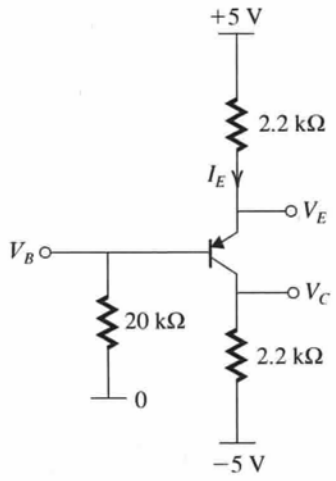
6.60



If active. $|V_{BE}| = 0.7$ V

$$I_B = \frac{5 - 0.7}{20\ \text{k}\Omega + (\beta + 1)2.2\ \text{k}\Omega} = 0.0325\ \text{mA}$$

$V_B = 20\ \text{k} \times 0.0325 = 0.65$ V

$V_E = V_B + 0.7\ \text{V} = 1.35$ V

$V_C = -5 + \beta I_B\ 2.2 = -1.425$ V

$|V_C - V_E| = 2.78\ \text{V} > 0.4$

$\therefore$ active mode

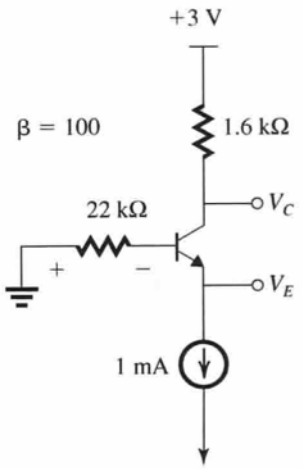
Largest R_C for active mode

$V_C = V_E - 0.3\ \text{V} = 1.35 - 0.3 = 1.05$ V

$$I_{C\max} = \frac{1.05 - (-5)}{2.2\ \text{k}} = 2.75\ \text{mA}$$

6.63

(a)



$I_B = I_E/(\beta + 1) = 0.0099$ mA

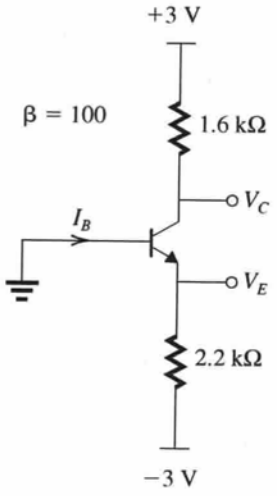
$V_B = 0 - I_B \times 22\text{ k} = -0.22$ V

$V_E = V_B - 0.7 = -0.92$ V

$I_C = \beta I_E/(\beta + 1) = 0.99$ mA

$V_C = 3 - 0.99 \times 1.6 = 1.42$ V

(b)



$V_B = 0$

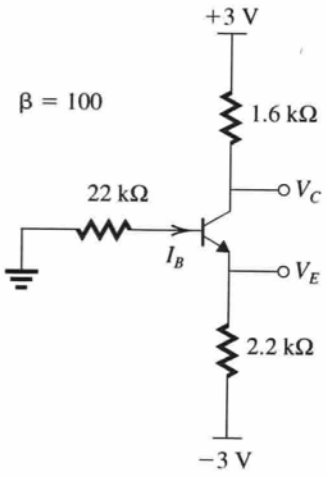
$V_E = V_B - 0.7\ \text{V} = 0.7\ \text{V}$

$I_E = \dfrac{-0.7-(-3)}{2.2} = 1.05\ \text{mA}$

$I_C = \beta I_E/(\beta+1) = 1.04\ \text{mA}$

$V_C = 3 - 1.04 \times 1.6 = +1.34\ \text{V}$

(c)



$\beta = 100$

$I_E = \dfrac{0-0.7-(-3)}{2.2+22/101} = 0.95\ \text{mA}$

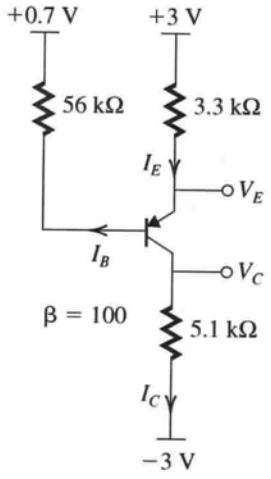
$V_E = -3 + 0.95 \times 2.2 = -0.91\ \text{V}$

$V_B = V_E + 0.7 = -0.21\ \text{V}$

$[V_B = 0 - 22 \times 0.95/101]$

$V_C = 3 - 1.6 \times 0.95 \times \dfrac{100}{101} = +1.5\text{V}$

(d)



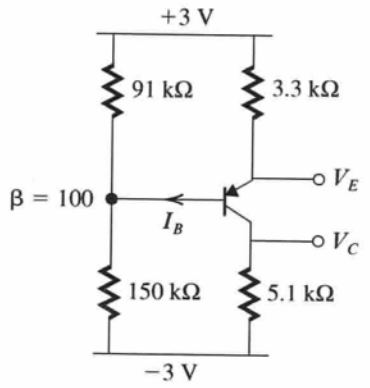
$I_E = \dfrac{3-0.7-0.7}{3.3+56/101} = 0.42\ \text{mA}$

$V_E = 3 - 0.42 \times 3.3 = +1.6\text{V}$

$V_B = V_E - 0.7\ \text{V} = +0.9\ \text{V}$

$V_C = -3 + 5.1 \times 0.42 \times \dfrac{100}{101} = -0.88\text{V}$

(e)



Let

$V_{BB} = -3 + \dfrac{150 \times 6}{150+91} = +0.73\ \text{V}$

$R_{BB} = 91 \parallel 150 = 56.6\ \text{k}\Omega$

$I_E = \dfrac{3-0.7-0.7}{3.3+56.6/101} = 0.41\ \text{mA}$

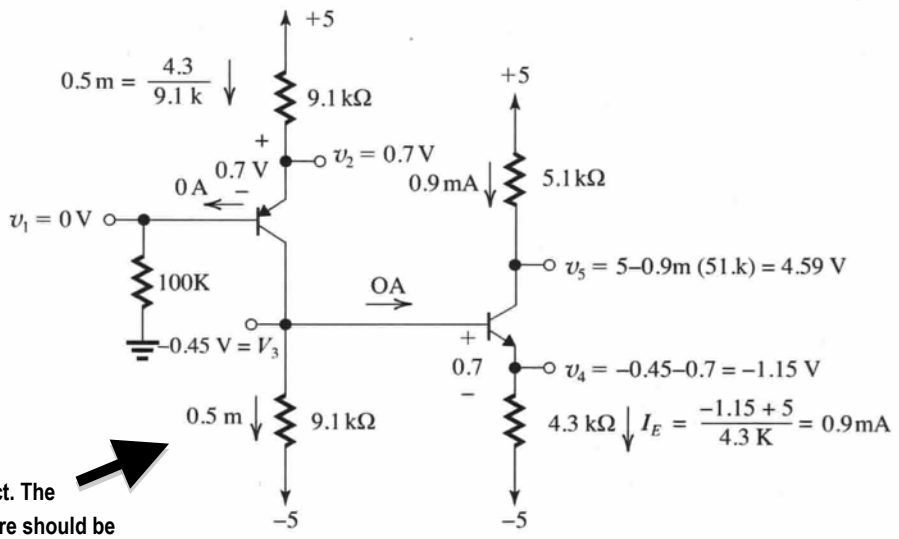
$V_E = 3 - 0.41 \times 3.3 = +1.63\ \text{V}$

$V_B = V_E - 0.7 = +0.93\ \text{V}$

$V_C = -3 + 5.1 \times 0.41 \times \dfrac{100}{101} = -0.93\ \text{V}$

6.67

(a) $\beta = \infty$



This label is incorrect. The current as shown here should be the base current of M2.

$$+5 - I_{E1}(9.1\ K) - 0.7 - I_{B1}(100\ K) = 0$$

$$I_{B1} = \frac{I_{E1}}{\beta + 1}$$

$$4.3 = I_{E1}\left(9.1\ K + \frac{100\ K}{101}\right)$$

$$I_{E1} = \frac{4.3}{10,090} = .43\ mA$$

$$V_2 = 5 - 9.1\ K(.43\ m) = 1.36\ V$$

$$V_1 = 1.36 - 0.7 = .66\ V$$

$$I_{C1} = \alpha I_{E1} = .426\ m$$

$$-5 + 9.1\ K(I_{C1} + I_{B2}) - 0.7 - I_{E2}(4.3\ K) + 5 = 0$$

$$9.1\ K(.426\ m) + \frac{9.1\ K\ I_{E2}}{101} - 0.7 - I_{E2}(4.3\ K) = 0$$

$$I_{E2} = \frac{3.2}{4210} = .75\ mA$$

$$V_4 = -5 + I_{E2}(4.3\ K) = -1.8\ V$$

$$V_3 = V_4 + 0.7 = -1.08\ V$$