rest on a smooth horizontal surface. Let $M \gg m$.
- (a) Find the speeds of the blocks just after the collision.
 - (b) How far from the point of collision the blocks slide, given that the kinetic friction between the blocks and the surface is $\mu = 0.2$?