If you leave a 100 W bulb on all day, how much does it cost?

In CO, Excel charges about 10 cents per kW*hr.

Note: A kiloWatt-hour (kWh) is a unit of energy (Power x time).

A) Less than a penny
B) A couple of cents
C) About a quarter
D) Over $2
E) ???

**Spring 2014**

**PHYS-2010**
**Guest lecturer:**
**Dr. Michael Dubson**

**Lecture 28 - Momentum**

## Announcements:

- Written HW Fri.
- There is a prelab this week!

- Reading **Giancoli Ch 7**.
  (7.1- .6 this week)

*Want to explore teaching?*
*This **Fall 2014** consider…*

**Step 1: EDUC 2020 (1 credit)**

- Teaching kids in Elementary school
- Scholarships, fellowships and internships available

CU Boulder Teach
Science & Mathematics

**http://cuteach.colorado.edu/**

Elevator #1 can lift mass m up distance h in time t. Its power output is $P_1$.

Elevator #2 can lift mass 2m up distance 2h in time t. What is $P_2$?

A) $P_1$ B) $2P_1$ C) $4P_1$
D) Something else

Elevator #1 can lift mass m up to the top of a building at speed v. Its power output is $P_1$.

Elevator #3 can lift the same mass m up the same building at twice the speed. What is $P_3$?

A) $P_1$ B) $2P_1$ C) $4P_1$
D) Something else

A spring loaded dart gun shoots a dart up 3 m.

If you compress the spring twice as much, how high will it go? (neglect friction)

A) 6 m
B) 9 m
C) 12 m
D) .75 m (i.e. ¼ as high)
E) Something else!

The same gun is loaded with the original stretch, But is now aimed at $45^0$ above horizontal.
Will it reach the same height?
(neglect friction)

A) Yes
B) No

Collisions and momentum

Let's define a new quantity,

a measure of "oomph":

Momentum p = mv

It's a vector! $\vec{\mathbf{p}} = m\vec{\mathbf{v}}$

CLAIM (to be proven later)

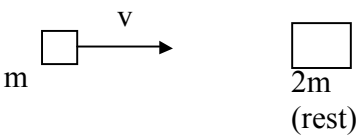
For isolated systems (even with internal friction), total momentum is conserved.

$$\vec{\mathbf{p}}_{\text{tot}} = \sum_i \vec{\mathbf{p}}_i = \sum_i m_i \vec{\mathbf{v}}_i = \text{const}$$

(for isolated system)

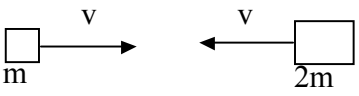
In which situation is the magnitude of the total momentum the largest?

**I:**




A) I B) II C) Both same!

**II:**



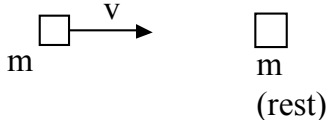
In which situation is the magnitude of the total momentum the largest?

A) I

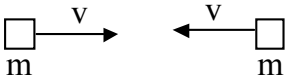
B) II

C) Both same!

**I:**




**II:**




For isolated systems (even with internal friction), total momentum is conserved.

What happens *after* the collision shown?


A) Both stop dead

B) They bounce and return at equal/ opposite speeds

C) Not enough information to decide!

## ELASTIC COLLISIONS

$\Delta KE = 0$, total KE is conserved

## INELASTIC COLLISIONS

Some KE is lost (to heat, or deformation)

TOTALLY INELASTIC COLLISIONS:

Objects stick together, lots of KE is lost!

A car is sitting on the surface of the Earth and both the car and the Earth are at rest. (Pretend the Earth is not rotating or revolving around the Sun.) The car then accelerates to a final velocity.

After the car reaches its final velocity, the magnitude of the Earth's momentum is _____ the magnitude of the car's momentum.

A) more than B) the same as C) less than
D) Not enough info to answer!

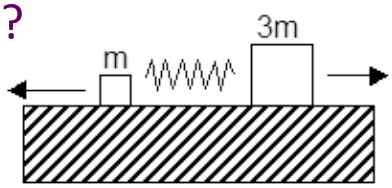
$m_1$ and $m_2$ approach each other on a frictionless table and collide.
Can all the KE of both masses be converted to heat during the collision?

A) Yes, no matter what the momenta are

B) Yes, depending on the momenta!

C) No, never

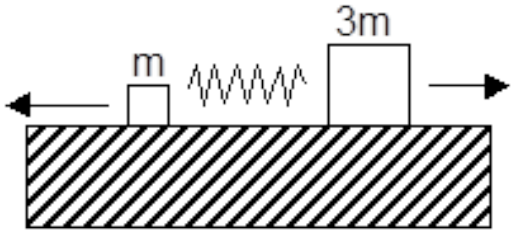
M and 3M are at at rest on a frictionless table. An ideal compressed spring between them expands, pushing them apart. The final speed of M is _____ the speed of 3M?




A) Equal to B) 2x C) 3x

D) 4x E) ???

In the previous question, the final KE of M is _____ the KE of 3M?




A) Equal to B) Greater than C) Less than