AP physics 2 notes Ch 26 – Relativity

$v = f\lambda$, $c = v = 3.0 \times 10^8\, m/s$

the speed of light is always the same in a vacuum, regardless of the speed of the object producing the light

$E = hf = \frac{hc}{\lambda} = pc$ this is the energy of a quantum of light, as light seen as a particle

$\Delta t = \frac{\Delta t_0}{\sqrt{1 - \frac{v^2}{c^2}}}$ Δt_0 = time for an observer at rest

time dilation is a relativistic effect that causes time for a person moving to move slower than for a person at rest.

$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$ Relativistic mass is the mass of the kinetic energy gained by the particle

$L = L_0\sqrt{1 - \frac{v^2}{c^2}}$ Relativistic length contraction.

$p = \frac{mv}{\sqrt{1 - \frac{v^2}{c^2}}} = \gamma mv$ Relativistic momentum $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$

$E = K + mc^2 = \gamma mc^2$ total energy of a particle

$K = \gamma mc^2 - mc^2$ the kinetic energy of a particle according to Einstein

$E = mc^2$ Energy is related to mass – mass can be converted into energy (as in a nuclear reaction) and energy can be converted into mass.

Einstein's Photoelectric effect (evidence of light as a particle) known as photons

When light strikes the surface of a metal, the outer electrons absorb the photon gaining kinetic energy. If the kinetic energy is greater than the binding energy for the electron, the electron leaves with that difference in kinetic energy. ϕ is known as the work function. It is the minimum energy required to free the electron.

$$K = hf - \phi$$

$$K = \frac{hc}{\lambda} - \phi$$

X-rays – the x stands for unknown, but the name caught on even though we kind of know they are high energy electromagnetic waves.

The Compton Effect – X-rays can be "bounced" off of atoms reflecting them at an angle. The electron gains energy and the photon loses energy thereby changing its frequency

$$\lambda = \frac{h}{p}$$

$$E_{electron} = -2.178 \times 10^{18} \frac{Z^2}{n^2} \text{ Joules}$$

$$E_{electron} = 6.242 \times 10^{18} \frac{Z^2}{n^2} \text{ eV}$$

$$E = mc^2$$