Physics 4810 / 7810 Week 11 (zoinks!)

Day 20: Fa2008:
Politics, Society and Physics

Rotatitonal Motion and Rigid Body

Eyes to web
Project DRAFT due in two weeks
Draft can be various levels of finished
--- more you provide me, more response you get

Our Class Norms…

- Again, potentially charged topics
- Please focus on ideas, not people
- CONSTRUCTIVE critiques are the best
- It is okay & encouraged for you to differ with:
  - Authors
  - Professor
  - And maybe each other…
- Debate, Dissent, and Discussion are patriotic ;)

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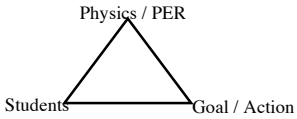
Silent Lie

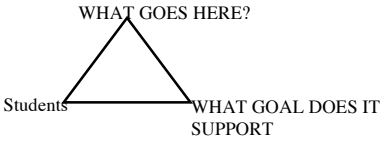
- What is the silent lie for:
  - Fish
  - Mahajan
  - Bartlett
- What are their stated goals?

Mediation

- Tools mediate (allow for thought) thought



How would BARTLETT/MAHAJAN/FISH change physics?



Context

- Context is the collection of components and the relations among them – the connected whole which includes constituent elements *and* the relations among them.
- Birdwhistell uses the analogy of a rope to develop such a notion of context:

Context as Rope

The fibers that make up the rope are discontinuous; when you twist them together you don't make them continuous, you make the thread continuous .... even though it may look in a thread as though each of those particles[fibres] are going all through it, that isn't the case... Obviously, I am not talking about the environment. I am not talking about inside and outside. I am talking about the conditions of the system

(Birdwhistell as quoted in R. McDermott 1993, p. 274).

Practice this

I leave my house lights on over night, how much money did I waste (hint: you pay approx. 10cents /(kW*hr))

Energy = power*time = 100W * 8 hrs = 800 W*hr = 0.8 kW*hr.

Since you pay about $0.10 for each kW*hr, that's about 8 cents. No big deal. Does this mean energy is cheap?

More Practice

- What if I have to produce this energy 0.8 kW*hrs?

Assume I am about 1/10th of a horse
0.1 horsepower running on a treadmill
1 hp = 750 Watts.
So I produce about 75 Watts.
For how long to get 800 Watt - hrs?
(more than the amount of time I left the bulb on!)
Is energy still cheap?
[I'm willing to pay you 8 cents to do this]

Exponential growth

- Al Bartlett contends, "The greatest shortcoming of the human race is our inability to understand the exponential function."

Orders of Magnitude / Exponential Growth

- How much will a hamburger cost in 2052?
- When will we run out of fossil fuels?
- How long does it take to charge a flash?
- How close do circuit components have to be to take advantage of / avoid quantum tunneling?

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Why OoM problems?

What can students / instructors learn?

Estimation / Orders of Magnitude

- Useful if you don't have exact data
- Too complex a calculation -- simplify formula
- Gives **trends**

Simple growth (interest) vs. compounded.

- Every year I'll give you 15% simple interest on your $1000 of principle investment..for the next 50 years
- I.e. $150/year…. Or $7500
- What if I got interest on the interest?
  - i.e. Year two, I get 0.15*$1150…
- Or instantaneously!
  - $P(t) = P_o * e^{rt}$ where r = interest rate= 0.15, t=time
  - t = 50 years ---> r*t = 7.5 --> e^{rt} = 1808
  - P(50yrs) = $1000*$e^{rt}$ = $1,800,000 !!!!!

Solved by a simple equation

$P(t) = P_o * e^{rt}$
t = time =1yr r=growth rate 0.05 / yr

Time to double … ie. When is P(t)/Po = 2?
$\ln(P(t)/Po) = \text{Ln}(2) = \ln(e^{rt}) = rt$
0.69 = r x t
Rule of 70: 70/(percent rate) = t= time to double

e.g. 3 % growth/year => 27 years to double
a $7.50 hamburger costs $30 in ~54 years.
If it were 6% -> doubling time = 70/6 = 13 years
a $7.50 hamburger costs $120 in 52 years

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OoM problems

- What makes an OoM problem physics?
- Share with each other your OoM problems
- What makes a good problem?
- Can an OoM problem be political but apartisan?

Population example

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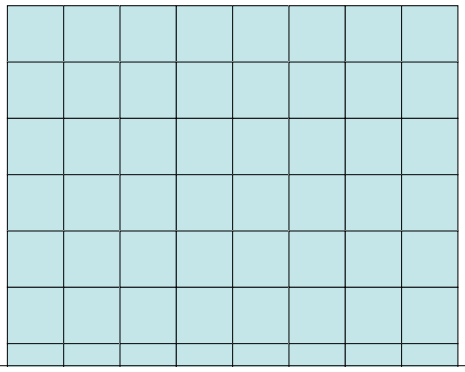
Bacteria in a bottle
Bacteria divide once every minute
Start at 11AM
At noon the bottle is filled

- What time is it when the bottle 1/2 full?
- What time is it when the bottle is 1/32 full?
- Three adventurous bacteria are sent out to find new bottles at 11:55. They find 3 new bottles!!! Quadrupling all known space for bacteria.
- How much more time did they buy themselves?

A graphical example



Real-world example

- Let us look at some current approximate, data (1997).

	United States	World
Population	270 million	5700 million
Annual increase	3 million	90 million
Annual growth rate	1 % per year	1.6 % per year

What's the doubling time?

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Is this an issue?

- 70 years seems like a while?
- Are we sustainable right now?
- Think about food and non-renewable energy for example.

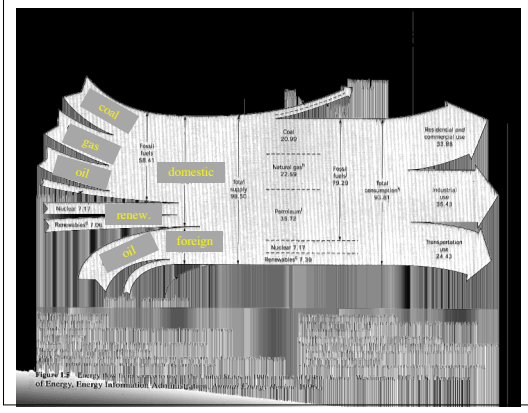
Energy & Environment Phys 3070

http://www.colorado.edu/physics/phys3070

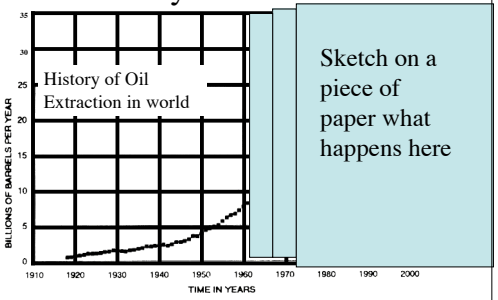
- Loads of data at:
  www.eia.doe.gov (energy information administration)

- Global coal USE is about 100 QBtu/yr = 5E9 ton/year
- Global coal *reserves* are estimated (high end est.) at 20,000 Qbtu
- Global fossil fuel USE is about 400 QBtu/yr
- Global oil *reserves* are estimated (high end est.) at 10,000 Qbtu

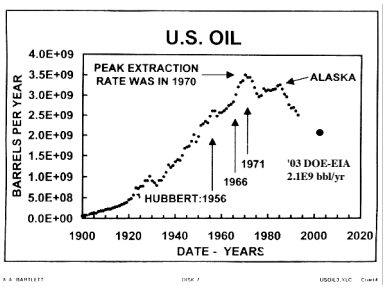
- US coal USE is 20 QBtu/yr = 1E9 ton/year
- US fossil fuel USE is about 100 QBtu (of which 40 is petroleum)



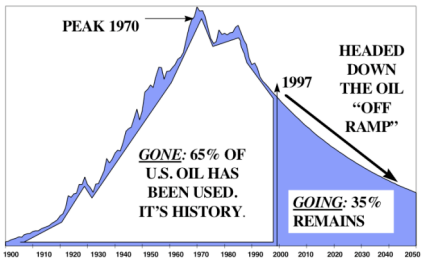
History of Oil Use



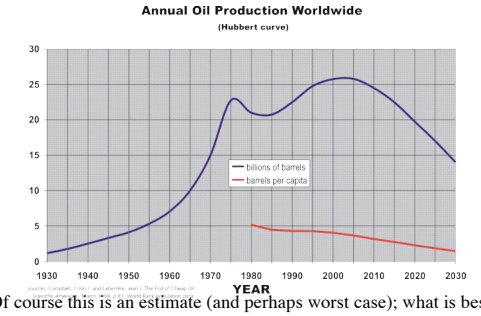
What about US oil?



U.S. Oil Curves

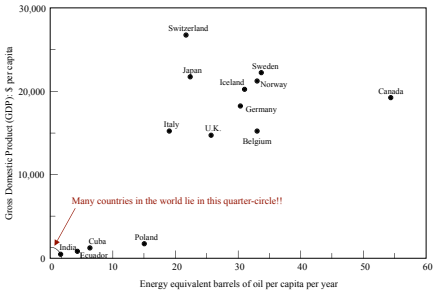


What does this mean?



Of course this is an estimate (and perhaps worst case); what is best case?

How does the US use energy?



What is inevitable?