1. Circuits Drill

(a) Find the voltage $V_R$ and current $i_R$ in the following circuits.

i. 

ii. 

(b) Use nodal analysis to manually set up a system of equations whose solution would provide $V_1$ and $V_2$. You may leave your equations in terms of $G_i$, $V_s$, $V_1$, $V_2$ and $I_S$ where $V_1$ and $V_2$ are the unknowns. Then formulate this as a matrix equation.

i. 

ii. 
(c) What happens to the output voltage \( V_R \) (and the current \( i_R \)) if we attach a load of 8 kΩ to the output as depicted in the following circuit:

![Circuit Diagram](image)

(d) What if the load is \( \frac{8}{3} \) kΩ? What if the load is 80 kΩ? For each situation, what is the current through each branch and the power dissipated by each circuit element?

(e) Say that we want to support loads in the range of 8kΩ to 10kΩ. We would like to maintain 4V across these loads. How can we approximately achieve this by setting \( R_1 \) and \( R_2 \) in the following circuit?

![Circuit Diagram](image)

(f) How much power will each resistor draw in this case? Is this efficient?