Homework 4

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1.5

Energy of a single photon:

$$E = \frac{hc}{\lambda} = \frac{6.626 \cdot 10^{-34} \cdot 2.998 \cdot 10^{8}}{550 \cdot 10^{-9}} \approx 3.61 \cdot 10^{-19}$$

Number of photons emitted from lamp:

$$\frac{100}{3.61 \cdot 10^{-19}} \approx 2.77 \cdot 10^{20}$$

$$\frac{N_{lamp}}{4\pi R^2} = \frac{N_{eye}}{\pi r^2}$$

$$R = \sqrt{\frac{r^2 N_{lamp}}{4N_{eye}}} = \sqrt{\frac{0.0025^2 \cdot 2.77 \cdot 10^{20}}{4 \cdot 100}} \approx 2.08 \cdot 10^{6} m$$

1.9

a)

$$W = E - K_{max} = 4.22eV$$

b)

$$v = 8.6 \cdot 10^{5} m/s$$

c)

$$I = 169 W/m^2$$

1.15

$$K = E - E' = \frac{2}{3}mc^2$$

1.19

$$\phi = \pi/6,\ z_1 = e^{i\pi/6},\ z_1^* z_1 = e^{-i\pi/6} e^{i\pi/6} = 1$$

$$\phi = \pi 3,\ z_1 = e^{i\pi/3},\ z_2^* z_2 = e^{-i\pi/3} e^{i\pi/3} = 1$$

1.27

a)

$$z = z_1 + z_2$$

$$z^* z = \sin^2\left[\frac{2\pi(l_1 - l_2)}{\lambda}\right]$$

b)

$$l_1 = l_2 + \frac{\lambda}{4}$$

c)

$$z^* z = \sin^2 \frac{5\pi}{6} = 0.25$$

1.40

$$d\sin\psi + d\sin\theta = m\lambda,\ m = 0, \pm 1, \pm 2, ...$$

1.43

$$t = \frac{n_1}{c}\sqrt{a^2 + x^2} + \frac{n_2}{c}\sqrt{(D - x)^2 + b^2}$$

$$\frac{dt}{dx} = \frac{n_1}{c}\frac{x}{\sqrt{a^2+x^2}} - \frac{n^2}{c}\frac{(D-x)}{\sqrt{(D-x)^2+b^2}}$$

1.45 The probability of a series of steps is the "square" of the product of probability amplitudes. If it can occur in more than one way the probability is the "square" of the sum of the probability amplitudes.