

# hw09

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September 29, 2014

Due Wednesday, October 1 at the beginning of class.

The device in the circle is the symbol for a vacuum tube diode. Voltage source  $V_f$  and the element across it are the filament and is the part that “glows” – it “boils off” electrons from a hot wire by thermionic emission. These electrons are now in the free space vacuum within the circle part and can be accelerated by electric fields.

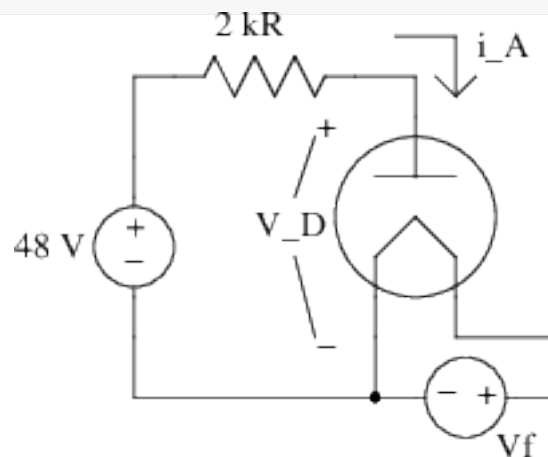
Current  $i_A$ , the anode current is a function of the voltage across the device  $v_D$  and is given by the expression:

$$i_A = \frac{4A\epsilon_0}{9d^2} \left( \frac{2q}{m_e} \right)^{1/2} (v_D)^{3/2} \quad (\text{A})$$

This is a function of the applied voltage  $v_D$ , geometry, and physical constants and is called the *Child-Langmuir* law. For our purposes, assume:

$$i_A = (42 \times 10^{-4})(v_D)^{3/2} \quad (\text{A})$$

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In [1]: from IPython.display import SVG, Image, display
display(Image('./hw09-sch.png'))
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For the above schematic, find the values of  $v_D$  and  $i_A$ . Analyze the circuit and write the relevant equations. Solve the circuit twice using the following methods:

1. Guess and iterate method described in class.
2. Your choice of a computer-based non-linear equation solver (such as Matlab or Python).