Physics 30 – Lesson 28
Quantization of Light

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1)

$E = hf$

$E = 4.14\times10^{-15} eV\cdot s(100.7\times10^{6} Hz)$

$\boxed{E = 4.17\times10^{-7} eV}$

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$E = 4.17\times10^{-7} eV \times 1.60\times10^{-19}\,\frac{J}{eV}$

$\boxed{E = 6.67\times10^{-26} J}$

2)

$E = \frac{hc}{\lambda}$

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$E = \frac{6.63\times10^{-34} J\cdot s(3.0\times10^{8}\,{}^{m}\!/_{s})}{450\times10^{-9} m}$

$\boxed{E = 4.42\times10^{-19} J}$

3) $E = 1.0 MeV$ $E = hf$

$f = ?$ $f = \frac{E}{h}$

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$f = \frac{1.0\times10^{6} eV}{4.14\times10^{-15} eV\cdot s}$

$\boxed{f = 2.4\times10^{20} Hz \quad \text{gamma ray}}$

4)

$E = \frac{nhc}{\lambda}$

/4 $Pt = \frac{nhc}{\lambda}$

$n = \frac{Pt\lambda}{hc}$

$n = \frac{1.5\times10^{-3} W(1s)(632.8\times10^{-9} m)}{6.63\times10^{-34} J\cdot s(3.0\times10^{8}\,{}^{m}\!/_{s})}$

$\boxed{n = 4.77\times10^{15}\ photons}$

5)

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$$E = \frac{nhc}{\lambda}$$

$$Pt = \frac{nhc}{\lambda}$$

$$n = \frac{Pt\lambda}{hc}$$

$$n = \frac{2.5W(1s)(500\times10^{-9}m)}{6.63\times10^{-34}J\cdot s(3.0\times10^{8}\,{}^{m}/_{s})}$$

$$\boxed{n = 6.3\times10^{18}\ photons}$$

6)

/2 Photographic film responds to the energy of light. Red light has a low frequency and therefore a low energy (E = hf), therefore it does not have enough energy to affect the photographic film.

7)

/2 Reddish stars have a lower surface temperature than white stars which have a lower surface temperature than blue stars.

8)

/2 All objects do radiate energy, however they radiate wavelengths that we cannot see – i.e. microwaves, radio waves, infra-red, etc.

9)

A particle is a material object that has a confined mass and energy. Particles tend to collide with other particles and they interact in a "field" like manner.

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Waves are forms of energy that are spread out over space. Waves interact by interfering with one another rather than bouncing off one another.

10)

Electrons have mass, charge and they travel at speeds less than the speed of light. They have particle properties which are readily observable and they have wave like properties that become more pronounced if they are moving at high speeds.

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Photons have energy, no charge and they always travel at the speed of light. They have a particle nature and they have wave characteristics as well. Low energy photons have a more pronounced wave nature while high energy photons have a more pronounced particle nature