HW Solution 10

November 12, 2010

38.18

(a) $\Delta E = 0 - (-20eV) = 20eV$

(b) When the atom in the $n = 1$ level absorbs a 18 eV photon, the final level of the atom is $n = 4$.

$n = 4 \to n = 3$, 3 eV ;

$n = 4 \to n = 2$, 8 eV ;

$n = 4 \to n = 1$, 18 eV;

$n = 3 \to n = 2$, 5 eV ;

$n = 3 \to n = 1$, 15 eV;

$n = 2 \to n = 1$, 10 eV .

The possible energies of emitted photons are: 3 eV, 5 eV, 8 eV, 10 eV, 15 eV, and 18 eV.

(c) There is no energy level 8 eV higher in energy than the ground state, so the photon cannot be absorbed.

(d) The photon energies for $n = 3 \to n = 2$ and for $n = 3 \to n = 1$ are 5 eV and 15 eV. The photon energy for $n = 4 \to n = 3$ is 3 eV.

The work function must have a value between 3 eV and 5 eV.

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(a) The threshold frequency, f_{th} , is f where $V_0 = 0$. From the graph this is $f_{th} = 4.56 * 10^{14} Hz$.

(b) $\lambda_{th} = \frac{c}{f_{th}} = 658nm$

(c) $\phi = hf_{th} = 1.89eV$

(d) $eV_0 = hf - \phi \ \therefore V_0 = (\frac{h}{e})f - \phi$. the slop is $\frac{h}{e}$.

$\frac{h}{e} = \frac{1.48V - 0.24V}{8.20 * 10^{14} Hz - 5.18 * 10^{14} Hz} = 4.11 * 10^{-15} V/Hz$

$h = (4.11 * 10^{-15} V/Hz)(1.60 * 10^{-19} C) = 6.58 * 10^{-34} J \cdot s$