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_{SS} is the small signal gain, V is the *output* voltage, and V_{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_{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?