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Study Date: Subject's Code: Group:

Deadline: Class's Code:

Homework/Assignments:

<u>SCORES</u>	<u>COMMENTS</u>

Q1)

a) As the image can be obtained via screen and the lens is at middle between object (candle) and image (screen), this lens is convergent.

b)

#1: $d = ? \text{ cm}$; $d' = 30 \text{ cm}$; $f = ? \text{ cm}$

#2: $d \leftarrow d+4$; $d'' = 30 - 2 \times 4 = 22 \text{ cm}$; $f = ? \text{ cm}$

$$\Rightarrow \left\{ \begin{array}{l} \frac{1}{d} + \frac{1}{30} = \frac{1}{f} \\ \frac{1}{d+4} + \frac{1}{22} = \frac{1}{f} \end{array} \right. \rightarrow \frac{1}{d} - \frac{1}{d+4} = \frac{1}{30} - \frac{1}{22}$$

$$(\Rightarrow) d(d+4) = 165 \times 2$$

$$\rightarrow \begin{cases} d = \sqrt{334} - 2 & (\text{accepted}) \\ d = -\sqrt{334} - 2 & (\text{rejected}) \end{cases}$$

Q2)

$$m_1 = 10^{-9}(\text{g}) \Rightarrow 10^{-12}(\text{kg}); v_1 = 10^{-2}(\text{m/s.})$$

$$m_2 = 9.1 \times 10^{-31}(\text{kg}); E_2 = 1.6 \times 10^{-19}(\text{J})$$

a) Wavelength of smoke:

$$\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{10^{-12} \times 10^{-2}} = 6.63 \times 10^{-20}(\text{m})$$

Wave length of electron

$$v = \sqrt{\frac{2E}{m}} = \sqrt{\frac{1.6 \times 10^{-19} \times 2}{9.1 \times 10^{-31}}} \approx 593000(\text{m/s.})$$

$$\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{9.1 \times 10^{-31} \times 593000} \approx 1.229 \times 10^{-9}(\text{m})$$

$$= 1.229(\text{nm})$$

b) As the wavelength of smoke particle was too small, even smaller than X-ray or Gamma decay, it cannot be detected while the wave property of electron in the ultraviolet range, which makes it detectable.

Q3.)

$$E_n = \frac{-13.6}{n^2} \text{ (eV)}$$

a) Why Balmer spectrum: $n > 2 \rightarrow n_0 = 2$

consider $n_2 = \{3; 4; 5; 6; \infty\}$

$$\Delta E_{21} = \frac{hc}{\lambda} = \left(\frac{-13.6}{n^2} - \frac{-13.6}{2^2} \right)$$

$$\Rightarrow \lambda = \frac{hc}{\frac{-13.6}{n^2} + \frac{13.6}{2^2}} = \frac{(6.63 \times 10^{-34} \text{ Js})(3 \times 10^8 \text{ m/s})}{\left(\frac{1.6 \times 10^{-19} \text{ J}}{\text{eV}} \right) \left(\frac{13.6}{2^2} - \frac{13.6}{n^2} \right) \text{ (eV)}}$$

$$n=3 \rightarrow \lambda_3 = 6.58 \times 10^{-7} \text{ (m)} = 658 \text{ (nm)}$$

$$n=4 \rightarrow \lambda_4 = 4.875 \times 10^{-7} \text{ (m)} = 487.5 \text{ (nm)}$$

$$n=5 \rightarrow \lambda_5 = 4.353 \times 10^{-7} \text{ (m)} = 435.3 \text{ (nm)}$$

$$n=6 \rightarrow \lambda_6 = 4.113 \times 10^{-7} \text{ (m)} = 411.3 \text{ (nm)}$$

$$n=\infty \rightarrow \lambda_{\infty} = 3.656 \times 10^{-7} \text{ (m)} = 365.6 \text{ (nm)}$$

b) As can be seen, the most frequently state $\{3; 4; 5; 6\}$ is within the range of visible color light (red \rightarrow purple)

Even at the critical point of visible light (purple: 380 nm)

the ~~stat quantum must be~~ state highest quantum state

must be $n=10$, so this Balmer spectrum was the

earliest discovered. Compared to Lyman and Pasen,

where the light was partially invisible

(88)

Q4)

$$v_1 = 40000 \text{ km/h} = \frac{1}{27} c$$

$$v_2 = 0.25c$$

$$t = 37.5 \text{ min} = \frac{5}{8} \text{ (h)} = 2250 \text{ (s)}$$

a) Distance of spaceship

$$\begin{aligned} d_1 &= v_1 t = (40000 \text{ km/h}) \times (\frac{5}{8} \text{ h}) \\ &= 25000 \text{ (km)} = 25 \times 10^6 \text{ (m)} \end{aligned}$$

b) As two objects move relatively fast, time delays was significant.

$$t_{\text{rest}} = \frac{t}{\sqrt{1 - \frac{u^2}{c^2}}} \Rightarrow \frac{t_2}{\sqrt{1 - \frac{u_2^2}{c^2}}} = \frac{t_1}{\sqrt{1 - \frac{u_1^2}{c^2}}}$$

$$\Rightarrow t_2 = \frac{(2250 \text{ s})}{\sqrt{1 - (\frac{1}{27})^2}} \times \sqrt{1 - 0.25^2}$$

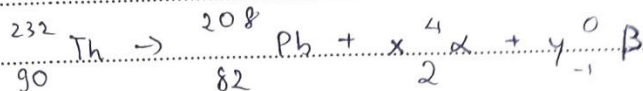
$$= 1489.26 \text{ (s)}$$

Distance of particle:

$$\begin{aligned} d_2 &= 0.25 \times (3 \times 10^8 \text{ m/s}) (1489.26 \text{ s}) \\ &= 3.351 \times 10^{11} \text{ (m)} \end{aligned}$$

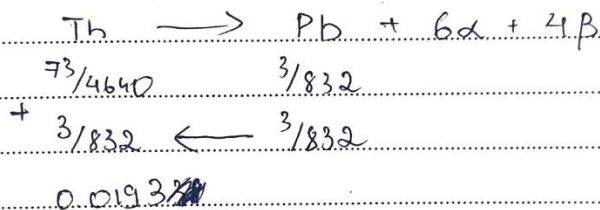
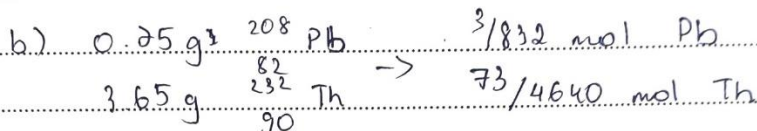
b) As can be seen, due to time delay, the actual time that particle ~~rest~~ moves was equal to 66.18.9% compared to the res comparable which lowers the actual distance if without time delay.

Q5)



a) Reaction above: From them we have

$$\begin{cases} 232 = 208 + 4x + 0y \\ 90 = 82 + 2x - y \end{cases} \rightarrow \begin{cases} x = 6 \\ y = 4 \end{cases}$$



So from 0.0193 mol of Th decays to ${}^{73}/4640$ at the end, we have equation

$$N = N_0 e^{-t/T}$$

$$\frac{73}{4640} = 0.0193 \times e^{-t/14} \rightarrow e^{-t/14} = 0.8152$$

$$\rightarrow t = -14 \ln(0.8152)$$

$$= 2.861 \text{ (billion years)}$$

So the age of rock is approximate 2.861 billion years