Lecture 4, Problem 1:

~~Pro~~

(1): Calculate the energy of a single photon:

$$E = \frac{hc}{\lambda} = \frac{hc}{5.27 \cdot 10^{-7}} = 3.77 \cdot 10^{-19}\ J$$

Then,

$$\frac{6.022 \cdot 10^{23}\ \text{Photons}}{1\ mol} \cdot \frac{3.77 \cdot 10^{-19}\ J}{\text{photon}} = \cancel{22.7\ KJ}\ 227\ KJ$$

(2): Red.

Problem 2

(1): $\frac{4\ 990\ 000\ J}{mol} \cdot \frac{1\ mol}{6.022 \cdot 10^{23}\ photons} = 8.29 \cdot 10^{-18}\ J/photon$

The n; solving

$8.29 \cdot 10^{-18}\ J = \frac{hc}{\lambda} \Rightarrow \lambda = 24\ nm$

(2): $E = \frac{hc}{500\ nm} = \frac{hc}{5 \cdot 10^{-7}\ m} = 3.97 \cdot 10^{-19}\ J$; $\frac{(2)}{(1)} = 0.048$

21 photons $\Leftarrow 20.83 = \frac{(1)}{2} = \frac{1}{0.048}$

(3): $E = h\nu = h\ 1.71 \cdot 10^{15}\ s^{-1} = 1.13 \cdot 10^{-18}\ J$

emitted = input − workfuntion

$\phi = (1.13 \cdot 10^{-18} - 3.61 \cdot 10^{-19})\ J = 7.7 \cdot 10^{-19}\ J$

Problem 3

(1): $E = h\nu = 1.13 \cdot 10^{-18}$ J

emitted = (input - workfunction)

workfuntion = input - emitted

$= 1.13 \cdot 10^{-18} - 3.61 \cdot 10^{-19}$

$= 7.7 \cdot 10^{-19}$ J

(2): $1.4 \cdot 10^{11} \cdot 3.61 \cdot 10^{-19}$ J $= X \cdot 0.2$

implies

$X = 7.9 \cdot 10^{-7}$ watts

Problem 4

(a): Convert the UV ~~wavelength~~ energy to eV ~~per photon~~;

$$E = 7.2 \cdot 10^{-19} J \cdot \left(\frac{1.6022 \cdot 10^{-19} J}{1 eV} \right)^{-1} \simeq 4.5 eV$$

$$(4.5 - 4.33) eV = 0.17 eV,$$

$$\lambda = \frac{h}{0.17 eV} = 3 \cdot 10^{-9} m$$

(b): $7.2 \cdot 10^{-19} J / \cancel{photon} = \frac{hc}{\lambda} \Rightarrow \lambda = 280 mm$

(c): Fe has a greater work function, and shorter wavelengths have higner energies; thus, shorter.