Solution to Sample 3

1.) $n = 3 \Rightarrow l = 0, 1, 2$ **3 possible values**

b) m_l : $-2, -1, 0, 1, 2$ **5 possible values**

c.) m_s : $\pm \frac{1}{2}$ **2 possible values**

d.) Population $= 2n^2 = 2(3)^2 = 18$

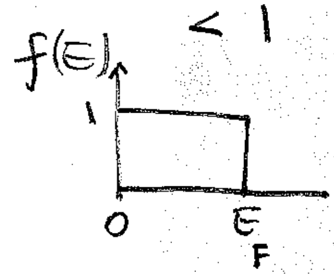
e.) Each subshell has own value of l
l has 3 values so **3 subshells**.

2.) a) $$f(E) = \frac{1}{e^{(E-E_f)/kT} + 1}$$

b.) $E = E_f \Rightarrow f(E_F) = \frac{1}{e^0 + 1} = \boxed{\frac{1}{2}}$

c.) $E > E_F \Rightarrow e^{(E-E_f)/kT} > 1$ so denominator $\uparrow$
$\Rightarrow f(E) \downarrow$.

d.) $E < E_F \Rightarrow e^{(E-E_F)/kT} < 1$ so denominator < 2
$\Rightarrow f(E) \uparrow$



e.) As $T \uparrow$ probability of finding electrons in states of $E > E_F$ $\uparrow$. See figure 42.25.

3a) Zeeman Effect → splitting of atomic Energy levels + associated spectrum lines when atoms are subject to a magnetic field. Confirms the quantization of Angular momentum.

b.) $l=1 \rightarrow l=0$

Energy of photon $= \frac{hc}{\lambda}$

W/ NO Magnetic field the difference in Energy would be $\frac{hc}{\lambda}$.

With a field of B Tesla there is no shift for $l=0$ ($m_l = 0$). For $l=1$ we have

$U = m_l \mu_B B = m_l \left(\frac{e\hbar}{2m}\right) B$

$U = m_l (5.788 \times 10^{-5} \frac{eV}{T}) B$

$U = 1 (5.788 \times 10^{-5}) B$ eV

$l = 1 \Rightarrow m_l = -1, 0, 1$

3 levels are separated by equal intervals of $(5.788 \times 10^{-5} B)$.

c) $j = \frac{7}{2}, \frac{9}{2} \Rightarrow j = l + \frac{1}{2} = \frac{9}{2} \Rightarrow l = 4$

$j = l - \frac{1}{2} = \frac{7}{2} \Rightarrow l = 4$ ✓

0 1 2 3 4 ⟷ l
s p d f g

so **g**

d) Conduction band − Valence Band = Band Gap Energy

Empty Conduction Band → insulator