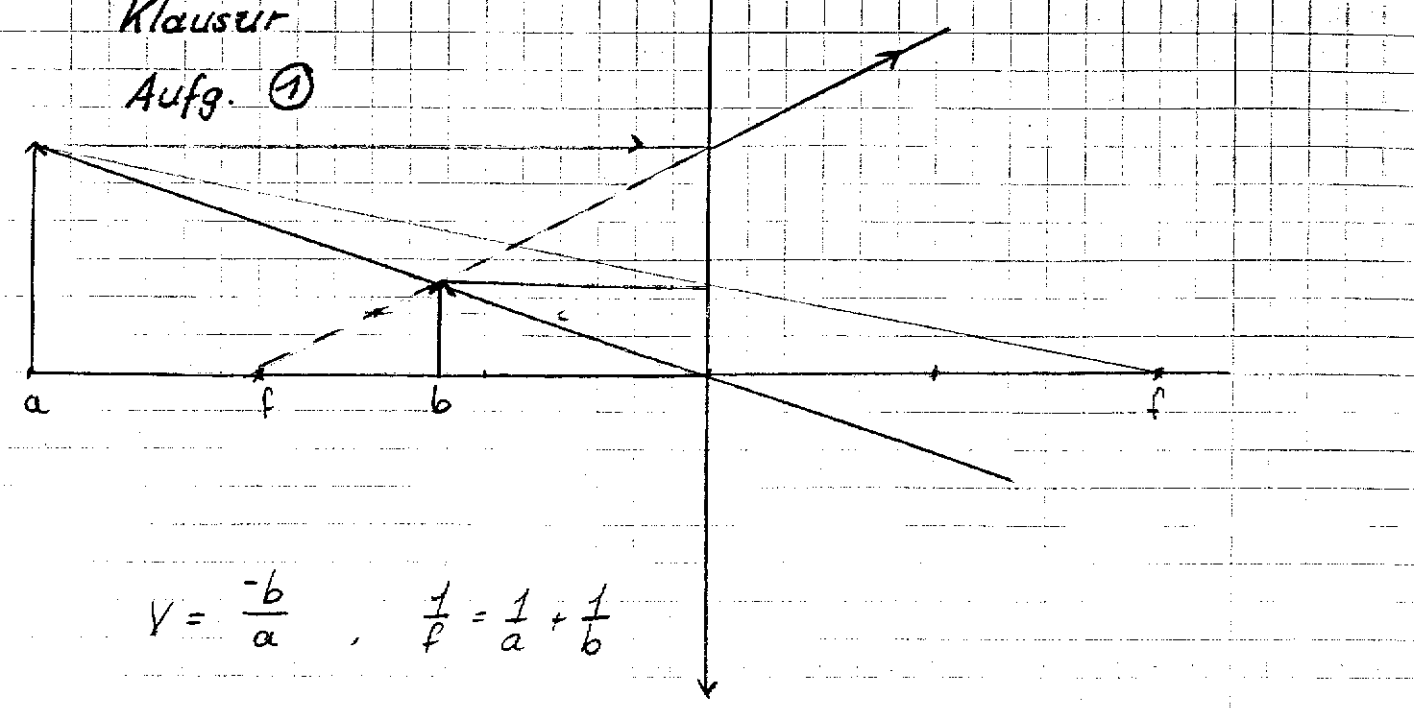
Klausur

Aufg. ①



$$V = \frac{-b}{a} \quad , \quad \frac{1}{f} = \frac{1}{a} + \frac{1}{b}$$

$$f = \frac{ab}{a+b} \quad , \quad af + bf = ab; \quad af = b(a-f)$$

$$\Rightarrow b = \frac{af}{a-f}$$

$$\frac{1}{f} = \frac{1}{a} + \frac{1}{b} \iff b = \left(\frac{1}{f} - \frac{1}{a}\right)^{-1} = \left(\frac{1}{-10cm} - \frac{1}{15cm}\right)^{-1}$$

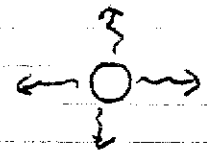
$$= -6cm$$

$$V = \frac{-b}{a} = \frac{6cm}{15cm} = \frac{2}{5}$$

$$B = V \cdot G = \frac{2}{5} \cdot 10cm = 2cm$$

Aufg. ②

1a) $r = 10cm$, $T = 800K$



$$I_k^{em} = \varepsilon \cdot A \cdot T^4 = \varepsilon \cdot 4\pi r^2 \cdot T^4 = 2918\,W$$

1b) 

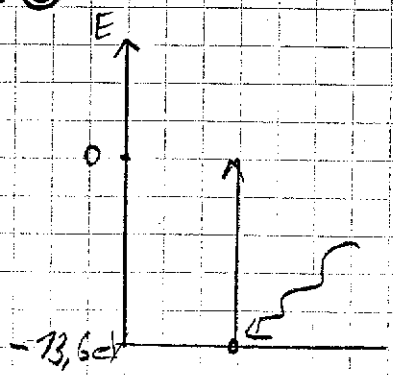
$$I_u^{abs} = \varepsilon \cdot A \cdot T_u^4 = 58W$$

$$I_{el} = I_k^{em} - I_{abs} = 2860W$$

2. $c = f \cdot \lambda$, $\lambda = \frac{c}{f} = 500nm$

Aufg. ③

1.



$|E_B| = h\nu = \frac{hc}{f}$

$\lambda < \frac{hc}{|E_B|} = 91\,nm$

2. $Z = 10$

$n = 1$

$n = 1, \ldots$
$l = 0, \ldots, n-1$
$m_l = -l, \ldots, 0, \ldots, l$
$m_s = \pm \frac{1}{2}$

	1	2	3	4	5	6	7	8	9	10
n	1	1	2	2	2	2	2	2	2	2
l	0	0	0	0	1	1	1	1	1	1
m_l	0	0	0	0	-1	-1	0	0	1	1
m_s	$-\frac{1}{2}$	$+\frac{1}{2}$	$-\frac{1}{2}$	$+\frac{1}{2}$	$-\frac{1}{2}$	$+\frac{1}{2}$	$-\frac{1}{2}$	$\frac{1}{2}$	$-\frac{1}{2}$	$\frac{1}{2}$

3. $d \to 2d$

$T_d \propto e^{-d}$

$T_{2d} \propto e^{-2d}$

$\frac{T_{2d}}{T_d} = \frac{e^{-2d}}{e^{-d}} = e^{-d}$

$T_{2d} = e^{-d} \cdot T_d$

4. $2n^2$ für $n = 4$ $\quad N = 2n^2 = 32$

$2 \cdot 4^2 = 32$

Aufg. ④

1. $a = 0{,}12\,nm$

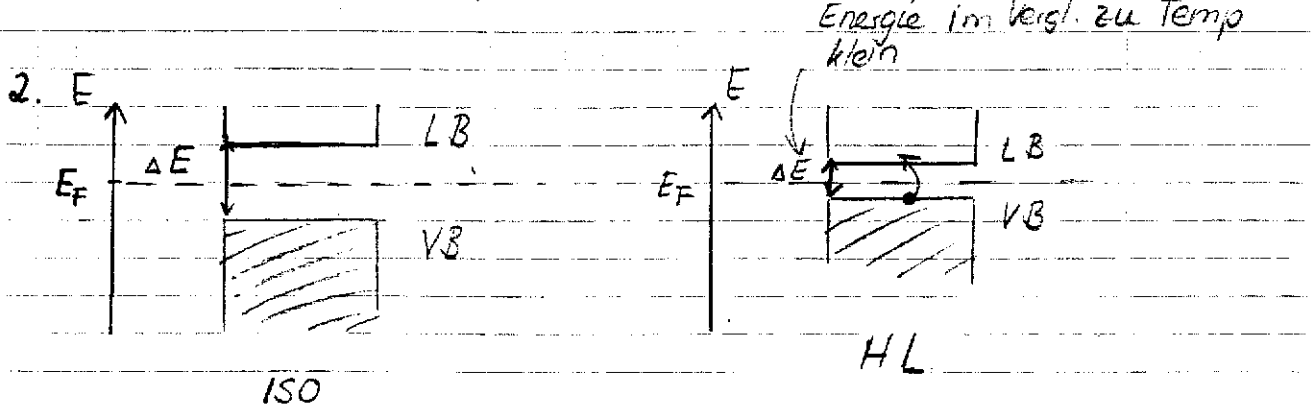
$$E = \frac{1}{2} m v_e^2 = \frac{p^2}{2m} = \frac{\hbar^2 k^2}{2m} \Big| = \frac{\hbar^2 \pi^2}{2m a^2} = 26\,eV$$

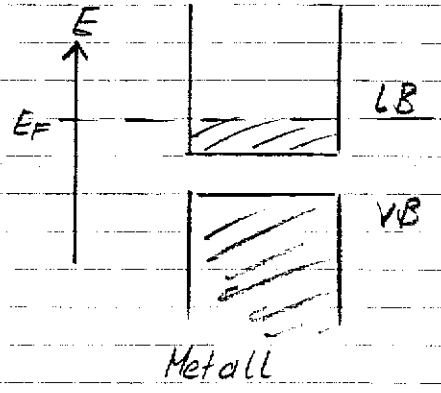
$k = \frac{\pi}{a}$

$\lambda = \frac{h}{p}$

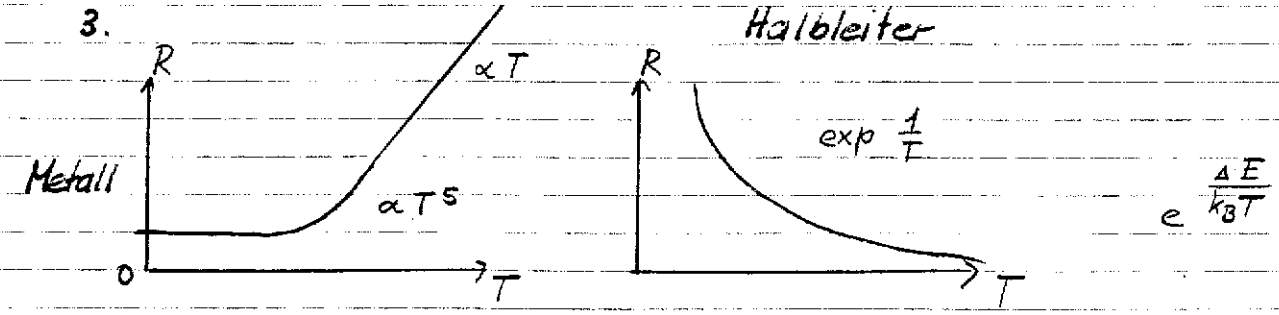
$p = \hbar k$

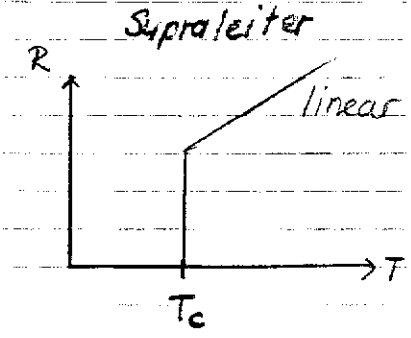
2.





3.





Aufg. ⑤

1. $\frac{dN}{dt} = -pN \Rightarrow \frac{1}{N} dN = -p\,dt$

a) $\int \frac{1}{N} dN = \int -p\,dt$

$\ln N = -pt$

b) $N(t) = ?$ $N(0) = N_0$

$$\int_{N(t=0)}^{N(t)} \frac{dN}{N} = \int_0^t -p\,dt'$$

$$[\ln N]_{N(t=0)}^{N(t)} = [-pt']_0^t$$

$$\ln N(t) - \ln N(t=0) = -pt$$

$$\ln N(t) = \ln N(t=0) - pt$$

$$N(t) = e^{\ln(N(0))} \cdot e^{-pt}$$

$$N(t) = N_0 \cdot e^{-pt}$$

oder $\ln \frac{N(t)}{N_0} = -pt$

$$\frac{N(t)}{N_0} = e^{-pt} \Rightarrow N(t) = N_0 e^{-pt}$$