2005 Part II Q6 Exp

a. secondary electron emission: electron current is reduced by a factor $(1-\gamma)$

b. Less electron current is being collected than there would be with $\gamma=0$. To compensate V_f increases relative to the $\gamma=0$ case to collect more electrons

$$n_e\left(\frac{T_e}{2\pi m_e}\right)^{1/2} \exp\left[\frac{-e(V_{sp}-V_f)}{T_e}\right](1-\gamma) = 0.6\, n_e\left(\frac{T_e}{m_i}\right)^{1/2}$$

$$\exp\left[\frac{-e(V_{sp}-V_f)}{T_e}\right] = 0.6\left(\frac{2\pi m_e}{m_i}\right)^{1/2}\frac{1}{1-\gamma}$$

$$V_{sp}-V_f = \frac{T_e}{e}\left[\ln\left[\frac{1}{0.6}\left(\frac{m_e}{2\pi m_e}\right)^{1/2}\right] + \ln(1-\gamma)\right]$$

eg. $\gamma=0.5$ effect is $+\ln(0.5) \approx -0.7\ \frac{T_e}{e}$

c. $\Rightarrow$ At $1-\gamma = 0.6\left(\frac{2\pi m_e}{m_i}\right)^{1/2}$

or $\gamma = 1-0.6\left(\frac{2\pi m_e}{m_i}\right)^{1/2}$ for Hydrogen, e.g. $\gamma=0.965$

Another way is emissive probes $\rightarrow$ emitting electrons also effectively reduces the electron current collected

d. Power flow would increase. Many more electrons are being collected bringing a lot of power with them. Ion flow is negligible at that point

e. Insulating limiter $\rightarrow$ No difference, still floating.