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1) a) fotoelektrisk effekt, Comptoneffekt,
b) Dubbelspalt försök (interferens), diffraktion i kristallgitter
c) n - huvudkvantatal, l - banimpulsmomentkvantatal, m_l magn.kv.tal, spinn m_s
d) $n = 1, 2, 3, \ldots$, $l = 0, 1, 2, \ldots n-1$, $m_l = -l, -l+1, \ldots l$, $m_s = \pm \frac{1}{2}$
e) $1s^2 2s^2 2p^6 3s^2 3p^6$

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

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

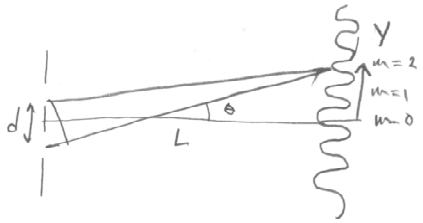
Normering: $1 = \int_{-\infty}^{\infty} |\psi|^2 dx = \int_0^a |\psi|^2 dx = A^2\left(\frac{a}{2} - 0\right) \Rightarrow A = \sqrt{\frac{2}{a}}$

$P_{1/5} = \left[\frac{x}{a} - \frac{1}{2n\pi}\sin\frac{2n\pi x}{a}\right]_0^{a/5} = \frac{1}{5} - \frac{1}{2n\pi}\sin\frac{2n\pi}{5}$

a) $n = 1 \Rightarrow P_{1/5} = 0.049$
b) $n = 3 \Rightarrow P_{1/5} = 0.23$
c) $n \to \infty \Rightarrow P_{1/5} = 0.2$
d) 0.2 enl. Bohrs korrespondensprincip

4) Våglängden bör alltså vara $\sim 10^{-11}$ m
a) $E = hf = \frac{hc}{\lambda} = 124\ keV$
b) $E = \frac{p^2}{2m_e} = \frac{h^2}{\lambda^2 \cdot 2m_e} = 15\ keV$
c) $E = \frac{p^2}{2m_n} = \frac{h^2}{\lambda^2 \cdot 2m_n} = 8.2\ eV$

5)



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

$$V = \frac{c}{n} = \frac{c\lambda_n}{\lambda_0} = \frac{cdY}{\lambda_0 Lm} = \frac{2.9979\cdot10^8\,m/s\cdot 30\cdot10^{-6}\,m\cdot 4.5\cdot10^{-2}\,m}{1.2\,m\cdot 2\cdot 694\cdot10^{-9}\,m} = 2.4\cdot10^8\,m/s = 0.81c$$

6) $E_{ruhe} = 1.69\,GeV = mc^2 \Rightarrow m = 3.0\cdot10^{-27}\,kg$

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

$$V = 2.297\cdot10^8\,m/s \Rightarrow \gamma = 1.56$$

$$\tau = \frac{L}{V} = \frac{L_p}{\gamma V} = \frac{19\,mm}{1.56\cdot 2.297\cdot10^8\,m/s} = 5.3\cdot10^{-11}\,s$$