

1

2d<sub>HK</sub> · sin θ = λ ; d<sub>HK</sub> =  $\frac{a}{\sqrt{1 + \frac{a^2}{4d^2}}}$  och a = 4,09 Å  
 Sökte reflektören d<sub>0</sub> h<sub>2</sub>k<sub>2</sub>g<sub>2</sub> = 16 (Ås är f-c)  
 ⇒ λ = 2 ·  $\frac{4,09 \text{ Å}}{\sqrt{16}}$  · sin 80° = 2,014 Å  
 $E_k = \frac{1}{2} m_0 v^2 = \frac{m_0 v^2}{2m_0} = \left( \lambda = \frac{h}{m_0 v} \right) = \frac{h^2}{2m_0 \lambda^2} = \left( m_0 = 1,67 \cdot 10^{-27} \text{ kg} \right)$   
 =  $3,29 \cdot 10^{-19} \text{ J} = 2,020 \text{ eV}$

2

P = Q · A där A = area av sändarförl. S = λ · N =  $\frac{h \cdot \nu}{c} \cdot N$   
 och Q = (u<sub>n</sub> - u<sub>p</sub> - u<sub>c</sub>) c<sup>2</sup>  
 ∴ P =  $\frac{h \cdot \nu}{c} \cdot 6,023 \cdot 10^{23} \cdot (1,008665 - 1,007275 - 0,000549) u c^2 =$   
 =  $84 \text{ W}$

3

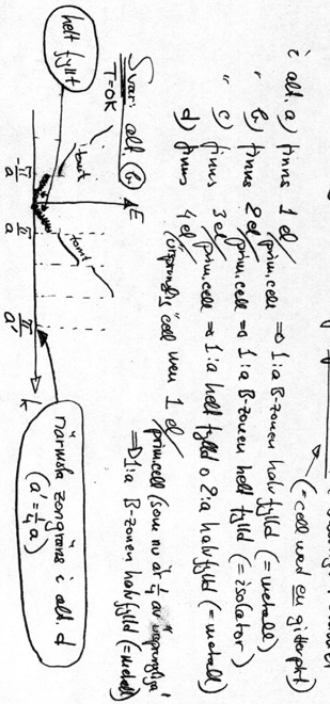
Diagram: u<sub>0</sub> → u<sub>0</sub>' → u<sub>0</sub>''  
 0,60c → 0,60c  
 Energi bevaras: u<sub>0</sub>c<sup>2</sup> =  $\frac{u_0' c^2}{\sqrt{1 - 0,6^2}} + \frac{u_0'' c^2}{\sqrt{1 - 0,6^2}} = \frac{10}{4} u_0 c^2$   
 ⇒ u<sub>0</sub>' =  $\frac{1}{4} u_0$   
 Q = [virkningsförmåga i vatten] c = [u<sub>0</sub> - 2u<sub>0</sub>'] c<sup>2</sup> =  
 = 0,2 u<sub>0</sub> c<sup>2</sup> =  $20 \text{ GeV}$

4

c) N(E<sub>F</sub>) =  $\frac{3}{2} \frac{N}{E_F}$   
 där N = 10<sup>22</sup>  
 {E<sub>F</sub> ≈ eV  
 ∴ N(E<sub>F</sub>) ≈ 10<sup>22</sup> (eV)<sup>-1</sup> och N(E<sub>F</sub>) · ΔE = 10 · 10<sup>9</sup> ⇒ ΔE ≈ 10<sup>-12</sup> eV  
 (allt N(E<sub>F</sub>) =  $\frac{3}{4} \frac{N}{E_F} \sqrt{\frac{2m}{\hbar^2}}$  där v = (u<sub>0</sub>)<sup>2</sup>)  
 ∴ N(E<sub>F</sub>) =  $\frac{3}{4} \frac{N}{E_F} \sqrt{\frac{2m}{\hbar^2}}$  och N(E<sub>F</sub>) =  $\frac{3}{4} \frac{N}{E_F}$

Sum: alternativ c) (Fermienergi ökar ≈ p eV)

2i) En B-zon rummer 2 del per primivertel i ursprung rummet



5

Diagram: A rectangular box representing a potential well. The height is 4 eV. The width is 1 nm. The Fermi level E<sub>F</sub> is indicated. The energy levels are labeled E<sub>1</sub>, E<sub>2</sub>, E<sub>3</sub>, E<sub>4</sub>, E<sub>5</sub>, E<sub>6</sub>, E<sub>7</sub>, E<sub>8</sub>, E<sub>9</sub>, E<sub>10</sub>, E<sub>11</sub>, E<sub>12</sub>, E<sub>13</sub>, E<sub>14</sub>, E<sub>15</sub>, E<sub>16</sub>, E<sub>17</sub>, E<sub>18</sub>, E<sub>19</sub>, E<sub>20</sub>, E<sub>21</sub>, E<sub>22</sub>, E<sub>23</sub>, E<sub>24</sub>, E<sub>25</sub>, E<sub>26</sub>, E<sub>27</sub>, E<sub>28</sub>, E<sub>29</sub>, E<sub>30</sub>, E<sub>31</sub>, E<sub>32</sub>, E<sub>33</sub>, E<sub>34</sub>, E<sub>35</sub>, E<sub>36</sub>, E<sub>37</sub>, E<sub>38</sub>, E<sub>39</sub>, E<sub>40</sub>, E<sub>41</sub>, E<sub>42</sub>, E<sub>43</sub>, E<sub>44</sub>, E<sub>45</sub>, E<sub>46</sub>, E<sub>47</sub>, E<sub>48</sub>, E<sub>49</sub>, E<sub>50</sub>, E<sub>51</sub>, E<sub>52</sub>, E<sub>53</sub>, E<sub>54</sub>, E<sub>55</sub>, E<sub>56</sub>, E<sub>57</sub>, E<sub>58</sub>, E<sub>59</sub>, E<sub>60</sub>, E<sub>61</sub>, 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