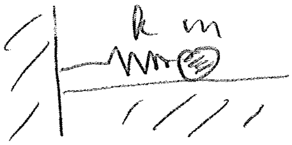
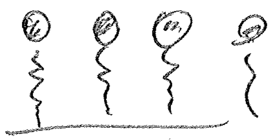


$$\frac{1}{2}kx^2 + \frac{1}{2}mv^2 = E$$

$$\bar{E} = \underline{kT}$$

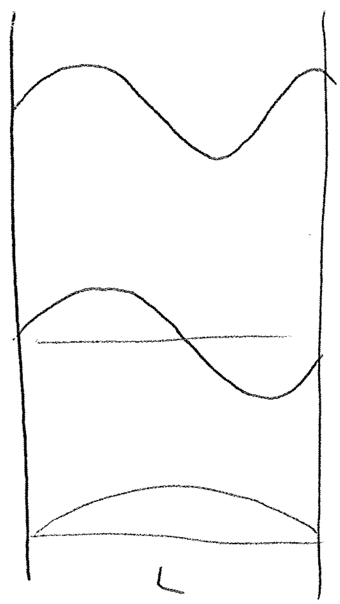
N



$$\underline{\bar{E} = NkT}$$

IF

$N \to \infty$ $\qquad$ $\bar{E} \Rightarrow \infty$

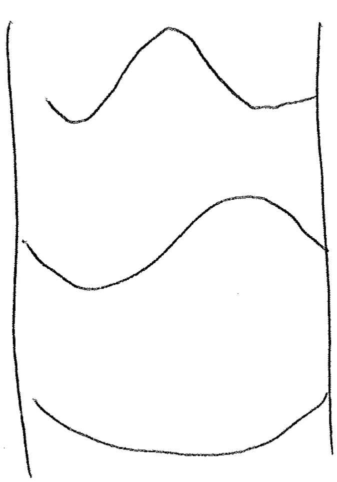


$E = E_0 \sin\left(\frac{3\pi}{L} x\right) \quad \lambda = \frac{2}{3} L$

$E = E_0 \sin\left(\frac{2\pi}{L} x\right) \quad \lambda = L$

$E = E_0 \sin\left(\frac{\pi}{L} x\right) \quad \lambda = L$

YOU COULD HAVE ALSO



$E = -E_0 \sin\left(\frac{3\pi}{L} x\right)$

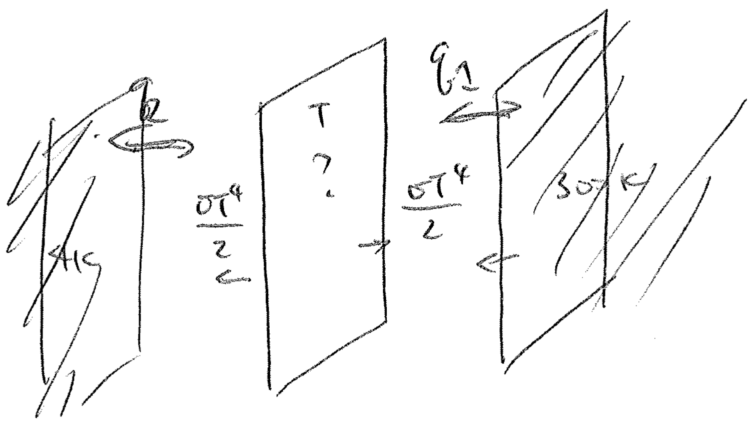
$E = -E_0 \sin\left(\frac{2\pi}{L} x\right)$

$E = -E_0 \sin\left(\frac{\pi}{L} x\right)$

BLACK BODY RADIATION

$$I_{TOTAL} = \sigma T^4$$ STEFAN BOLTZMANN LAW

$$\sigma = 5.67\times10^{-8}\ W/m^2\cdot K^4$$



$$\cancel{I_{TOTAL} = \sigma T^4}$$

$$\cancel{\frac{\sigma T^4}{2} = \frac{\sigma (4K)^4}{2}} =$$

$$q_2 = \frac{\sigma T^4}{2} - \frac{\sigma (4K)^2}{2}$$

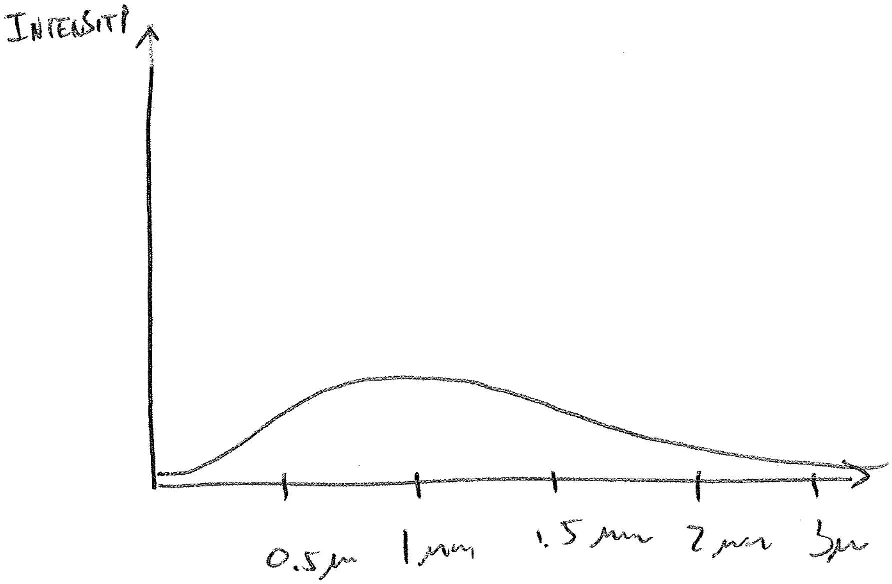
$$q_1 = \frac{\sigma (300)^4}{2} - \frac{\sigma T^4}{2}$$

$$\cancel{\sigma} T^4 = \frac{\cancel{\sigma}}{2}(300^4 - 4^4)$$

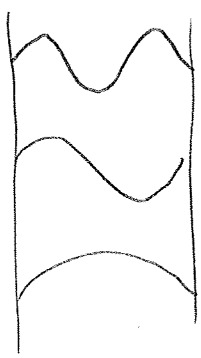
$$T^4 =$$

$$\boxed{T = 252\ K}$$

BLACK BODY RADIATION



CLASSICAL THEORY



$\bar{E} = kT$

$\bar{E} = kT$

$\bar{E} = kT$

LOTS OF OSCILLATORS

∞ ENERGY IF VERY SHORT WAVELENGTHS ARE ALLOWED

EACH OF THESE MODES ARE LIKE HARMONIC OSCILLATORS

WITH DIFFERENT λ

WAVE EQUATION

$$\frac{\partial^2 E}{\partial x^2} + \frac{\partial^2 E}{\partial y^2} + \frac{\partial^2 E}{\partial z^2} = \frac{1}{c^2}\frac{\partial^2 E}{\partial t^2}$$

$$E = E_0 \sin\left(\frac{n_x \pi}{L} x\right) \sin\left(\frac{n_y \pi}{L} y\right) \sin\left(\frac{n_z \pi}{c} z\right) \sin\left(\frac{2\pi c t}{\lambda}\right]$$

$$\downarrow$$

$$\left(\frac{n_x \pi}{L}\right)^2 + \left(\frac{n_y \pi}{L}\right)^2 + \left(\frac{n_z \pi}{L}\right)^2 = \left(\frac{2\pi}{\lambda}\right]^2$$

$$\downarrow$$

$$n_x^2 + n_y^2 + n_z^2 = \frac{4L^2}{\lambda^2}$$

NUMBER OF MODES AVAILABLE FOR λ

$$N = \frac{1}{8} \times 2 \times \frac{4\pi}{3} (n_x^2 + n_y^2 + n_z^2)^{3/2}$$

$$N = \frac{\pi}{3}\left(\frac{4L^2}{\lambda^2}\right)^{3/2} = \frac{8\pi L^3}{3\lambda^3}$$

AS λ IS ~~RAISED~~ GOES SMALLER MORE MODES ARE AVAILABLE

$$\frac{\partial N}{\partial \lambda} = -\frac{8\pi L^3}{\lambda^4}$$

MODES PER VOLUME PER UNIT WAVELENGTH $= -\frac{1}{L^3}\frac{dN}{d\lambda} = \frac{8\pi}{\lambda^4}$

EACH MODE MIGHT HAVE kT

NOW EACH MODE $\sim kT$

INTENSITY $\sim \frac{1}{\lambda^4} kT$ $\rightarrow$ ULTRAVIOLET CATASTROPHE