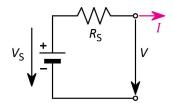
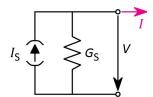
Homework 01

1. **Sources**: Consider the following two circuits. Assume that the two circuits are equivalent with respect to their properties at the two terminals.





- (a) Based on the circuit elements shown in the figure, give the output-voltage-versus-output-current function of the LHS (left-hand side) circuit. Sketch the function (Suggestion: y-axis = V and x-axis = I).
- (b) Give the output-current-versus-output-voltage function of the RHS (right-hand side) circuit. Sketch the function (Suggestion: y-axis = I and x-axis = V).
- (c) The two functions you sketched should be linear functions (straight lines). Can the two functions be identical?
- (d) How can one show that the two functions are identical?
- (e) For the two circuits to be equivalent, which two quantities (one of them a voltage and the other one a current) must be identical?
- 2. Linear and non-linear circuits: There are linear circuits and non-linear circuits.
 - (a) Define a linear circuit (in words).
 - (b) Define a non-linear circuit (in words).
 - (c) List all linear circuit elements that you know of.
 - (d) List some non-linear circuit elements.
 - (e) Is a real voltage source (ideal voltage source plus internal resistance) a linear circuit element? Justify your answer.
 - (f) Is a real current source (ideal current source plus internal conductance) a linear circuit element? Justify your answer.
 - (g) Draw an example of a linear circuit having an input and an output.
 - (h) Draw an example of a non-linear circuit having an input and an output.
 - (i) Is a linear circuit or a non-linear circuit generally simpler to analyze? Explain your answer.
- 3. **Superposition principle**: This problem concerns the superposition principle.
 - (a) Which condition must be met for us to be allowed to apply the superposition principle?
 - (b) Express the superposition principle in your own words.
 - (c) Express the superposition principle by using an *equation*.
 - (d) Which type of system prevents us from applying the superposition principle?