

Series 1

1. For 100g of this compound we have 42,04g of nickel and 57,96g of aluminum atomic masses

$$Ni = 58,71 \text{ g/mol}$$

$$Al = 26,98 \text{ g/mol}$$

$$\text{so for nickel we have } \frac{42,04 \text{ g}}{58,71 \text{ g/mol}} = 0,716 \text{ mol}$$

$$\text{u al u have } \frac{57,96}{26,98} = 2,1483 \text{ mol}$$

it means for 100g of the compound we have 2,8643 mol what are the fractions of each element?

$$\text{for } Ni = \frac{0,716}{2,8643} = 0,25$$

$$Al = \frac{2,1483}{2,8643} = 0,75$$

so the proportion is 1 of Ni for 3 of Al $\Rightarrow Ni_1 Al_3$

$$2. 1 \text{ eV} = 1,6 \times 10^{-19} \text{ J}$$

a) the lower energy transition line is from $3 \rightarrow 2$

$$\text{so } \Delta E = E_i - E_f = -1,59 + 3,4 = 1,89 \text{ eV} = \text{photon energy}$$

$$\text{since } E = h\nu = 3,02 \times 10^{-19} \text{ J} \quad \Rightarrow \nu = \frac{E}{h} = \frac{3,02 \times 10^{-19} \text{ J}}{6,63 \times 10^{-34} \text{ J.s}} = 4,55 \times 10^{14} \text{ Hz}$$

$$\lambda = \frac{hc}{E} = 659 \text{ nm}$$

b) the most energetic line corresponds to a transition from $m=8 \rightarrow m=2 \Rightarrow \Delta E = 3,4 \text{ eV}$

c) check the transitions $4 \rightarrow 2; 5 \rightarrow 2$ until you start getting wavelengths below the visible spectrum.

3. the ground state means $n=1$

so we want the energy difference between $n=1$ and $n=4$

$$\Delta E = 12.75 \text{ eV}$$

4. Taking the coordinates of the two points and subtracting the respective values we get

$$\frac{1}{4} - \frac{3}{4} = -\frac{1}{2}$$

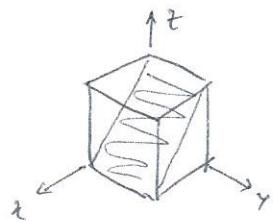
$$\frac{1}{2} - 0 = \frac{1}{2} \rightarrow \text{converting into integers} \Rightarrow$$

$$\frac{1}{2} - \frac{1}{4} = \frac{1}{4}$$

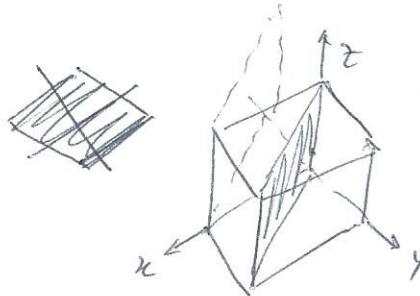
$$\begin{matrix} & 2 \\ & 1 \end{matrix} \quad \begin{pmatrix} \text{- above} \\ \text{means a} \\ \text{negative} \\ \text{value} \end{pmatrix}$$

or $[\bar{2}\bar{2}1]$

5. a)

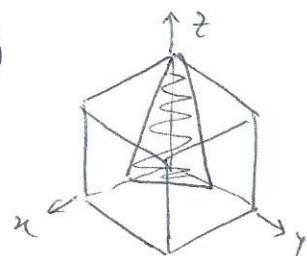


b)

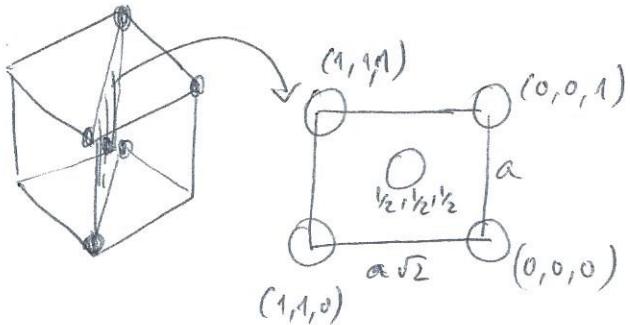


all planes must be drawn inside the cube

c)



6.



7. For BCC structure the relation between the lattice parameter a and the atomic radius is $a = \frac{4R}{\sqrt{3}}$

8. For FCC $a = \frac{4R}{\sqrt{2}}$ and $d_{hkl} = \frac{a}{\sqrt{h^2+k^2+l^2}}$

9. For copper (FCC) we saw in prob 8 that $a = 0.369 \text{ nm}$
we have 4 atoms per cell

one atom has a mass of $\frac{63,54 \text{ g/mol}}{N_A (6,02 \times 10^{23} \text{ atoms/mol})}$

so in the cell we have $4 \times \frac{63,54}{N_A} = 4,22 \times 10^{-28} \text{ g}$

the volume of the cell is $V = a^3 = 4,7 \times 10^{-29} \text{ m}^3$

$$\rho = \frac{m}{V} = \frac{4,22 \times 10^{-28}}{4,7 \times 10^{-29}} \text{ g/m}^3 = 8,98 \text{ g/cm}^3$$