

Physics 101: Lecture 10

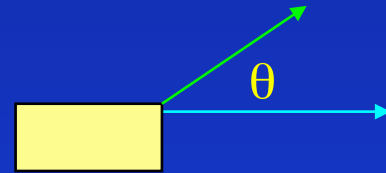
Potential Energy & Energy Conservation

- Today's lecture will cover Textbook Sections 6.5 - 6.8

Review

- Work: Transfer of Energy by Force

- $W_F = |\mathbf{F}| |\mathbf{d}| \cos\theta$



- Kinetic Energy (Energy of Motion)

- $K = \frac{1}{2} mv^2$

- Work-Kinetic Energy Theorem:

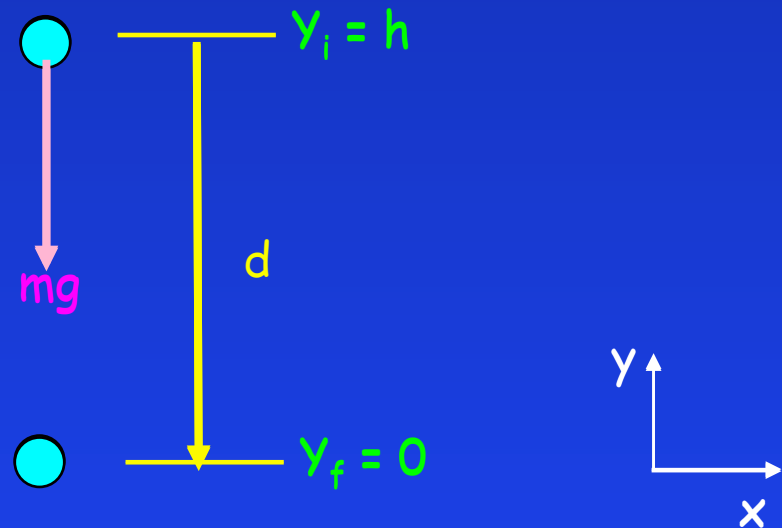
- $\Sigma W = \Delta K$

Preview

- Potential (Stored) Energy U

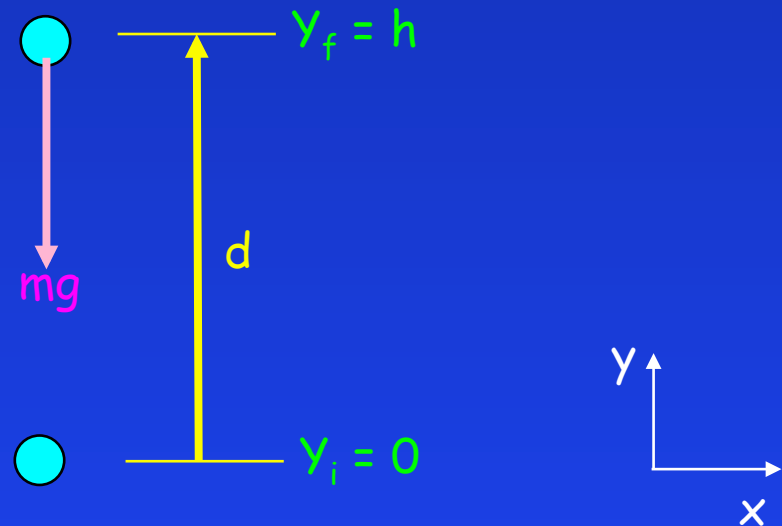
Work Done by Gravity 1

- Example 1: Drop ball



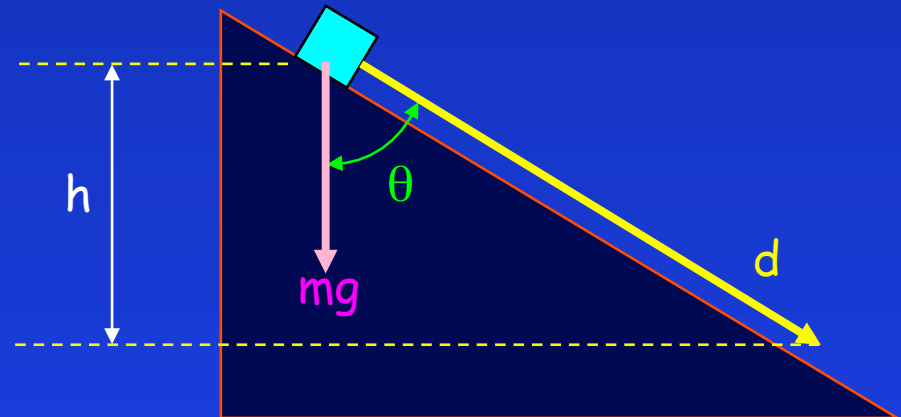
Work Done by Gravity 2

- Example 2: Toss ball up



Work Done by Gravity 3

- Example 3: Slide block down incline



Work and Potential Energy

- Work done by gravity independent of path

➤ $W_g = -mg\Delta y = -mg(y_f - y_i)$

- Define $U_g = mgy$

- Works for any **CONSERVATIVE** force

- Modify Work-Energy theorem

$$\sum W_{nc} = \Delta K + \Delta U$$

Conservation ACT

Which of the following statements correctly define a Conservative Force:

- A. A force is conservative when the work it does on a moving object is independent of the path of the motion between the object's initial and final positions.
- B. A force is conservative when it does no net work on an object moving around a closed path, starting and finishing at the same point.
- C. Both of the above statements are correct.
- D. Neither of the above statements is correct.

Skiing Example (no friction)

A skier goes down a 78 meter high hill with a variety of slopes. What is the maximum speed she can obtain if she starts from rest at the top?

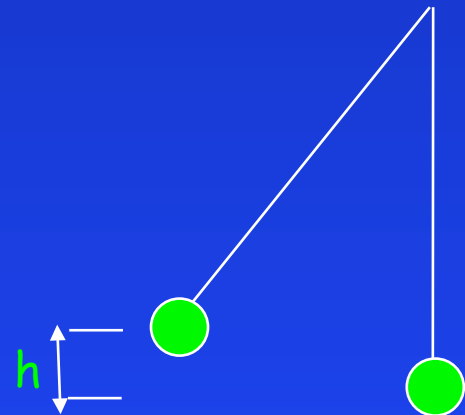


Pendulum ACT

- As the pendulum falls, the work done by the string is

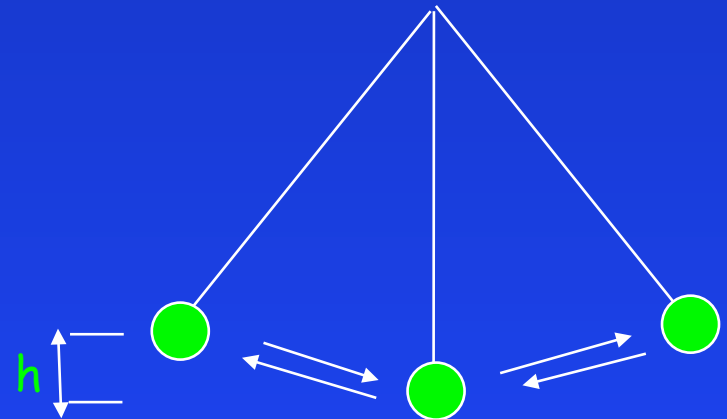
1) Positive 2) Zero 3) Negative

How fast is the ball moving at the bottom of the path?



Pendulum Demo

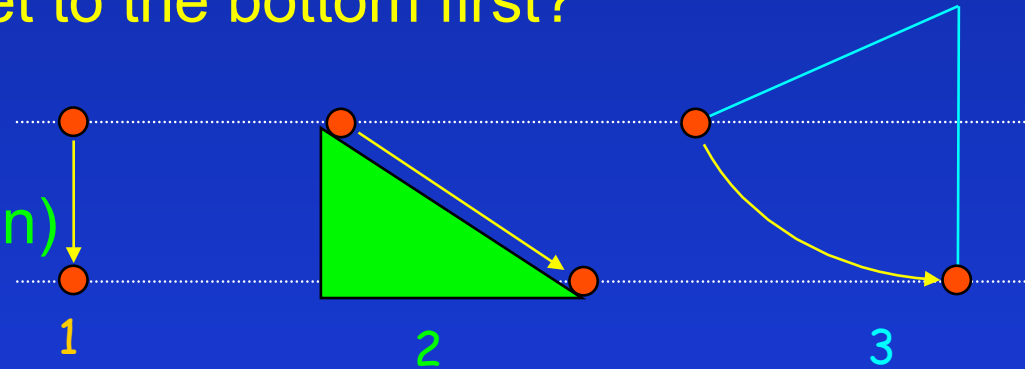
With no regard for his own personal safety your physics professor will risk being smashed by a bowling ball pendulum! If released from a height h , how far will the bowling ball reach when it returns?



Lecture 10, Preflight 1

Imagine that you are comparing three different ways of having a ball move down through the same height. In which case does the ball get to the bottom first?

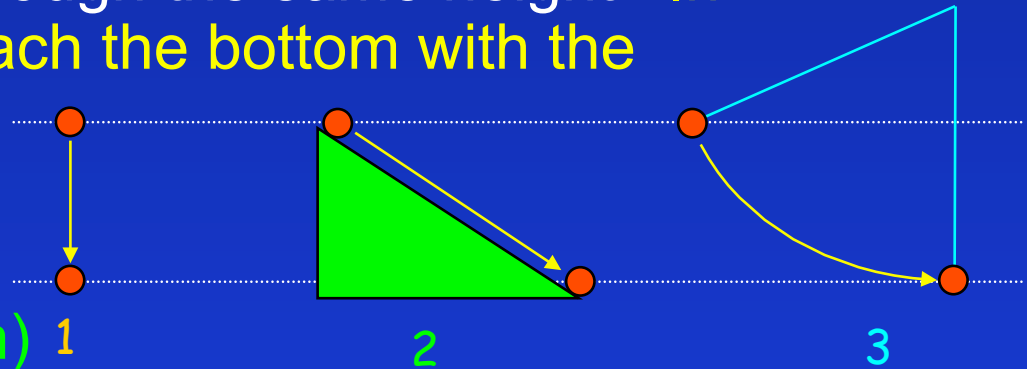
- A. Dropping
- B. Slide on ramp (no friction)
- C. Swinging down
- D. All the same



Lecture 10, Preflight 2

Imagine that you are comparing three different ways of having a ball move down through the same height. In which case does the ball reach the bottom with the highest speed?

1. Dropping
2. Slide on ramp (no friction)
3. Swinging down
4. All the same



Skiing w/ Friction

A 50 kg skier goes down a 78 meter high hill with a variety of slopes. She finally stops at the bottom of the hill. If friction is the force responsible for her stopping, how much work does it do?



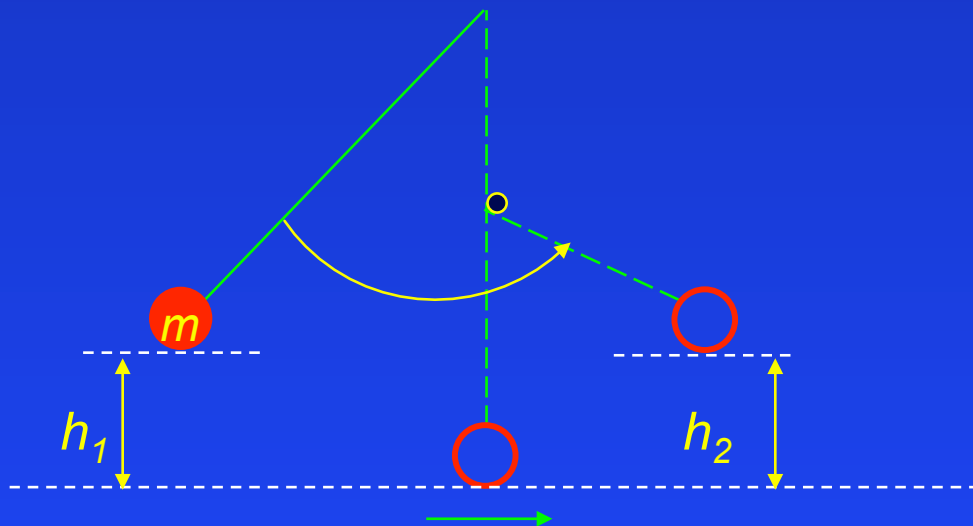
Galileo's Pendulum ACT

How high will the pendulum swing on the other side now?

A) $h_1 > h_2$

B) $h_1 = h_2$

C) $h_1 < h_2$



Power (Rate of Work)

- $P = W / \Delta t$

- Units: Joules/Second = Watt

- How much power does it take for a (70 kg) student to run up the stairs in 141 (5 meters) in 7 seconds?

Summary

➤ Conservative Forces

» Work is independent of path

» Define Potential Energy U

$$\blacksquare U_{\text{gravity}} = m g y$$

$$\blacksquare U_{\text{spring}} = \frac{1}{2} k x^2$$

➤ Work – Energy Theorem

$$\sum W_{nc} = \Delta K + \Delta U$$