Phys141 – Fri 9/30

- **Today: Chapter 7+8 end**
- **Administrative:**

On Mon: Review of Ch 1-8

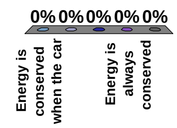
Exam next Wed: Review HW, labs, lecture notes
I put a "fake" HW on webassign that contains practice questions for Chapter 1-4 (you don't get points for it…)

I expect clickers by today! Please register them.

Next week: Lab # 6!!

Is energy conserved when a moving car hits a stationary car on an airtrack?

1. Energy is conserved when the carts collide elastically and bounce off each other
2. Energy is conserved if the carts stick after colliding and do not bounce
3. Energy is never conserved when two carts collide
4. Energy is always conserved
5. unsure



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Elastic Potential Energy

Work done by an external applied force on a spring-block system:
(define spring at rest: x=0)

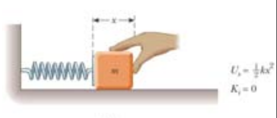
F=kx (Hooke's law for spring)

$W = \int F \bullet dr = \int (kx)dx$

$W = \frac{1}{2}kx^2$

-> elastic potential energy:
$U_s = ½\, kx^2$

(a)



(b)

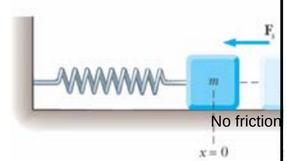
NOTE: Stored potential energy can be converted into kinetic energy

Force: Spatial Derivative of Potential Energy

$$F_x = -\frac{dU}{dx}$$

Spring potential Energy: $U_s = ½\, kx^2$

$$F_s = -\frac{dU_s}{dx} = -\frac{d}{dx}\left(\frac{1}{2}kx^2\right) = -kx$$



Kinetic Energy: $K = ½\, mv^2$ → F = ??

Gravitational potential Energy: $U=mgy$ → $F = \frac{dU}{dy} = mg$

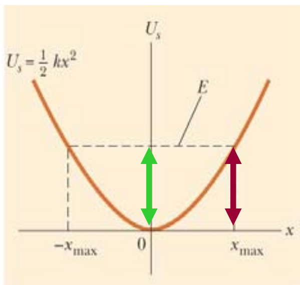
Interpreting Energy U(x)

At the point where U(x) is a minimum

-> *stable equilibrium*

i.e. no force exerted on object at x=0. Just above/below x=0 forces will push object back to x=0

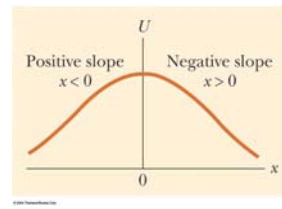
Object of energy E: two points xmin and xmax where all energy is potential energy, i.e. object does not move -> object moves between those two points



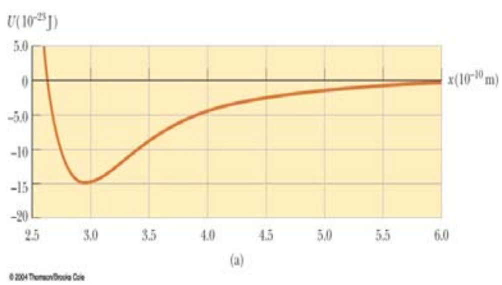
Another Energy Diagram

***U(x)* is a maximum**

-> *unstable equilibrium*



Potential Energy Curve of a neutral atom



- " Lennard-Jones function"

Potential Energy

There are many forms of potential energy, including:

- Gravitational U=mg Δr
- Elastic
- Electromagnetic
- Chemical
- Nuclear

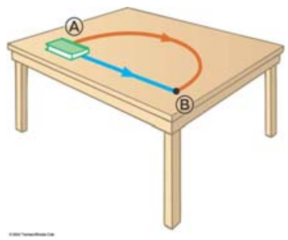
- All associated with ***conservative forces:***

"You always need the same work to get from A to B, no matter what path you take"

Nonconservative Forces

The work done against friction is greater along the red path than along the blue path

Because the work done depends on the path, friction is a nonconservative force

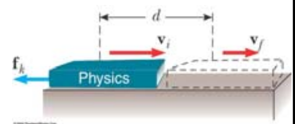


Internal Energy

Energy associated with an object's temperature: *internal energy*, E_{int}

Friction does work and increases the internal energy of the ***object and surface***

Drag does work and increases the internal energy of the ***object and surrounding fluid***



In practice, internal energy will **not** get converted back into useful work!

Mechanical Energy with nonconservative Forces

if friction is acting in a system:

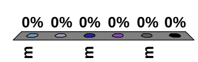
$\Delta E_{mech} = \Delta K + \Delta U = -f_k d$

ΔU is the change in all forms of potential energy

If friction is zero, this equation becomes the same as Conservation of Mechanical Energy

A cart on an air track is moving at 0.5 m/s when the air is suddenly turned off. The cart comes to rest after traveling 1 m. The experiment is repeated, but now the cart is moving at 1 m/s when the air is turned off. How far does the cart travel before coming to rest?

1. 1 m
2. 2 m
3. 3 m
4. 4 m
5. 5 m
6. impossible to determine



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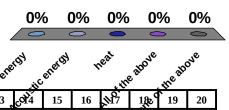
A rock is dropped into a metal basket. The gravitational potential energy (explained in detail later) gets converted into another form of energy which may get converted further. Which form(s) of energy are involved

1. Kinetic energy
2. Acoustic energy
3. heat
4. All of the above
5. None of the above



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Ways to transfer energy

- a) Work

- b) Mechanical Waves (for example sound waves)

- c) Heat

Ways to Transfer Energy

- d) Matter transfer

- e) Electrical Transmission

- f) Electromagnetic radiation

Power

Power = Rate of energy transfer
(energy transferred per unit time into/ out of system)

- In general, power can be expressed as

$$P = \frac{dE}{dt}$$

SI unit: Watt
1 watt = 1 joule / second = 1 kg · m^2 / s^2

- The ***power*** generated by work (due to a constant force) is

$$P = \frac{dW}{dt} = F \cdot \frac{dr}{dt} = F \cdot v$$