6. (a)

$n = \infty$ ————————————————— 0 eV

$n = 3$ ————————————————— -1.0 eV

$n = 2$ ————————————————— -3.0 eV

$n = 1$ ————————————————— -6.0 eV

(b) $\underline{n = 2 \text{ to } n = 1}$: $h\dfrac{c}{\lambda} = \Delta E_{2 \to 1}$

$$\left(6.63 \times 10^{-34} \text{ J} \cdot \text{s}\right)\dfrac{3.00 \times 10^8 \text{ m/s}}{\lambda} = \left|(-6.0 \text{ eV}) - (-3.0 \text{ eV})\right|\left(1.6 \times 10^{-19} \text{ J/eV}\right)$$

$\boxed{\lambda = 4.15 \times 10^{-7} \text{ m} = 415 \text{ nm}}$

$\underline{n = 3 \text{ to } n = 1}$: $h\dfrac{c}{\lambda} = \Delta E_{3 \to 1}$

$$\left(6.63 \times 10^{-34} \text{ J} \cdot \text{s}\right)\dfrac{3.00 \times 10^8 \text{ m/s}}{\lambda} = \left|(-6.0 \text{ eV}) - (-1.0 \text{ eV})\right|\left(1.6 \times 10^{-19} \text{ J/eV}\right)$$

$\boxed{\lambda = 2.49 \times 10^{-7} \text{ m} = 249 \text{ nm}}$

$\underline{n = 3 \text{ to } n = 2}$: $h\dfrac{c}{\lambda} = \Delta E_{3 \to 2}$

$$\left(6.63 \times 10^{-34} \text{ J} \cdot \text{s}\right)\dfrac{3.00 \times 10^8 \text{ m/s}}{\lambda} = \left|(-3.0 \text{ eV}) - (-1.0 \text{ eV})\right|\left(1.6 \times 10^{-19} \text{ J/eV}\right)$$

$\boxed{\lambda = 6.22 \times 10^{-7} \text{ m} = 622 \text{ nm}}$

(c)

___X___ Yes   _____ No   _____ It cannot be determined with the information given.

$\Delta KE = \left|\tfrac{1}{2}mv^2 - \tfrac{1}{2}mv_0^2\right| = \left|0 - \tfrac{1}{2}\left(9.11 \times 10^{-31} \text{ kg}\right)\left(1.3 \times 10^6 \text{ m/s}\right)^2\right| = 7.7 \times 10^{-19} \text{ J}$

$\Delta KE = 7.7 \times 10^{-19} \text{ J} / \left(1.6 \times 10^{-19} \text{ J/eV}\right) = 4.8 \text{ eV}$. This is greater than the energy difference between the $n = 1$ and $n = 2$ states (3.0 eV), so this transition is possible with the second electron keeping the remaining 1.8 eV of kinetic energy (4.8 eV - 3.0 eV = 1.8 eV).

(e) i. $\Delta E_{2 \to 1} = \left|(-6.0 \text{ eV}) - (-3.0 \text{ eV})\right|\left(1.6 \times 10^{-19} \text{ J/eV}\right)$

$\boxed{\Delta E_{2 \to 1} = 4.8 \times 10^{-19} \text{ J}}$

ii.

_____ Radio   _____ X-rays   ___X___ Visible light (2.8 x 10^{-19} J to 5.0 x 10^{-19} J)

7. (a) $m_{Defect} = m_{_1^2 H} - \{m_{_2^4 He} + m_{_1^1 H} + m_{_0^1 n}\}$

$m_{Defect} = 3(2.0141 \text{ u}) - (4.0026 \text{ u} + 1.0078 \text{ u} + 1.0087 \text{ u})$

$$m_{Defect} = 0.0232 \text{ u}$$

(b) $E = mc^2 = (0.0232 \text{ u})(1.66 \times 10^{-27} \text{ kg/u})(3.00 \times 10^8 \text{ m/s})^2$

$$E = 3.47 \times 10^{-12} \text{ J}$$

(c) # of deuterium atoms $= \dfrac{E_{US}}{E_{_1^2 H}} = \dfrac{10^{20} J}{3.47 x 10^{-12} J / atom}$

$$\text{# of deuterium atoms} = 2.88 \times 10^{31} \text{ atoms}$$

(d) ? kg water needed $= (2.88 \times 10^{31} \text{ atoms}) \left(\dfrac{1 mole}{6.02 x 10^{23} \, atoms} \right) \left(\dfrac{0.018 kg}{1 mole} \right) \left(\dfrac{1}{0.0015} \right) = 120 \text{ kg/mole}$

$$m_{water} = 5.74 \times 10^9 \text{ kg}$$