# Physics 623: HW 7

1) For the below positive feedback circuit, let's assume that the open loop amplifier gain $A$ saturates as the input voltage is increased with the following functional dependence: $A = -A_{SS}\left(1 - |V|/V_{\mathrm{SAT}}\right)$.

Here $A_{\mathrm{SS}}$ is the small signal gain, $V$ is the *output* voltage, and $V_{\mathrm{SAT}}$ is called the saturation voltage (for a real op-amp, the open-loop gain will decrease somewhat at large output amplitudes, although not necessarily with this functional form).

Note that $A$ is negative. That is, the feedback goes to the inverting input of the amplifier. Assume $\beta = \left(1\Big/\left(1 + i\frac{f}{f_c}\right)\right)^4$ (this is a four-pole low-pass filter, where each pole has a corner frequency $f_c$).

a) What is the minimum value of $A_{\mathrm{SS}}$ such that oscillation will occur?

b) What will be the amplitude of the steady-state output voltage?

c) Assume $A_{\mathrm{SS}} = 100$ and $V_{\mathrm{SAT}} = 10$ V, and $f_c$ = 100 Hz.

i. Will the circuit oscillate?
ii. At what frequency will oscillation occur?
iii. Will it be an undistorted sine wave? Why or why not? (No calculations expected – this would be a job for a computer, or someone willing to do a lot of complex algebra.)