

WEDNESDAY OCT 7th

TODAY: TEST #2 followed by **GROUP WORK**
(plus next segment of “Saved by the Sun” video)

ANNOUNCEMENTS:

The **MIDTERM EXAM** is 1 week from TODAY:
on **WEDNESDAY Oct 14th**

A complete study guide w/ practice Qs will be posted by Friday
Preceptor/TA **STUDY SESSIONS NEXT WEEK** on Mon & TUE

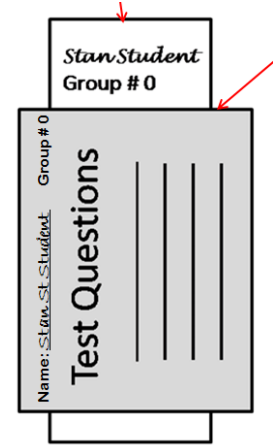
→ MONDAY’S CLASS on OCT 12TH
BE THERE!

We’ll be starting an important new topic,
PLUS there will be practice Q’s and info
about the **MIDTERM EXAM**

RE-CAP of Individual Test procedure when you are finished:

✓ Double check to be sure your **NAME & GROUP #** are on **BOTH** the **TEST & ANSWER FORM**.

✓ Insert the **ANSWER FORM (name & Group # visible)** inside your folded **TEST** to hide your answers like this →



✓ **THEN** raise your hand & a TA will collect BOTH items from you

✓ **Maintain ABSOLUTE classroom silence** while others are finishing their tests. **NO** talking, texting & **NO LEAVING THE CLASSROOM**, etc.

✓ While waiting for others to finish, you may do the following **IN SILENCE**:

- (1) Snooze, daydream, THINK (!) . . . or plan your weekend
- (2) Read the Wildcat, etc. (but no **CLASS MATERIALS** allowed) – and **absolutely NO PHONES & NO TEXTING!**

OK, time to put yourselves in . . .

Silent Mode



GROUP TEST RECAP:

Every member of your group should have a chance to scratch!

The position of the star moves from box to box and line to line so you can't "explore" to try to find it!

If you accidentally scratch off a box on the wrong line it counts! **BE CAREFUL!!!!**

If-At Answer Form

	A	B	C	D	Score
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	_____
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

You may use an INDEX CARD (provided) to keep yourself from scratching on the wrong line






Please don't write on the card & return it with your group answer form

After you are done with the Group Test complete: (1) G-2 and (2) the half-page form

(1) DISCUSS & RANK the Energy Generating Sources & fill in your rankings on the short form:



Types of Electricity-Producing Power Sources
RANK THEM: #1 = Most Efficient #4 = Least Efficient

- burning fossil fuel (coal) for electricity _____  
- sunlight to electricity in a solar panel _____ 
- hydro power turbines _____ 
- wind turbines _____ 

(2) ENTER YOUR GROUP'S FOOTPRINT RESULTS on back →
Team Competition TBA after Midterm
(Give to a TA when completed)

ECOLOGICAL FOOTPRINT RESULTS: GROUP # _____

NAME	# Planets Needed	Global Acres needed	Tons of CO ₂ Produced
1			
2			
3			
4			
Calculate Your GROUP AVERAGE:			
USA Average	5	22.1	23

**OK
CLASS
TIME**



CHECKPOINT

TEST #2 Recap


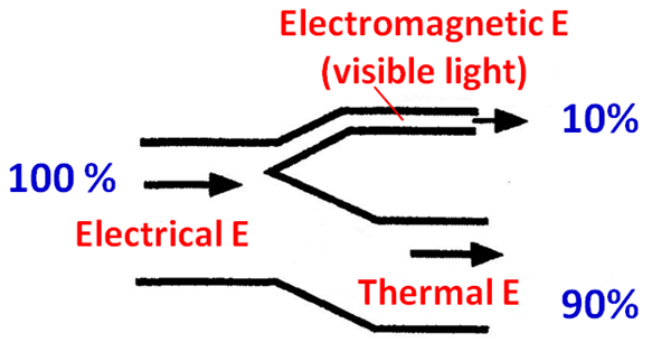

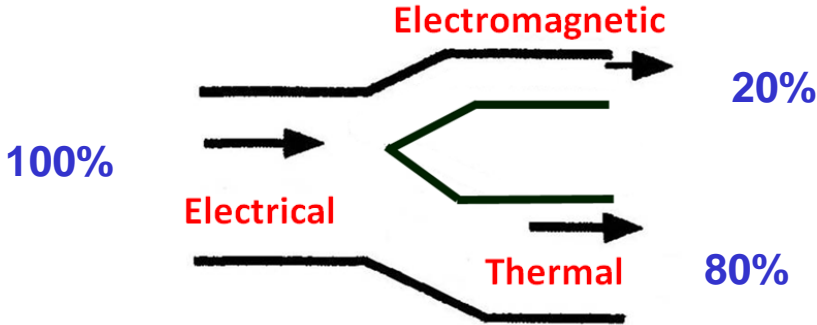

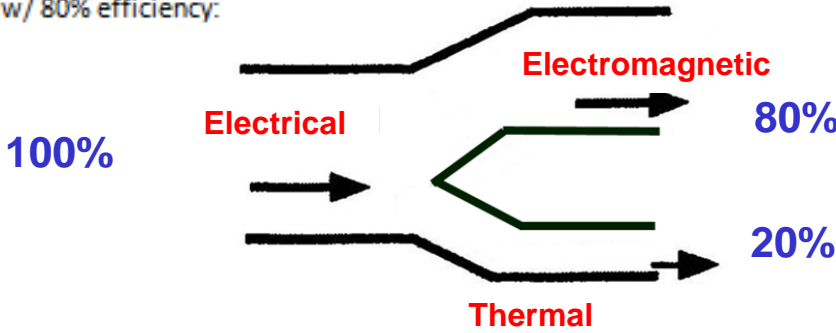
EASIEST Q?

HARDEST Q?

(what tripped you up?)

Any remaining fuzziness?

G-2 ENERGY EFFICIENCY THE ANSWERS

	<p>Diagram for Incandescent bulb</p> 	<p>3</p>
	<p>Diagram for CFL bulb:</p> 	<p>2</p>
	<p>Diagram for LED w/ 80% efficiency:</p> 	<p>1</p>



Common 60W
Incandescent Bulb

uses 60W per bulb
for 800 lumens

1 bulb lasts 1,200 hrs

20 years = 21 bulbs

An **INCANDESCENT BULB** uses heat caused by an electrical current. When electrical current passes through a wire, it causes the wire to heat. The wire, or filament, gets so hot that it glows and gives off **VISIBLE LIGHT**.

In a **CFL**, an electric current is driven through a tube containing argon gas and a small amount of **mercury** vapor. This generates UV radiation that excites a fluorescent coating (called phosphor) on the inside of the tube, which then emits **VISIBLE LIGHT**.



Common 14W
CFL Bulb

uses 14W per bulb
for 800 lumens

1 bulb lasts 10,000 hrs

20 years = 3 CFL bulbs



Source: <http://www.energystar.gov/>

2 Japanese and 1 American Share Nobel in Physics for Work on LED Lights

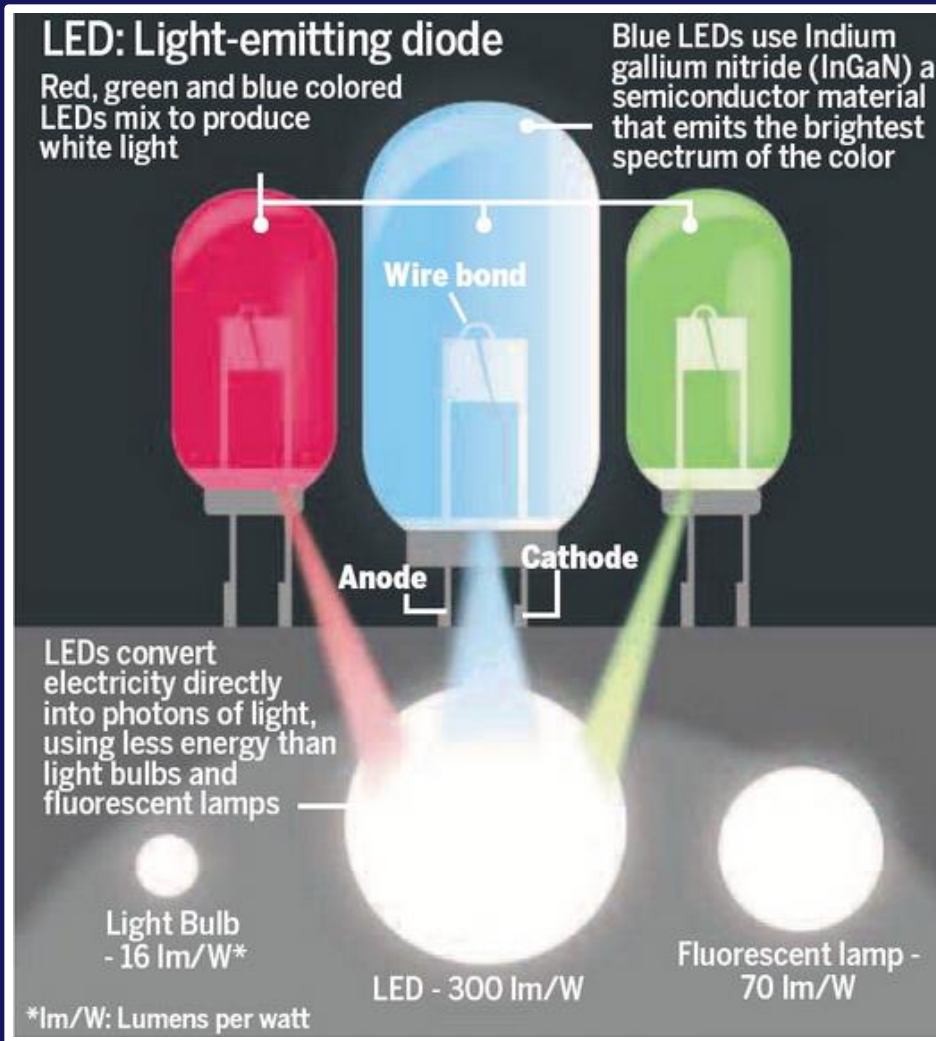


From left, the researchers Isamu Akasaki, Hiroshi Amano and Shuji Nakamura were awarded the Nobel Prize in Physics for “the invention of efficient blue light-emitting diodes, which has enabled bright and energy-saving white light sources.” Randall Lamb/Agence France-Presse — Getty Images

“They succeeded where everyone else had failed,” the academy said.

Their work has spurred the creation of a whole new industry. The committee that chose the winners said light-emitting diodes, or LEDs, would be the lighting source of the 21st century, just as the incandescent bulb illuminated the 20th.

LED Light Bulbs



uses 12.5W per bulb
for 800 lumens

1 bulb lasts 25,000 hrs

20 years = 1 LED bulb



“LEDs convert electricity directly into photons of light. . .”

uses 12.5W per bulb
for 800 lumens

1 bulb lasts 25,000 hrs

20 years = 1 LED bulb



An **LED** is what's called a "solid-state lighting" technology, or SSL.

Instead of **emitting light from a vacuum** (as in an incandescent bulb) or a **gas** (as in a CFL), an SSL **EMITS LIGHT** from a piece of **SOLID MATTER** (a semiconductor.) An LED produces **light when electrons move around within its semiconductor structure**. (i.e., motion in the QUANTUM world!)

Because LED lighting systems don't radiate heat, **the heat produced from the power going into the product must be drawn away from the LEDs**. This is usually done with a heat sink, that absorbs the heat produced and dissipates it into the surrounding environment.

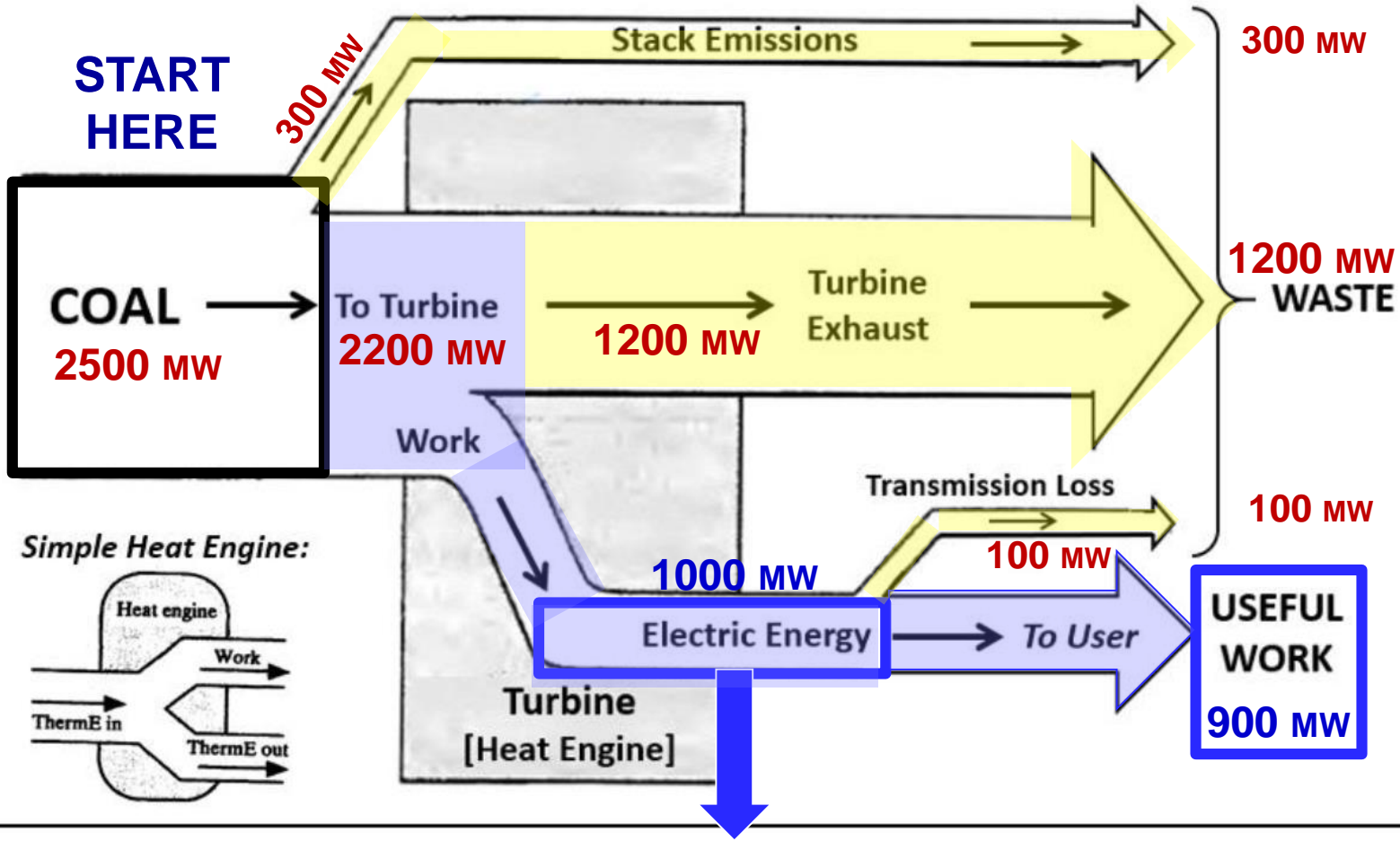
Thermal management is probably the single most important factor in the successful performance of an LED product over its lifetime

<http://electronics.howstuffworks.com/led1.htm>

ENERGY TRANSFORMATIONS & THE COAL POWER PLANT

MW = megawatt

Complex Heat Engine:

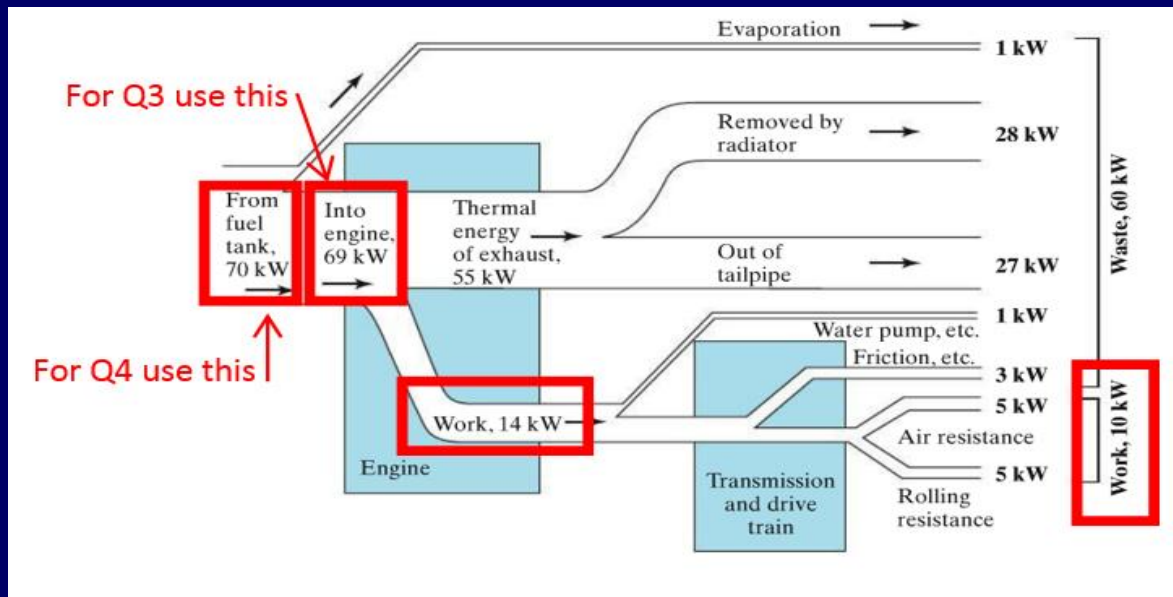


Energy Efficiency of ELECTRICITY GENERATION = 40%

Energy Efficiency of PRODUCING USEFUL ELECTRICITY = 36%

(900 MW electrical energy produced ÷ 2500 MW in coal fuel = 0.36 = 36%)

G-2



Q1. What % of the energy in the fuel going into the engine does work running the engine? **20%** = Engine's Energy Efficiency (*rounded*)

$$14 \text{ kW (engine work)} \div 69 \text{ kW (from fuel into engine)} = 20.29\%$$

p 100

Q2. What % of all the energy in the fuel eventually does “work” that moves the car (by overcoming air resistance and rolling resistance)? **14%** = Overall Energy Efficiency of the Automobile (*rounded*)

$$10 \text{ kW (moving work)} / 70 \text{ kW (from fuel into engine)} = 14.29\% \quad \text{p 42}$$

NOTE : kW values on p 100 are old and have been updated – see p 42 values from lecture

Q5. Why are FREIGHT TRAINS more efficient?

- fewer stops and starts, once a force gets it moving, it stays moving, hence less fuel for acceleration fuel and deceleration is needed
- a small frontal area relative to the large load a long freight train carries (less air resistance)
- rolls on steel wheels on steel tracks, no “tire squeezing” and less rolling resistance
- Other?

Q6. Why is AIR FREIGHT the LEAST efficient mode?

- huge amount of jet fuel (force) needed at take-off PLUS fuel needed to keep the plane in the air in addition to accelerating it forward at high speeds
- amount of cargo a plane can carry is limited and the heavier the cargo weight, the more fuel needed
- Other?

Q7. Why is BICYCLING more efficient than walking?

- wheels on a bicycle take advantage of the Law of Inertia and keep rolling once started by pedaling
- walking requires you to start and stop your legs with each step (lots of acceleration which requires a force and therefore requires you to do work.
- Other?

Q 8. Suggest ways to promote energy efficiency and reduce the amount of pollution and greenhouse gases entering the atmosphere due to transportation.

- **Enact fuel efficiency standards**
- **Use incentives to promote hybrids & electric vehicles**
- **Promote carpooling**
- **Encourage mass transit while discouraging cars**
- **Move freight by train instead of truck**
- **Plan cities that encourage walking, bicycling, and transit and discourage driving**
- **OTHER?**

TIME TO: Turn in your Short Form!

WHICH GROUP(S) GOT THE CORRECT RANKING?



Rank the Efficiency of Each Type of Electricity-Producing Power Source:

#1 = Most Efficient

- burning fossil fuel (coal) for electricity



Coal-fired electric power plant

- sunlight to electricity in a solar panel



Photovoltaic (PV) panel

- hydro power turbines



Hydroelectric plant

- wind turbines



Wind farm



ANSWER: Rank the Efficiency of Each Type of Electricity-Producing Power Source:

#1 = Most Efficient

#3 burning fossil fuel (coal) for electricity ~ **33-38%**



Coal-fired electric power plant

#4 sunlight to electricity in a solar panel ~ **20%** going **↑**



Photovoltaic (PV) panel

#1 hydro power ~ **85-90%** turbines



Hydroelectric plant

#2 wind turbines ~ **30-45%** **↑**



Wind farm



GROUP BONUS ACTIVITY

(up to 5 Bonus pts)



What to do: As a group, learn the reasons for these efficiency ratings and report back to the whole class the week after the Midterm . . .
(details to be posted in class follow up)

MORE OF



<http://www.pbs.org/wgbh/nova/solar/>

SEE YOU NEXT
MONDAY!