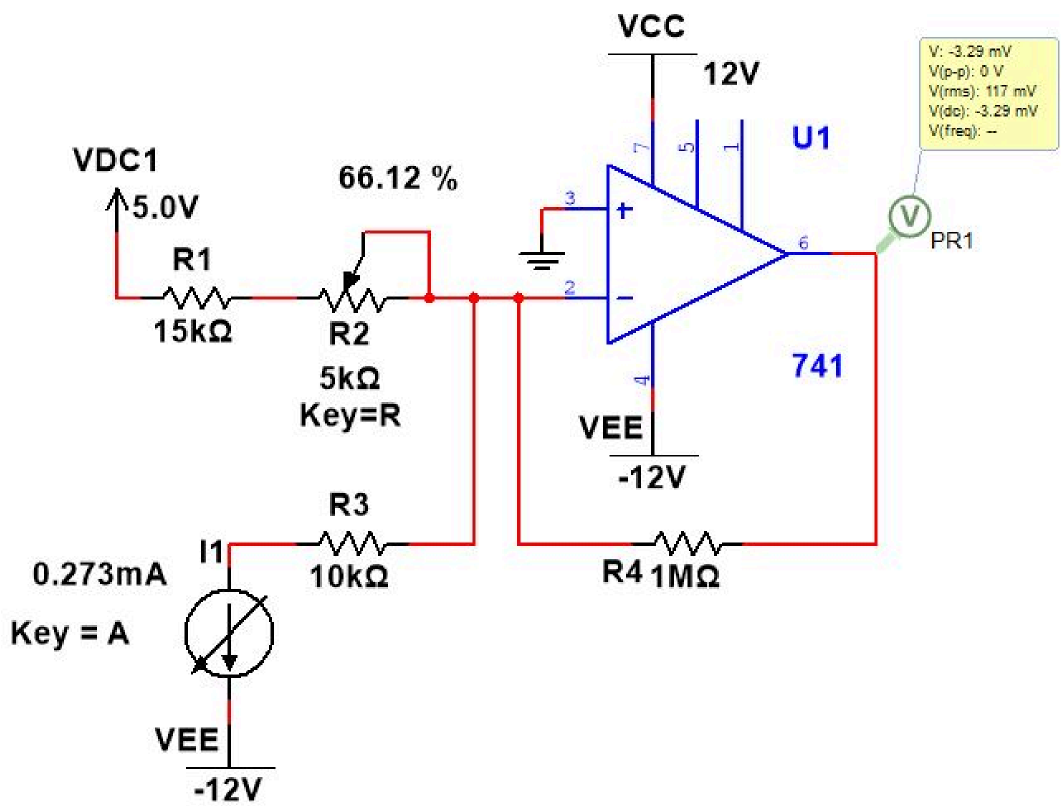
Some devices operate as current sources, rather than as voltage sources. One such is the AD590 or AD592 temperature sensor, which produces a signal of 1 μA per Kelvin degree, K. The Kelvin scale has the same step size as the Celsius scale, but it starts at 0 K for absolute zero, which is approximately -273ºC. Using Multisim, build the circuit below.

V_{DC1} is "V_REF1" from "Sources" -> "SIGNAL_VOLTAGE_SOURCES" and I_1 is "DC_INTERACTIVE_CURRENT" from "Sources" -> "SIGNAL_CURRENT_SOURCES", and will simulate the temperature sensor.

Edit the potentiometer to have an "Increment" of 0.01%.

Edit I_1 to have a "Maximum value" of 500uA and an "Increment" of 0.2%.



Set the current source to 273 μA, then adjust the potentiometer until the output is a close as possible to 0 V.

Now, vary the current to the values indicated below, and record, to the nearest whole number, the output voltage observed.

Input Current, μA	Output Voltage, V
268	-5
269	-4
270	-3
271	-2
272	-1
273	0
274	1

275	2
276	3
277	4
278	5

What do these numbers best represent, in the real world?

- ◯ Temperature in Kelvin degrees
- ◉ Temperature in Celsius degrees
- ◯ Volts DC

Now, to analyze this circuit. First, disable V_{DC1} by shorting it to ground. From this half of the circuit, determine the relationship between V_{out} and I_1, which we will call I_{in}: V_{out} = 1000000 x I_{in}

Using this relationship, what would the output voltage be at a temperature of 0°C? 273 V

Clearly, this is much too large a voltage to be produced by a 741 op amp, which can only be powered from -30 V to +30 V, and the output voltage is limited to one or two volts less than the power supply voltage.

Assuming that the combined resistance of R_1 and R_2 is 18.306 kΩ, determine the current supplied from V_{DC1}.

273 μA

Use this current to determine the DC offset for the output that is provided by V_{DC1} when I_1 is disabled. -273 V

Clearly, this is also much too large a voltage for the 741 op amp to produce. However, combined with the other part of the output signal, the result is within range.

Combine your results into a transfer function:

V_{out} = 1000000 x I_{in} - 273

Verify that this transfer function produces the results you recorded in the table above. By injecting a current to compensate for the sensor current at 0°C, we have converted the sensor's current to voltages that directly represent the temperature in Celsius degrees.

If we were using this circuit as a thermometer, we would display the voltage at the output as temperature in Celsius degrees. This is referred to as an "Inverse Transfer Function", where the output of our circuit is mathematically manipulated to display the measured quantity in its native unit of measure. Although ITFs are usually more complex, ours looks like this:

T = V_{out}, °C