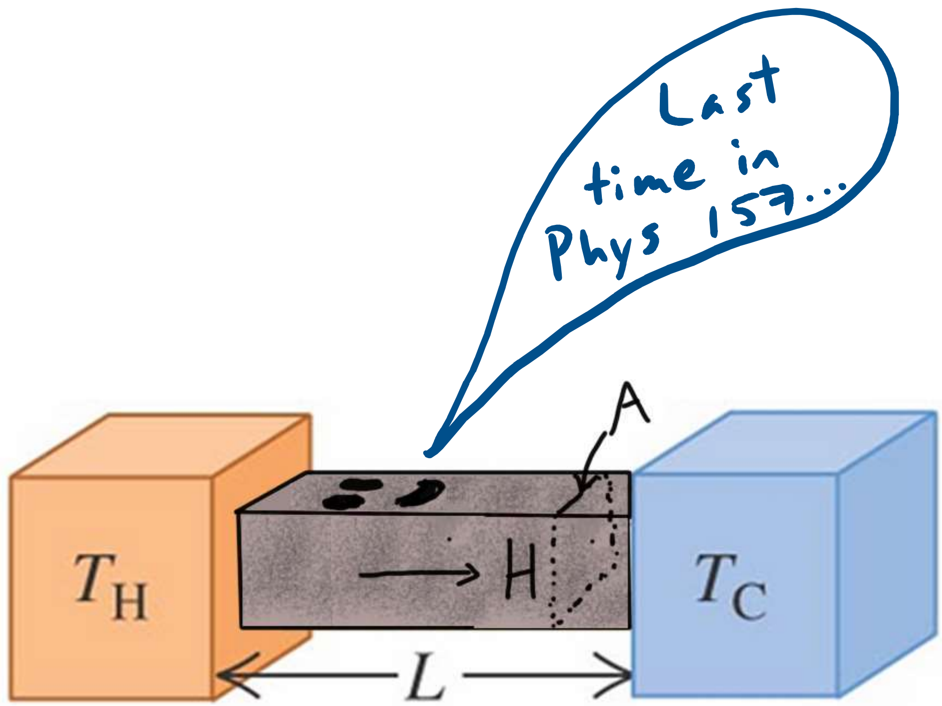
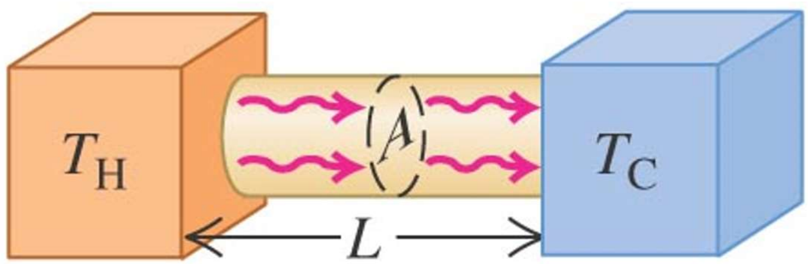

Last time in Phys 157...
A
T_H
H
T_C
L

THERMAL CONDUCTIVITY: Determines heat current from temperature gradient.



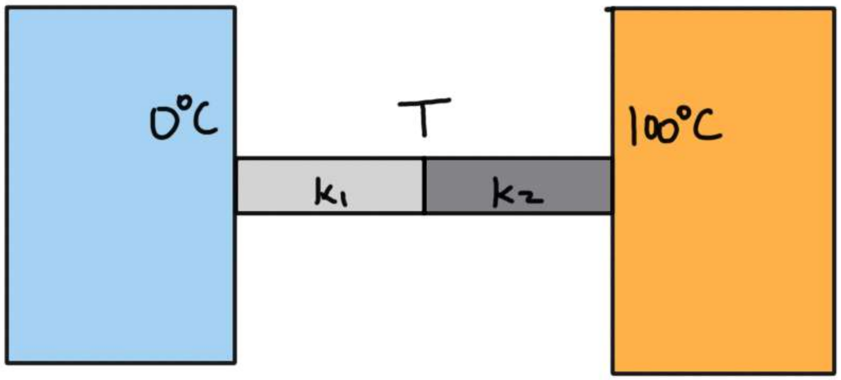
$$H = kA\underbrace{\frac{T_H - T_C}{L}}_{\text{temperature gradient}}$$

Heat current
"
Heat per time

Thermal conductivity

Homework sessions: Monday 5-7pm, Hennings 200
Tuesday 5-7pm, Hennings 202

Two materials of equal dimensions but different thermal conductivities are placed side to side between objects kept at 0ºC and 100ºC, and a steady heat flow is established. If $k_1 < k_2$, we can say that the temperature T in the middle is:



A) Equal to 50ºC

B) Greater than 50ºC

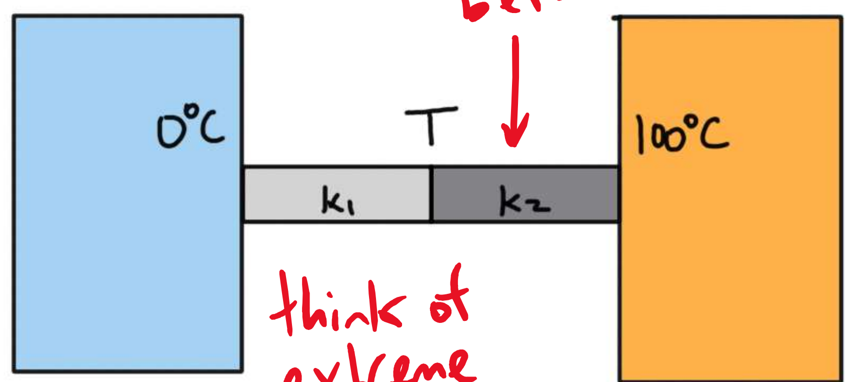
C) Less than 50ºC

EXTRA: How would you calculate the temperature.

Homework sessions: Monday 5-7pm, Hennings 200
Tuesday 5-7pm, Hennings 202

Two materials of equal dimensions but different thermal conductivities are placed side to side between objects kept at 0ºC and 100ºC, and a steady heat flow is established. If $k_1 < k_2$, we can say that the temperature T in the middle is:

better conductor



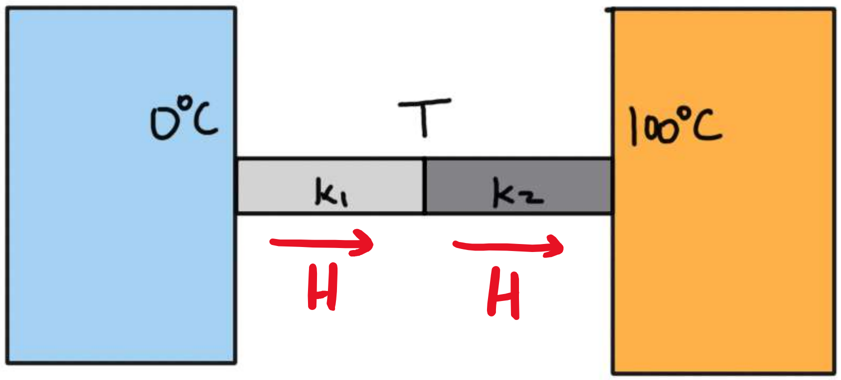
think of extreme case: if k_1 is an almost perfect insulator, T will be almost 100°C in steady state situation

A) Equal to 50ºC

B) Greater than 50ºC

C) Less than 50ºC

EXTRA: How would you calculate the temperature.



$k_1 < k_2$

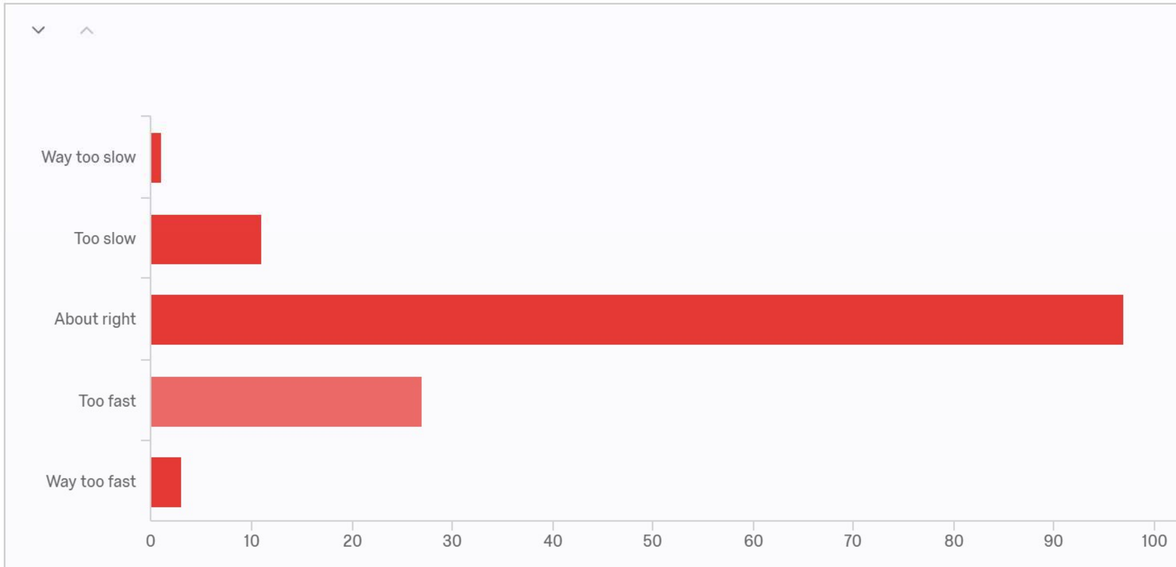
- H is the same for both parts.

- $H = k_1 \cdot A \cdot \dfrac{T - 0°C}{L} = k_2 \cdot A \cdot \dfrac{100° - T}{L}$

- $k_1 < k_2$ so $T - 0°C > 100°C - T$: T is closer to 100°

Q1 - The pace of the course is:

Page Optic

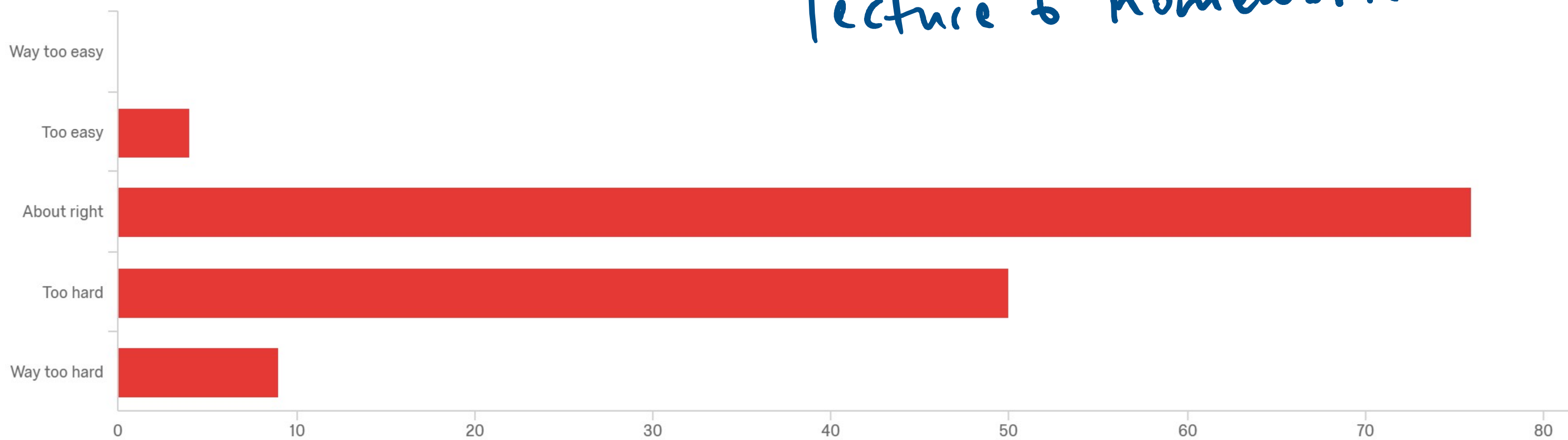


Q2 - The homework is:

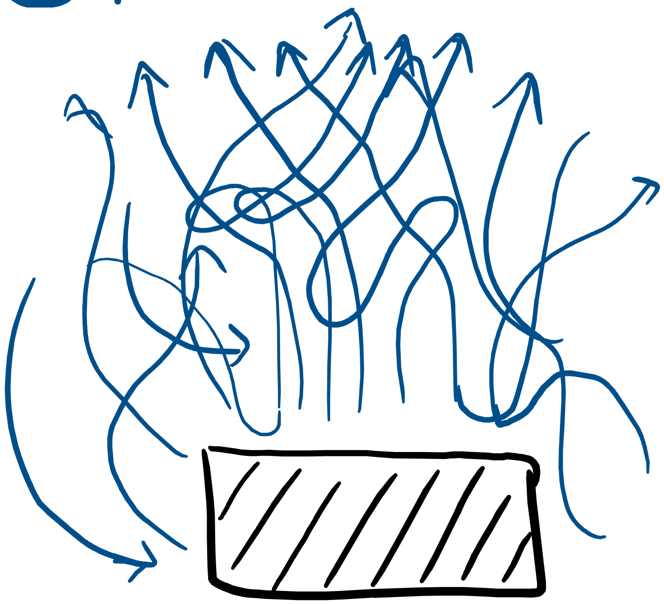
top Comments: tutorials could be improved

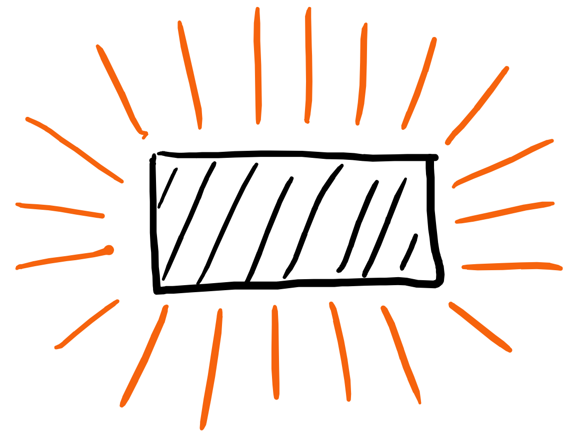
- more direct connection between lecture to homework.

Page Optio



Other mechanisms for heat transfer:





CONVECTION: heat transfer via macroscopic motion of fluids

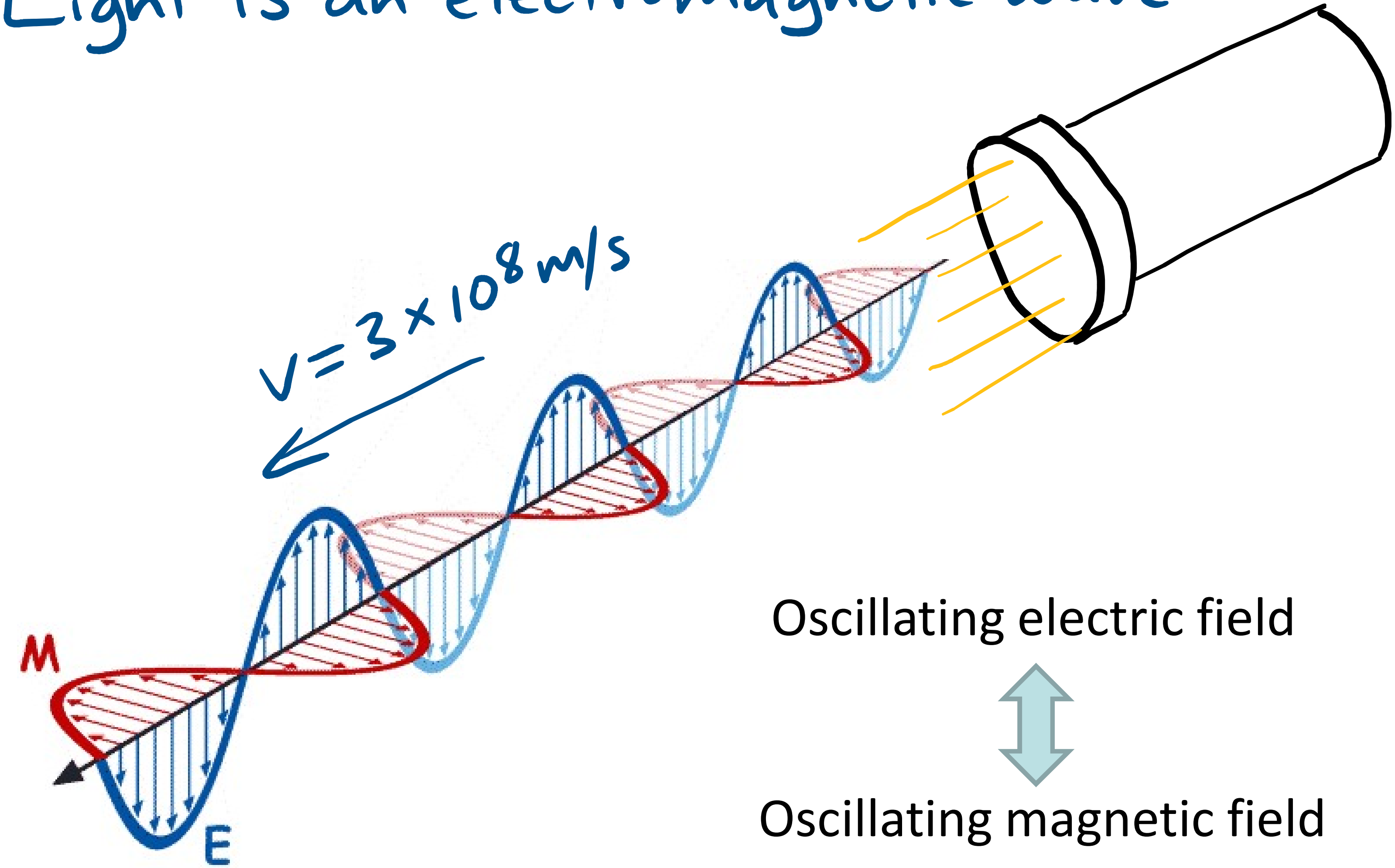
- very complicated fluid dynamics to understand

RADIATION: all objects give off electromagnetic radiation (light, IR, etc...)

- this carries energy away from the object

ELECTROMAGNETIC RADIATION:

Light is an electromagnetic wave:



Oscillating electric field

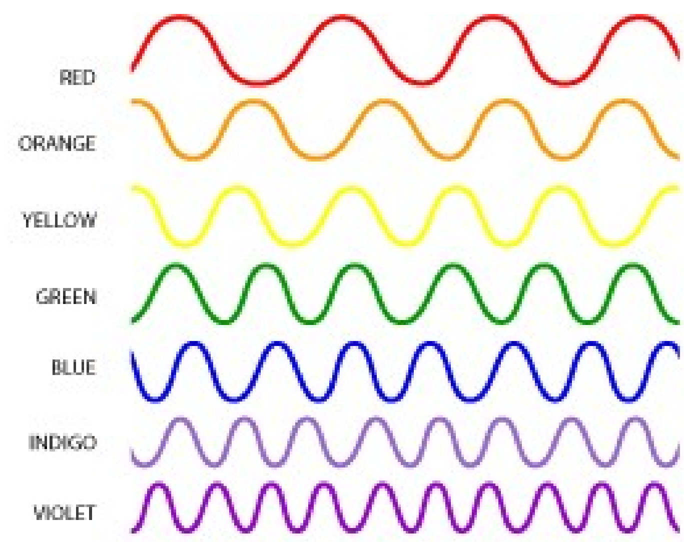
⇕

Oscillating magnetic field

James Clerk Maxwell 1864

Properties of Light

Colour: determined by wavelength



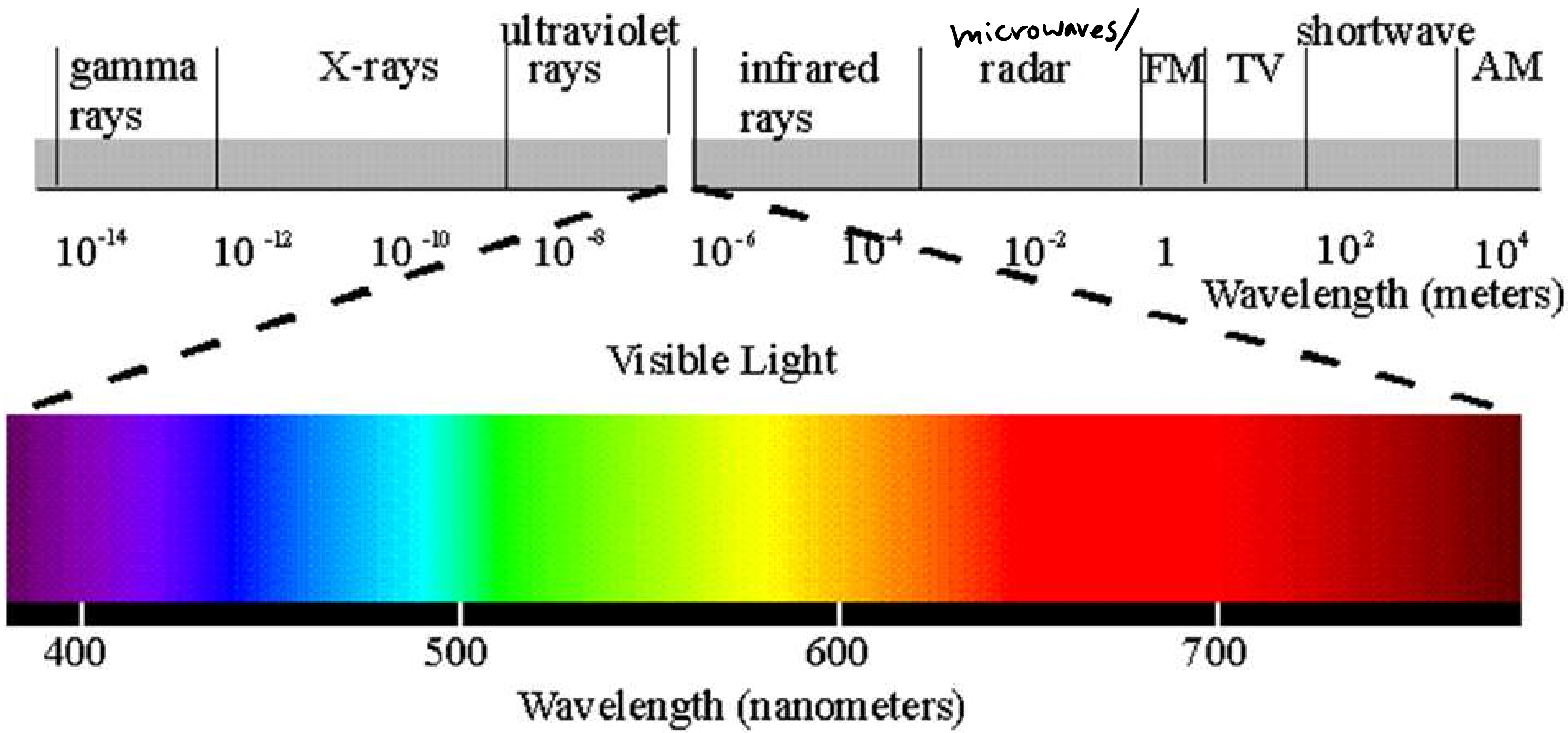
Intensity/brightness: determined by amplitude

↳ light carries energy!

Can have electromagnetic waves at all wavelengths:

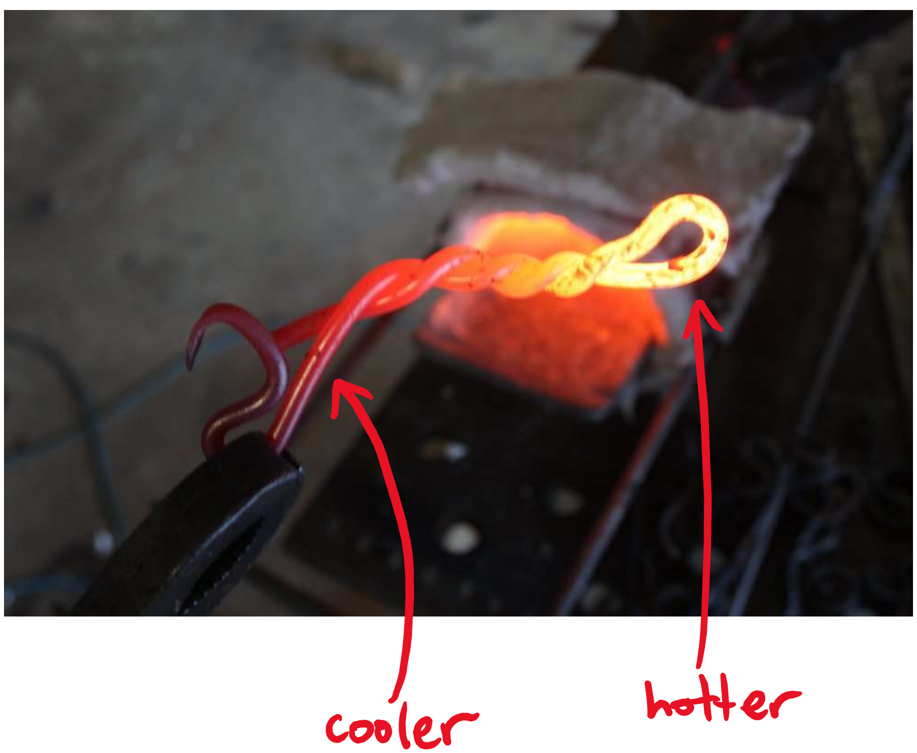
$v = 3\times10^8$ m/s

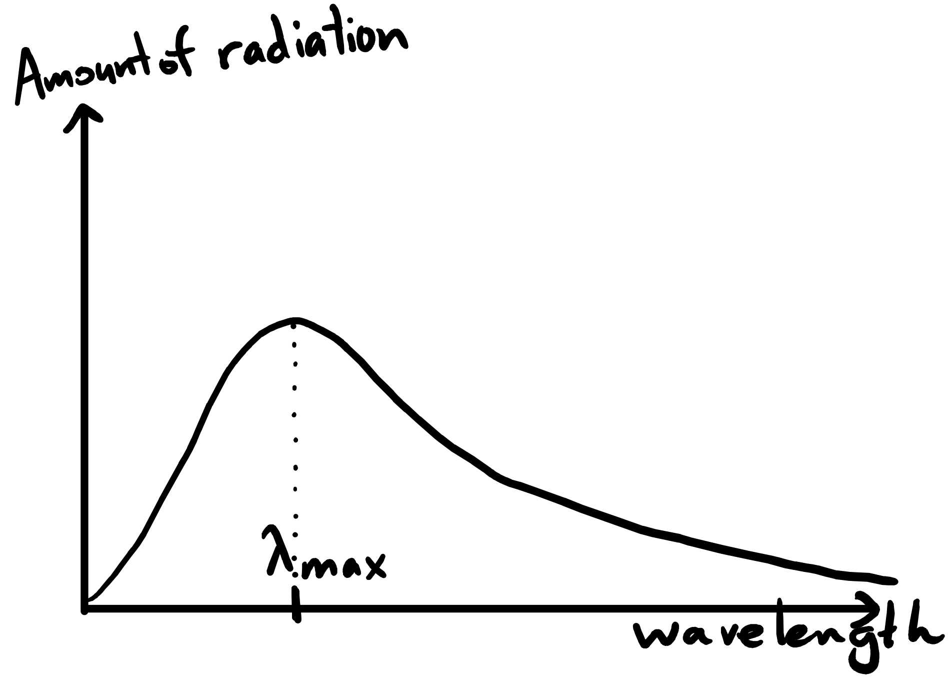
$v = 3\times10^8$ m/s

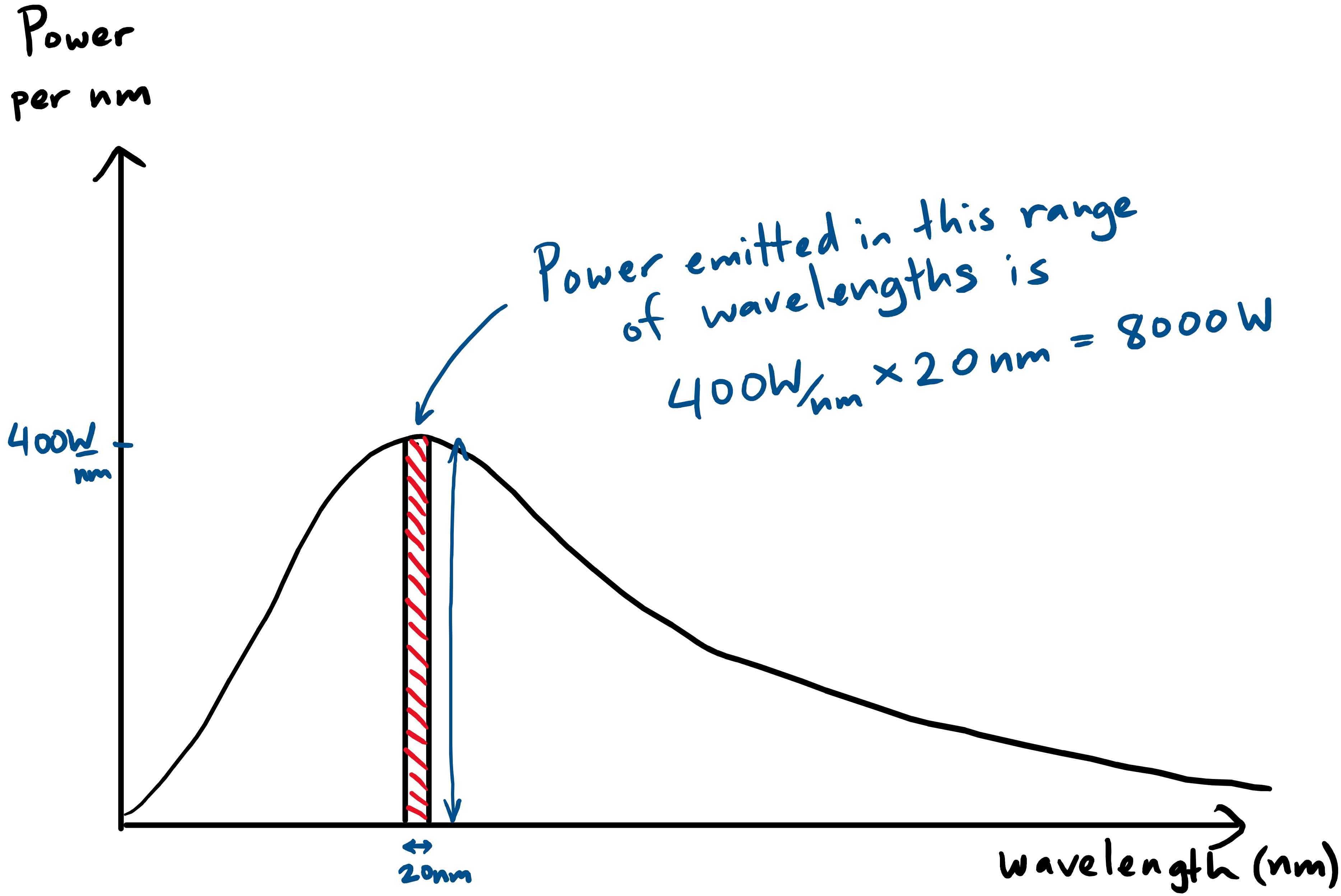


Thermal radiation from an object:

- typically in IR/visible
- can measure energy current at various wavelengths = spectrum



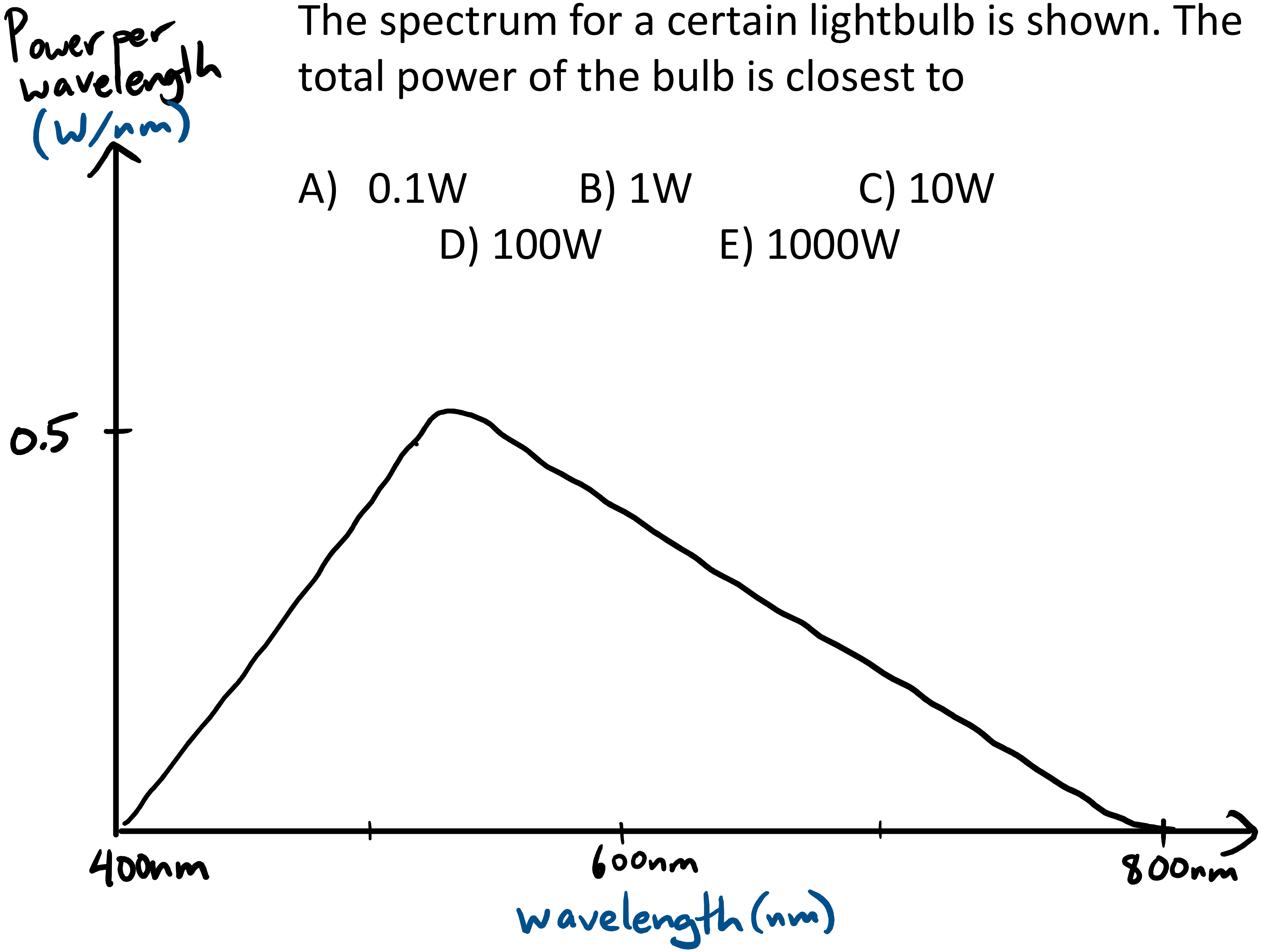




Power per nm
400W/nm
Power emitted in this range of wavelengths is
400W/nm × 20nm = 8000W
20nm
wavelength (nm)

The spectrum for a certain lightbulb is shown. The total power of the bulb is closest to

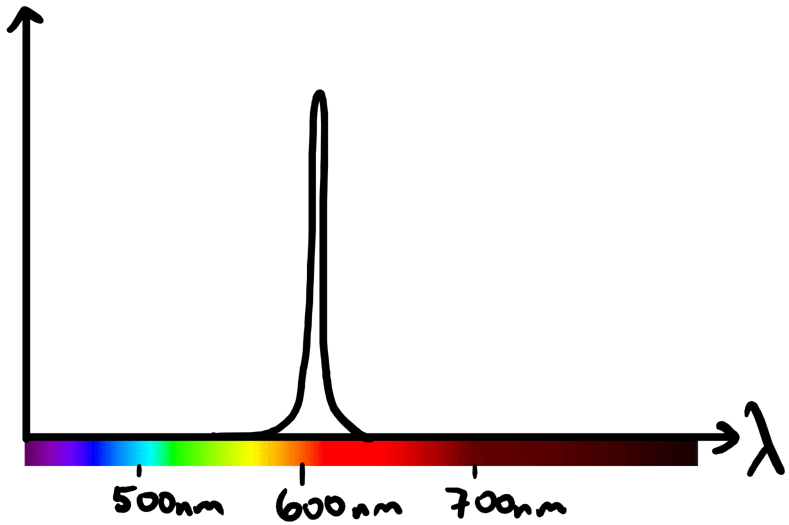
A) 0.1W B) 1W C) 10W D) 100W E) 1000W



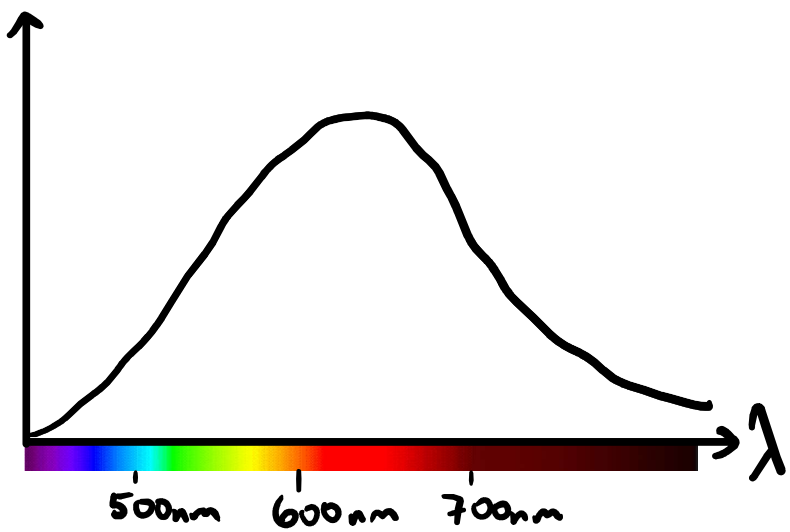
Which graph best represents the spectrum of radiation from the red hot ball in the picture?

from Youtube: 1000 Degree Metal Ball vs Milk

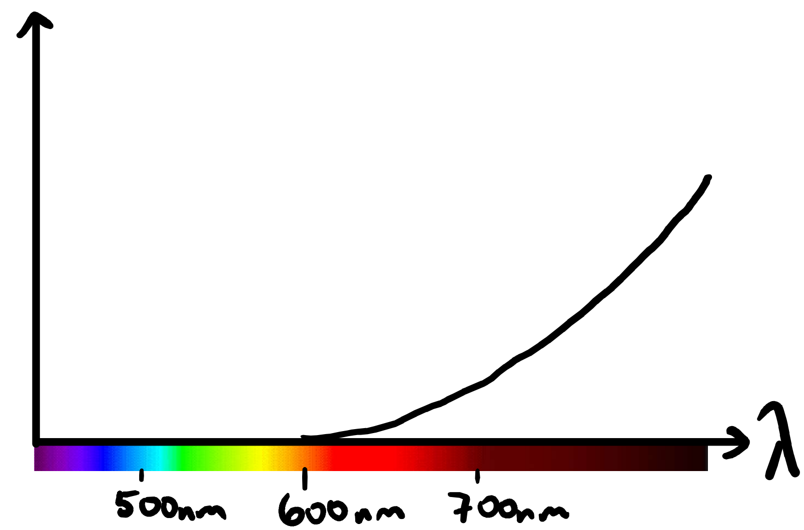
A)



B)



C)

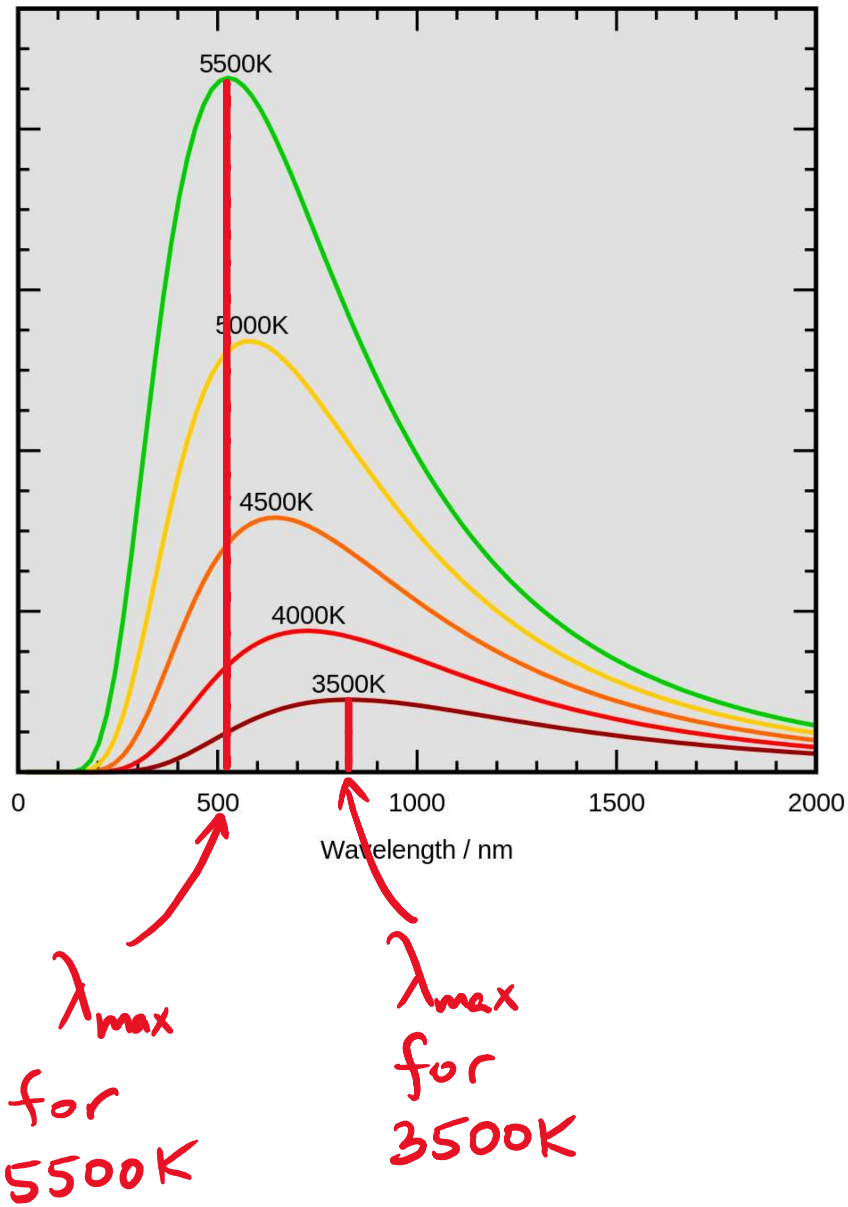


Blackbody spectrum

https://phet.colorado.edu/sims/blackbody-spectrum/blackbody-spectrum_en.html

In the simulation, what properties of the thermal spectrum change as we change the temperature?

Peak wavelength is inversely proportional to T

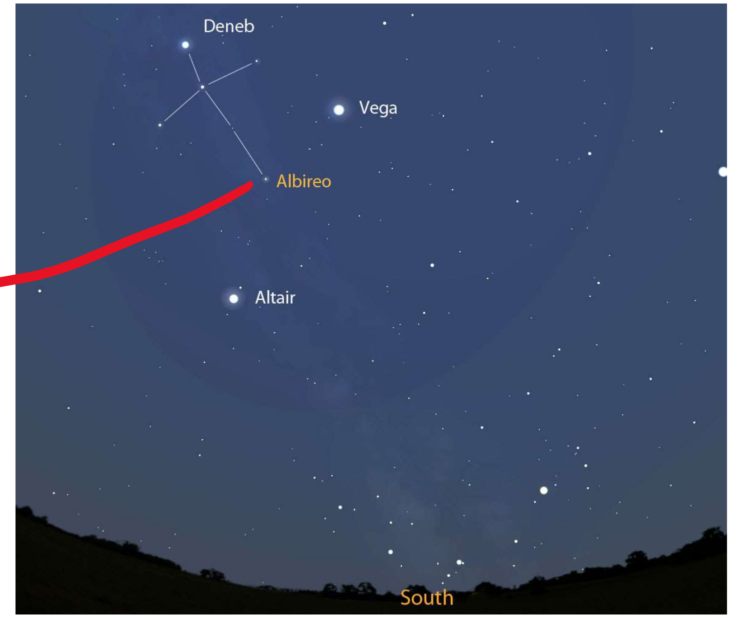


$$\lambda_{max} = \frac{b}{T}$$

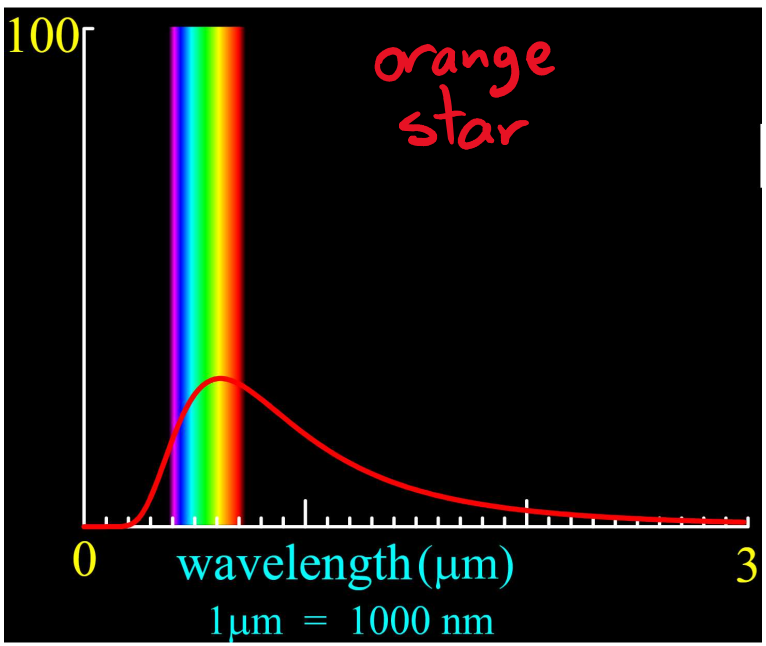
b = 2.9 K·mm

Wien displacement law

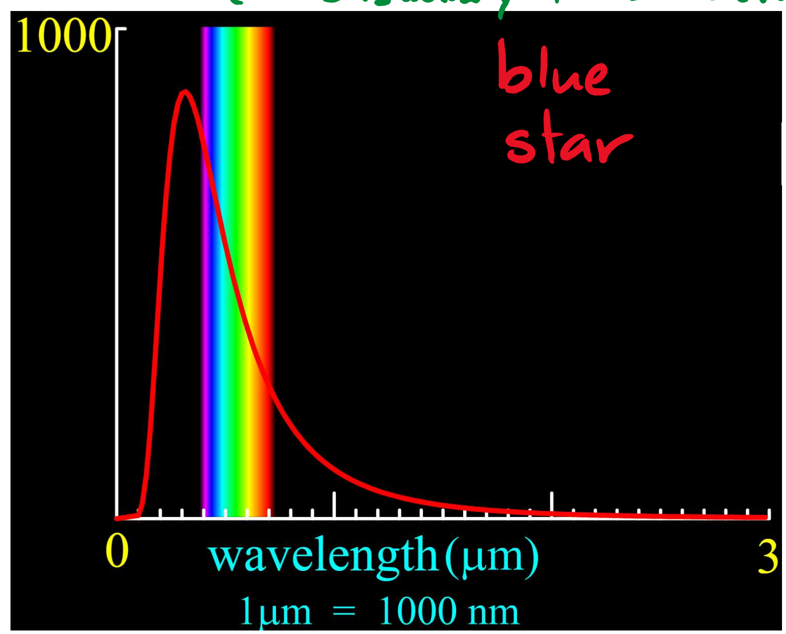
sun: peak at ≈500nm



(there is actually a third star we're ignoring!)



$T \approx 4500K$



$T \approx 12{,}000K$

Total Power From Thermal Radiation

heat current

surface area

$$H = A \cdot e \cdot \sigma \cdot T^4$$

emissivity

Stefan-Boltzmann constant

$5.67 \times 10^{8} \dfrac{W}{m^2 \cdot K^4}$

$e = 1$ perfect absorber (black)

$e = 0$ perfect reflector (mirror)