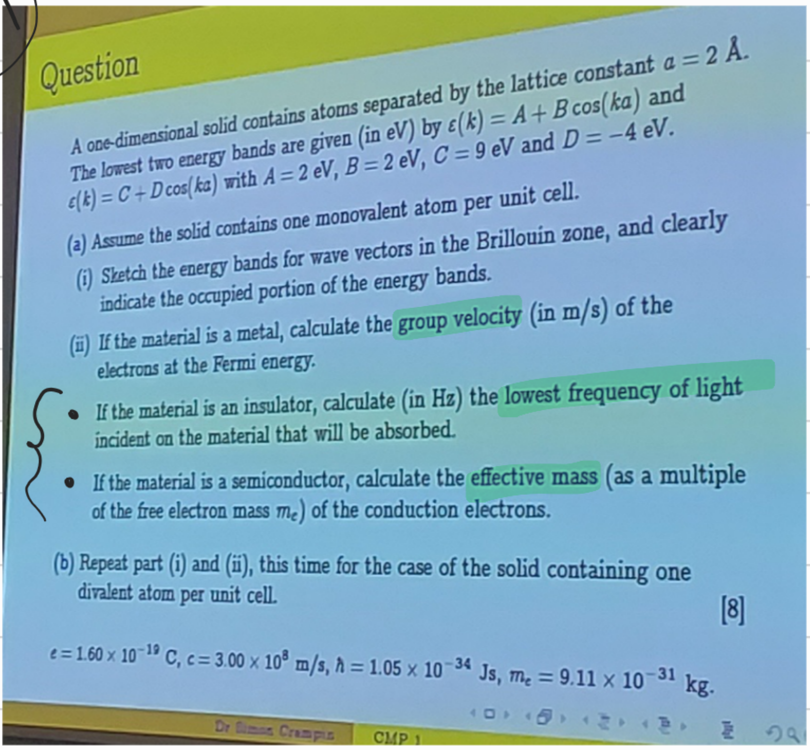
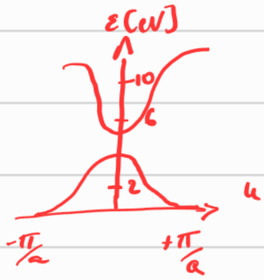
Q1



choose



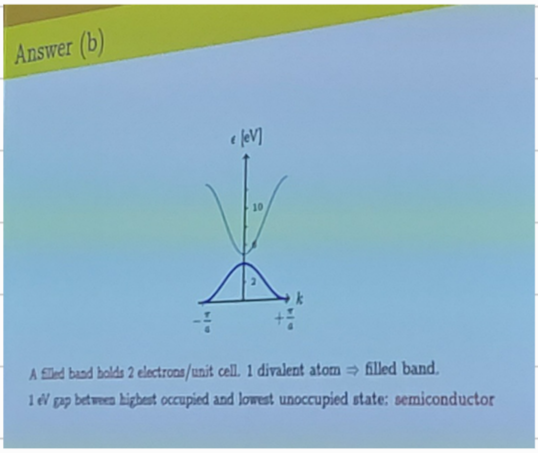
Filled band holds $2e$/unit cell: 1 monovalent atom ⇓ half filled band

group velocity $= \frac{1}{\hbar}\frac{d\varepsilon}{dk}$

At ε_F, $k = \pm\frac{\pi}{2a}$

$v = \pm 6.0 \times 10^5$ m/s

b)

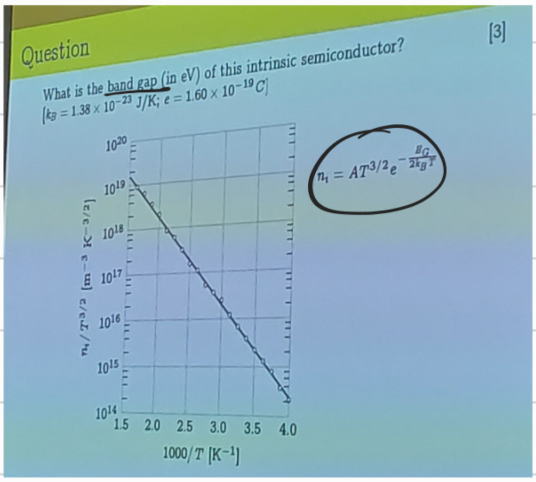


$m^* = \frac{\hbar^2}{\left(\frac{d^2\varepsilon}{dk^2}\right)}$ $= -Da^2\cos ka$ for upper band

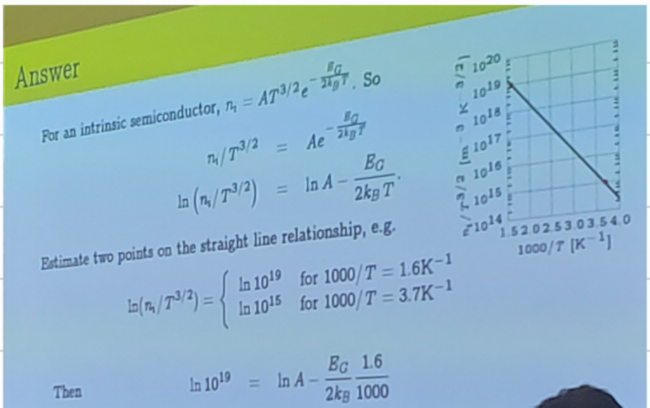
Semiconductor at bottom conduction band

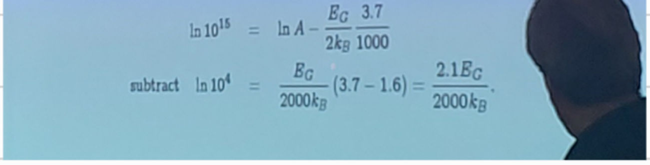
$k = 0$ lower band, $m^* = \frac{-\hbar^2}{Da^2} = \frac{-\hbar^2}{Da^2 m_e} m_e = 0.47 m_e$

Q2



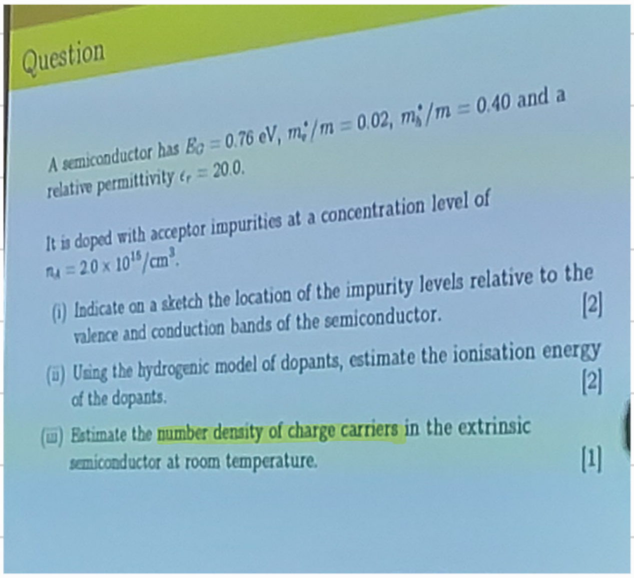
a) band gap



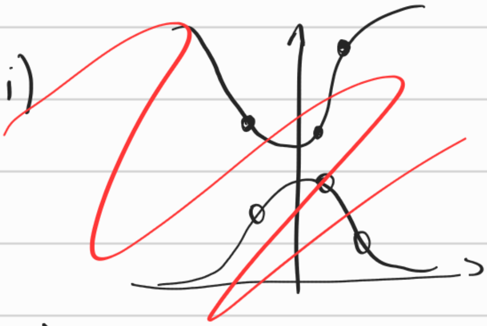


$E_G = \frac{2000k_B \ln 10^4}{21} = 0.76 \text{ eV}$

(Q3)

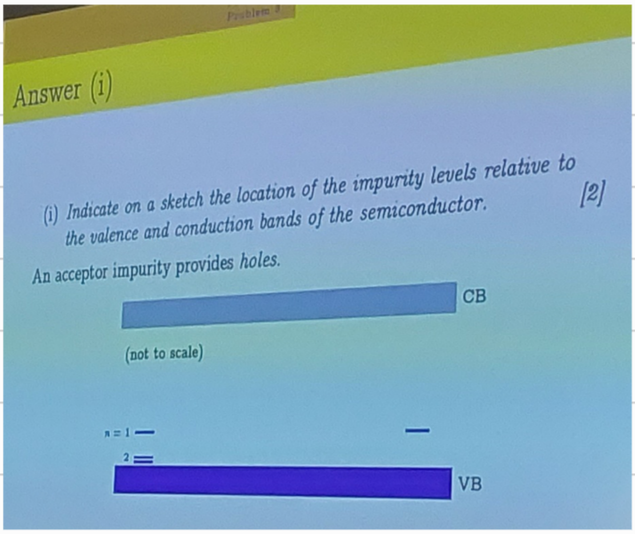


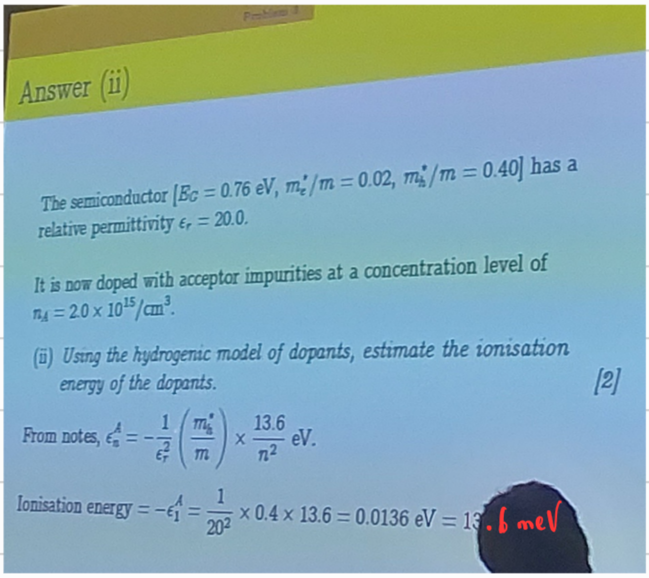
i)



ii) E_g

iii)





$n_A \simeq 2.0 \times 10^{15} / \text{cm}^3$