

- 1) a) fotoelektrisk effekt, Compton effekt,  
 b) Dubbelspalt försök (interferens), diffraction i kristallgitter  
 c) n-huvudkvanttal, l-baningsmomentkvanttal,  $m_l$  magnetiska, spin  $m_s$   
 d)  $n=1, 2, 3, \dots$ ,  $l=0, 1, 2, \dots, n-1$ ,  $m_l = -l, -(l-1), \dots, l$ ,  $m_s = \pm \frac{1}{2}$   
 e)  $1s^2 2s^2 2p^6 3s^2 3p^6$

- 2) a)  $d=2\pi$  ty konstruktiv interferens  
 b)  $2\pi = k \Delta x = \frac{2\pi}{\lambda} \Delta x \Rightarrow \lambda = \Delta x = \sqrt{5^2 + 12^2} - 12 = 7 \text{ m}$   
 $f = \frac{v}{\lambda} = 340 \text{ Hz}$   
 c)  $\Delta x = \frac{1}{2} \lambda \Rightarrow \lambda = 2 \text{ m} = f = \frac{v}{\lambda} = 170 \text{ Hz}$

3)  $A = \int |P|^2 dx = A^2 \int \sin^2 \frac{n\pi x}{a} dx = A^2 \left[ \frac{1}{2}x - \frac{a}{4n\pi} \sin \frac{2n\pi x}{a} \right]$

Normalis:  $1 = \int_{-\infty}^{\infty} |P|^2 dx = \int_0^a |P|^2 dx = A^2 \left( \frac{a}{2} - 0 \right) \Rightarrow A = \sqrt{\frac{2}{a}}$

$P_{\frac{1}{5}} = \left[ \frac{2}{a} - \frac{1}{2n\pi} \sin \frac{2n\pi x}{a} \right]_{\frac{a}{5}}^{\frac{a}{5}} = \frac{2}{5} - \frac{1}{2n\pi} \sin \frac{2n\pi}{5}$

a)  $n=1 \Rightarrow P_{\frac{1}{5}} = 0.049$

b)  $n=3 \Rightarrow P_{\frac{1}{5}} = 0.23$

c)  $n \rightarrow \infty \Rightarrow P_{\frac{1}{5}} = 0.2$

d) 0.2 enl. Bohrs korrespondensprincip

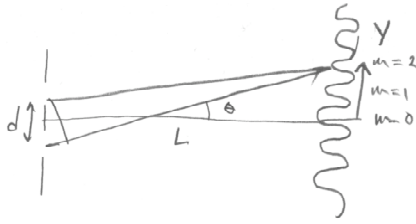
4) våglängden bör alltså vara  $\sim 10^{-11} \text{ m}$

a)  $E = hf = \frac{hc}{\lambda} = 124 \text{ keV}$

b)  $E = \frac{p^2}{2m_e} = \frac{h^2}{\lambda^2 \cdot 2m_e} = 15 \text{ keV}$

c)  $E = \frac{p^2}{2m_n} = \frac{h^2}{\lambda^2 \cdot 2m_n} = 82 \text{ eV}$

5)



$$\Delta = d \sin \theta \approx d \tan \theta = \frac{dY}{L} = m \cdot \lambda_n = 2 \lambda_n \Rightarrow \lambda_n = \frac{dY}{Lm}$$

$$V = \frac{c}{n} = \frac{c \lambda_n}{\lambda_0} = \frac{c d Y}{\lambda_0 L m} = \frac{2.9979 \cdot 10^8 \frac{m}{s} \cdot 30 \cdot 10^{-6} m \cdot 4.5 \cdot 10^{-2} m}{1.2 m \cdot 2 \cdot 694 \cdot 10^{-9} m} = 2.4 \cdot 10^8 \frac{m}{s} = 0.81c$$

6)

$$E_{i,lo} = 1.69 \text{ GeV} = mc^2 \Rightarrow m = 3.0 \cdot 10^{-27} \text{ kg}$$

$$E_{tot} = \gamma mc^2 = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}} \Leftrightarrow 1 - \frac{v^2}{c^2} = \frac{m^2 c^4}{E^2} \Leftrightarrow v = c \sqrt{1 - \frac{m^2 c^4}{E^2}}$$

$$v = 2.297 \cdot 10^8 \text{ m/s} \Rightarrow \gamma = 1.56$$

$$\tau = \frac{t}{\gamma} = \frac{L_p}{\gamma v} = \frac{19 \text{ mm}}{1.56 \cdot 2.297 \cdot 10^8 \text{ m/s}} = 5.3 \cdot 10^{-11} \text{ s}$$