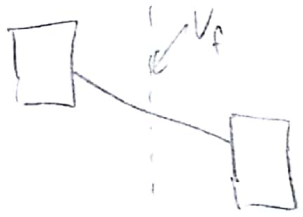
2013 II : Q4A Exp



$n \sim 10^5, 10^6\ cm^{-3}$ $T_e \sim 1-2\,eV$ ions: Oxygen

$A = 20\,m^2 = 20\left(\frac{100}{m}\,cm\right)^2 = 2\times10^5\,cm^2$

(a.) The two shuttles will be biased slightly above and below the floating potential. Note that for a double Langmuir probe such as this, the current is limited by the ion saturation current for both positive and negative bias.

$$I_{isat} = 0.6\,e n_e A_p \left(\frac{kT_e}{m_i}\right)^{1/2} \sim 10^{10}\,10^{6}\,10^{5}\left(\frac{10^{-12}}{16\cdot10^{-24}}\right)^{1/2}$$

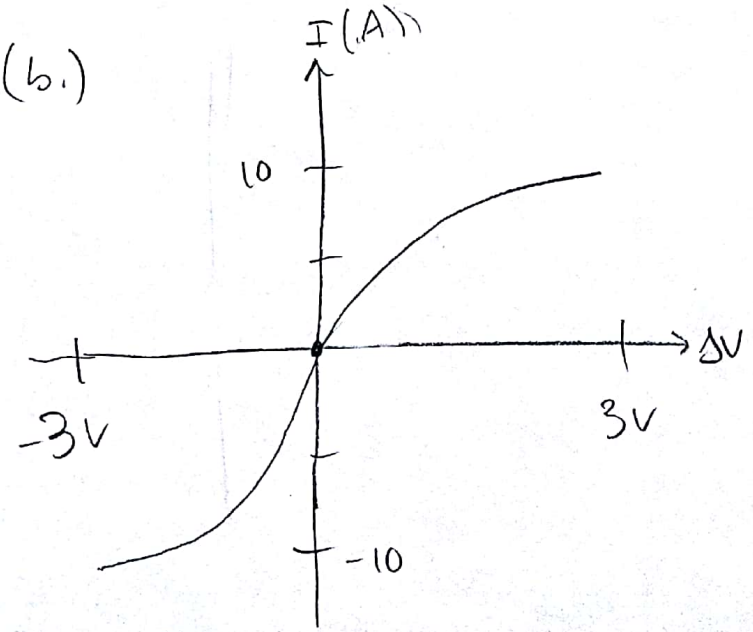
$\sim 10^7$ statampere $\sim 10^{-2}\,A \sim 10\,mA$

I_{isat} will occur at $V \sim \frac{(few\ kT)}{e} \sim 2\,eV/e \sim 2V$

Multiply by an order of magnitud for experimental safety.

want $\boxed{I \sim 100mA \text{ then } \Delta V \sim 20V}$

(b.)



$\Delta V = 0 \Rightarrow V = V_f \Rightarrow I = 0$

$I_{isat} \sim 10^7\,sA \sim 10^{-2}\,A = 10\,mA$

$$I = I_{isat}\left(1 - \exp\left(\frac{eV}{T_e}\right)\right)$$