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CALCULATE THE KINETIC ENERGY, POTENTIAL ENERGY AND TOTAL ENERGY of AN ELECTRON IN THE GROUND STATE of A HYDROGEN ATOM.

GROUND STATE LEVEL ENERGY

TOTAL ENERGY = KINETIC ENERGY + POTENTIAL ENERGY

$$\frac{mv^2}{r} = \frac{e^2}{4\pi\epsilon_0 r_1}$$

$$KE = \frac{1}{2}mv^2$$

$$PE = -\frac{e^2}{4\pi\epsilon_0 r_1}$$

$$\frac{1}{2}mv^2 = \frac{1}{2} \times \frac{e^2}{4\pi\epsilon_0 r_1}$$

$$= \frac{1}{2} \times \frac{(1.6\times10^{-19})^2}{4\times3.14\times8.854\times10^{-12}\times0.529\times10}$$

$$= 2.175\times10^{-18}\ J$$

$$1\ eV = 1.6\times10^{-19}\ J$$

$$\frac{2.175\times10^{-18}}{1.6\times10^{-19}} = 13.6\ eV$$

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CALCULATE THE ENERGY AND RADII of FIRST FOUR ORBITS FOR AN ELECTRON IN A HYDROGEN ATOM.

ENERGY

$$KE = \frac{1}{2} m v^2$$

$$PE = -\frac{e^2}{4\pi \varepsilon_0 r^2}$$

TOTAL ENERGY $= KE + PE = \frac{1}{2} m v^2 + \left(-\frac{e^2}{4\pi \varepsilon_0 r^2}\right)$ ✓

$$m v r = \frac{n h}{2\pi}$$

$$v = \frac{n h}{m r n \pi}$$

$$\frac{1}{2} m v^2 = \frac{-e^2}{4\pi \varepsilon_0 r^2}$$

$$\frac{1}{2} m \left[\frac{n h}{m r n \pi}\right]^2 = \frac{-e^2}{4\pi \varepsilon_0 r^2}$$

$$\frac{h}{2r\pi} = \frac{-e^2}{4\pi \varepsilon_0 r^2}$$

$$\frac{h}{2\pi} = \frac{-e^2}{4\pi \varepsilon_0 r}$$

$$4\pi \varepsilon_0 r h = -2\pi e^2$$

$$r = \frac{-2\pi e^2}{4\pi \varepsilon_0 h}$$ ✓

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AN ELECTRON IN A HYDROGEN ATOM MAKES A TRANSISTOR FROM A QUANTUM STATE of PRINCIPAL QUANTUM NUMBER $n=2$ TO THE GROUND STATE. WHAT IS THE ENERGY AND WHAT IS THE FREQUENCY FOR EMITTED LIGHT QUANTUM.

ADV THEORY 1

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ADV THEORY 2

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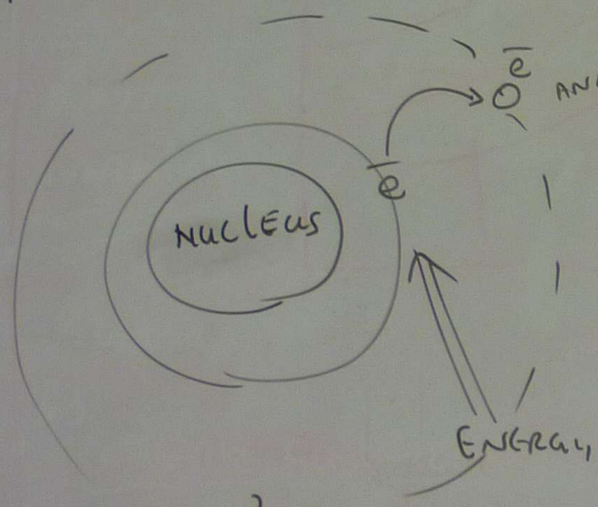

CHANGE OF STATE IS ASSOCIATED WITH ENERGY EMISSION

$$hf = |W_2 - W_1|$$

PLANK CONSTANT, FREQUENCY, ENERGY CHANGE

$$V = \frac{-e^2}{8\pi\epsilon_0 r_1}$$

$$mvr = \frac{nh}{2\pi} \rightarrow V = \frac{nh}{2\pi mr}$$

$$\frac{1}{2}mv^2 = \frac{e^2}{8\pi\epsilon_0 r_1}$$

$$\frac{1}{2}m\left[\frac{nh}{2\pi mr}\right]^2 = \frac{e^2}{8\pi\epsilon_0 r_1}$$

$$r = 529\times10^{-19}\ m^2$$

$$\frac{mv^2}{r_1} = \frac{e^2}{4\pi\epsilon_0 r_1^2}$$

$$W = KE + PE$$

$$W_h = \frac{-e^2}{8\pi\epsilon_0 \times 0.529\times10^{-19}}$$

$$= -\frac{13.6}{n^2}\ eV$$

$$W_1 = -\frac{13.6}{1^2}$$

$$W_2 = -\frac{13.6}{2^2}$$

$$f = \frac{|W_2 - W_1|}{h}$$

$$f = \frac{\left|\frac{-13.6}{2^2} - \frac{(-13.6)}{1^2}\right|}{6.254\times10^{-24}}$$

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