

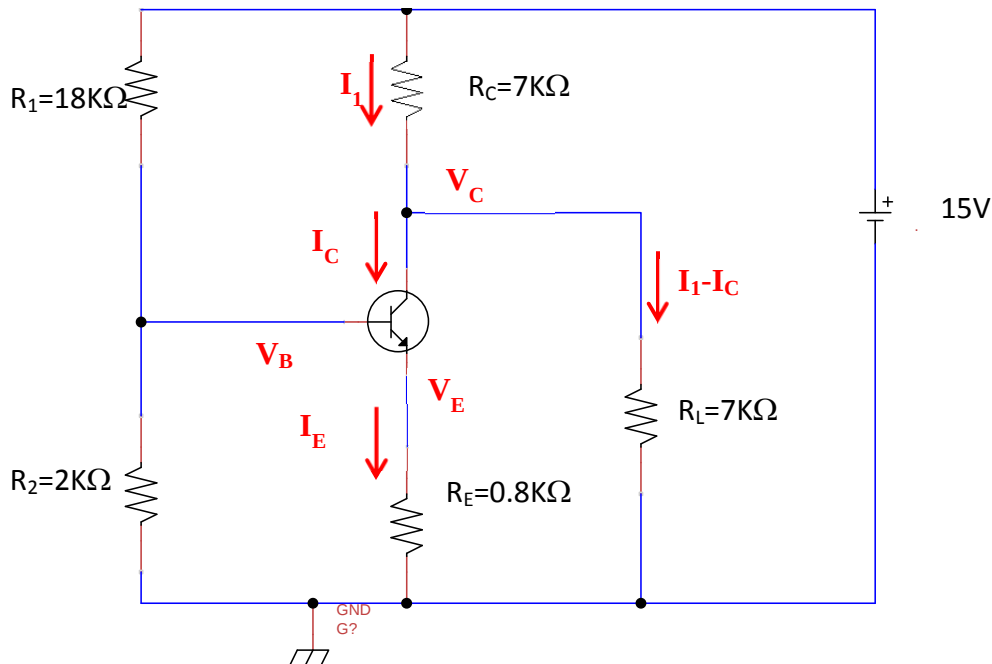
Time = 25 minutes

Name _____

Student ID _____

Question 1 – 7 points

Consider the following circuit. If $\beta=200$. Find the voltages at the three transistor terminals and the current in the terminals. As a first approximation, you can neglect the base current compared to the current in the biasing resistors (R_1 and R_2).



Since I_B is very small compared to the current in R_1 and R_2 , I will assume that $I(R_1)=I(R_2)$, so R_1 and R_2 act as a potential divider

$$V_B = 15 \cdot \frac{2}{2+18} = 1.5V$$

Assuming the transistor is ON, $V_{BE} = 0.7$, so $V_E = V_B - V_{BE}$

$$V_E = 1.5 - 0.7 = 0.8V$$

Since $V_E = 0.8V$, There is a voltage drop of 0.8 across R_E

$$I_E = 0.8 / 0.8 = 1 \text{ mA}$$

Since β is very high (200), α is close to 1 (0.995) and $I_C \approx I_E = 1 \text{ mA}$ (0.995 to be exact)

$$I_B = I_C / \beta$$

$$I_B = 0.005 \text{ mA}$$

By applying KVL on the rightmost loop

$$15 = 7I_1 + 7(I_1 - I_C)$$

$$I_1 = 22 / 14 = 1.5714 \text{ mA}$$

$$V_C = 15 - 1.5714 * 7 \quad \text{or} \quad (1.5714 - 1) * 7 = 4 \text{ V}$$

Question 2 – 3 points

In a BJT biased in the active-forward region, the base current $i_B = 2.8 \mu\text{A}$ and the emitter current is $i_E = 325 \mu\text{A}$.

Find β , α , i_C .

$$I_C = I_E - I_B = 325 - 2.8 = 322.2 \mu\text{A}$$

$$\beta = I_C / I_B = 322.2 / 2.8 = 115.0714$$

$$\alpha = \beta / (\beta + 1) = 0.991385$$