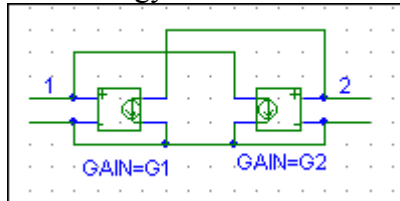
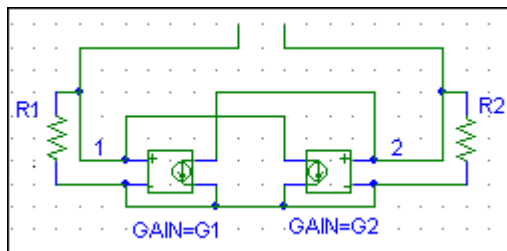


1. For the two back to back VCCSs shown below show that for real gains G_1 and G_2 the two port is passive if and only if $G_2 = -G_1$ in which case the circuit realizes a gyrator.



2. Find the I-V law for the following circuit, where I enters the upper left node and V is measured between the upper nodes. Here R_1 , G_1 , R_2 , and G_2 are real but may be of any sign. Determine which values give norators and which give nullators. Place a capacitor across the upper nodes and find the RC time constant for the resulting circuit for any real values of the parameters.



3. For the following circuit give the nonlinear Gvalue function and the state-variable equations needed to make this a Van der Pol oscillator when L and C are normalized to 1. Using the Gvalue function for the normalized $f(x_1)$, denormalize and write the state variable equations. Then run Spice for both the normalized and the denormalized cases (if you use Unix Spice you need to use the polynomial nonlinearity VCCS, a B component; in PSpice you only need to type in the nonlinear function for the gain of the Gvalue component). Plot the limit cycles as well as $x_1(t)$ and $x_2(t)$ versus time. Check the frequency of the normalized versus the denormalized limit cycles and see if they agree with your change of time scale through the normalization.

