4.63

(α)
Και για τα δύο τρανζίστορς ισχύει:

$$V_{BB} = V_{CC}\frac{R_2}{R_1+R_2} = 15\cdot\frac{47}{100+47} = 4.8\,V \tag{1}$$

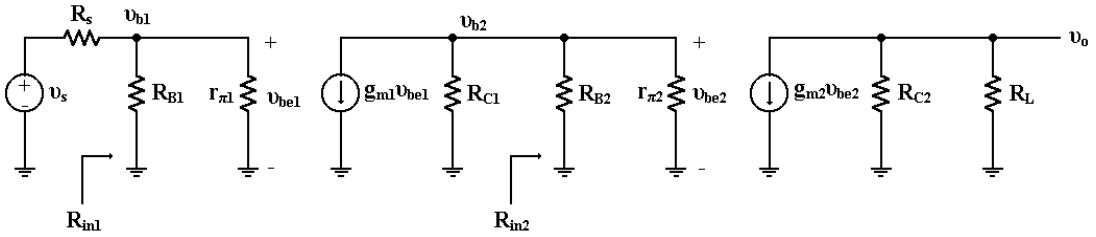
$$R_B = R_1 // R_2 = \frac{R_1 R_2}{R_1+R_2} = \frac{100\cdot 47}{100+47} = 32\,k\Omega \tag{2}$$

$$V_{BB} = I_B R_{BB} + V_{BE} + I_E R_E \Rightarrow I_E = \frac{V_{BB}-V_{BE}}{R_E + \frac{R_B}{\beta+1}} = \frac{4.8-0.7}{3.9+\frac{32}{101}} = 0.97\,mA \tag{3}$$

$$I_C = \alpha I_E = \frac{\beta}{\beta+1} I_E = 0.96\,mA \tag{4}$$

$$V_C = V_{CC} - I_C R_C = 8.5\,V \tag{5}$$

(β)



Ισχύει ότι $R_{B1} = R_{B2} = R_B = 32$ kΩ και $R_{C1} = R_{C2} = R_C = 6.8$ kΩ. Άρα έχουμε:

$$g_{m_1} = g_{m_2} = \frac{I_C}{V_T} = \frac{0.96}{0.025} = 38.4\,mA/V \tag{6}$$

$$r_{\pi_1} = r_{\pi_2} = \frac{\beta}{g_m} = \frac{100}{38.4} = 2.6\,k\Omega \tag{7}$$

$$r_{o_1} = r_{o_2} = \infty \tag{8}$$

(γ)

$$R_{in_1} = R_{B_1} // r_{\pi_1} = 2.4\,k\Omega \tag{9}$$

$$\frac{\upsilon_{b_1}}{\upsilon_s} = \frac{R_{in_1}}{R_s + R_{in_1}} = \frac{2.4}{5+2.4} = 0.32\, V/V \tag{10}$$

(δ)

$$R_{in_2} = R_{B_2} // r_{\pi_2} = 2.4\, k\Omega \tag{11}$$

$$\frac{\upsilon_{b_2}}{\upsilon_{b_1}} = -g_{m_1}\left(R_{C_1} // R_{in_2}\right) = -38.4 \cdot \frac{6.8 \cdot 2.4}{6.8+2.4} = -68.1\, V/V \tag{12}$$

(ε)

$$\frac{\upsilon_o}{\upsilon_{b_2}} = -g_{m_2}\left(R_{C_2} // R_L\right) = -38.4 \cdot \frac{6.8 \cdot 2}{6.8+2} = -59.3\, V/V \tag{13}$$

(στ)
Το συνολικό κέρδος τάσης είναι:

$$\frac{\upsilon_o}{\upsilon_s} = \frac{\upsilon_{b_1}}{\upsilon_s} \cdot \frac{\upsilon_{b_2}}{\upsilon_{b_1}} \cdot \frac{\upsilon_o}{\upsilon_{b_2}} = 0.32 \cdot (-68.1) \cdot (-59.3) = 1292.2\, V/V \tag{14}$$