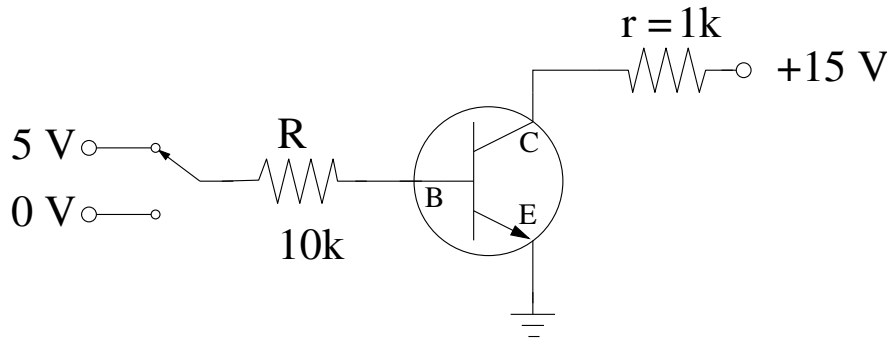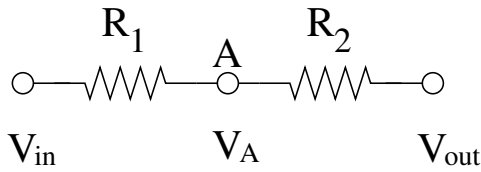Name: _____

1.   Calculate the current through the resistor r in the transistor switch shown below when the input is set to 5 V.

2.

R_1 A R_2

V_{in} V_A V_{out}

For the voltage divider shown on the left, **prove** that the voltage V_A at point A is given by

$$V_A = \frac{V_{in}\, R_2 + V_{out} R_1}{R_1 + R_2}.$$

When incorporated into a Schmitt Trigger, V_{out} can only take on two possible values: 0 ("low") and V_{DD} ("high"). A change in the output can only occur when the voltage V_A crosses through a threshold voltage V_T. **Show** that if the output is low, the input voltage required to switch to the high state is
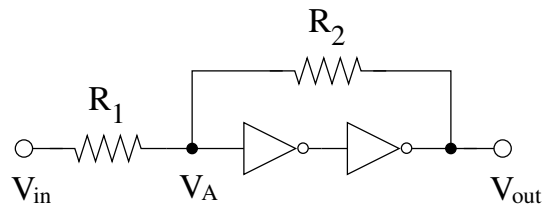
$$V_{\text{low-to-high}} = \frac{(R_1 + R_2)\, V_T}{R_2}$$

while, if the output is high, the input voltage required to switch to the low state is

$$V_{\text{high-to-low}} = -\frac{R_1\, V_{DD}}{R_2} + \frac{(R_1 + R_2)\, V_T}{R_2}.$$

Thus, the hysteresis of a Schmitt Trigger is given by

$$\Delta V = V_{\text{low-to-high}} - V_{\text{high-to-low}} = \frac{R_1\, V_{DD}}{R_2}$$

R_2

R_1

V_{in} V_A V_{out}

Schmitt trigger circuit