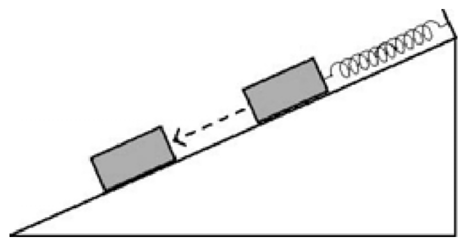
Conservation of Energy
Concept Questions

Question 1: A block of inertia m is attached to a relaxed spring on an inclined plane. The block is allowed to slide down the incline, and comes to rest. The coefficient of kinetic friction of the block on the incline is μ_k. For which definition of the system is the change in total energy (after the block is released) zero?



1. block
2. block + spring
3. block + spring + incline
4. block + spring + incline + Earth

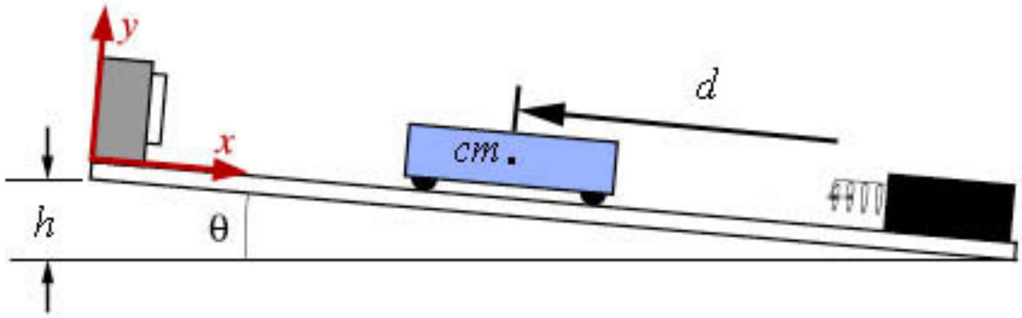
Question 2: (Note the slight notation change, using $h_{\max}$ instead of h_m.)

A spring-loaded toy dart gun is used to shoot a dart straight up in the air, and the dart reaches a maximum height $h_{\max}$. The same dart is shot straight up a second time from the same gun, but this time the spring is compressed only half as far before firing. How far up does the dart go this time, neglecting friction and assuming an ideal spring?

a) $h_{\max}$
b) $h_{\max}/2$
c) $h_{\max}/4$
d) $2h_{\max}$
e) $4h_{\max}$
f) The dart escapes to infinity.

Question 3

An object of mass m slides down a plane that is inclined at an angle θ from the horizontal. The object starts out at rest. The center of mass of the cart is an unknown distance d from an unstretched spring with spring constant k that lies at the bottom of the plane. Assume the inclined plane to be frictionless. The spring compress a distance x when the mass first comes to rest? Find an expression for the distance d.



1. $d = \frac{1}{2mg\sin\theta} k x^2 - x$

2. $d = \frac{1}{2mg\sin\theta} k x^2$

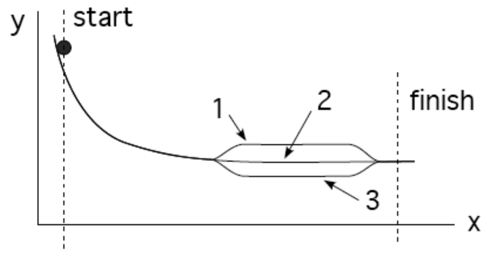
3. $d = \frac{1}{2mg} k x^2 - x\sin\theta$

4. $d = \frac{1}{2mg} k x^2$

5. $d = \frac{1}{2mg\sin\theta} k x^2 + x$

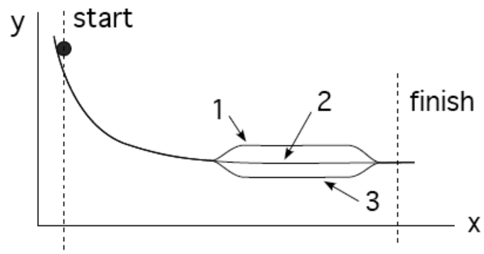
6. $d = \frac{1}{2mg} k x^2 + x\sin\theta$

Question 4: Marble Run A marble starts from rest and slides down hill. Which path leads to the highest speed at the finish?



1) 1
2) 2
3) 3
4) all result in the same final speed

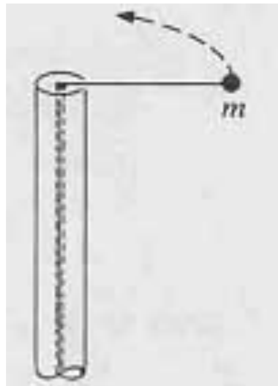
Question 5 Marble Run Shortest Time A marble starts from rest and slides down hill. Which path results in the shortest time to the finish?



1) 1
2) 2
3) 3
4) all result in the same final speed

Question 6 Conservation Laws 1

A tetherball of mass m is attached to a post of radius by a string. Initially it is a distance r_0 from the center of the post and it is moving tangentially with a speed v_0. The string passes through a hole in the center of the post at the top. The string is gradually shortened by drawing it through the hole. Ignore gravity and any dissipative forces. Until the ball hits the post,



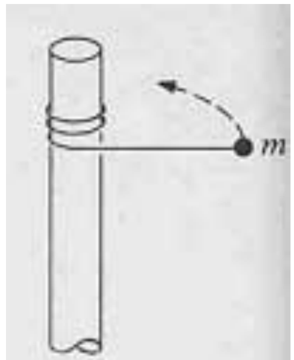
1. The kinetic energy of the ball is constant.

2. The kinetic energy of the ball changes.

3. Not enough information is given to determine whether the kinetic energy of the ball changes or not.

Question 7 Conservation Laws 2

A tetherball of mass m is attached to a post of radius R by a string. Initially it is a distance r_0 from the center of the post and it is moving tangentially with a speed v_0. The string wraps around the outside of the post. Ignore gravity and any dissipative forces. Until the ball hits the post,



1. The kinetic energy of the ball is constant.

2. The kinetic energy of the ball changes.

3. Not enough information is given to determine whether the kinetic energy of the ball changes or not.

Question 8 Trolley

A streetcar is freely coasting (no friction) around a large circular track. It is then switched to a small circular track. When coasting on the smaller circle its linear speed is

1. greater
2. less.
3. unchanged.