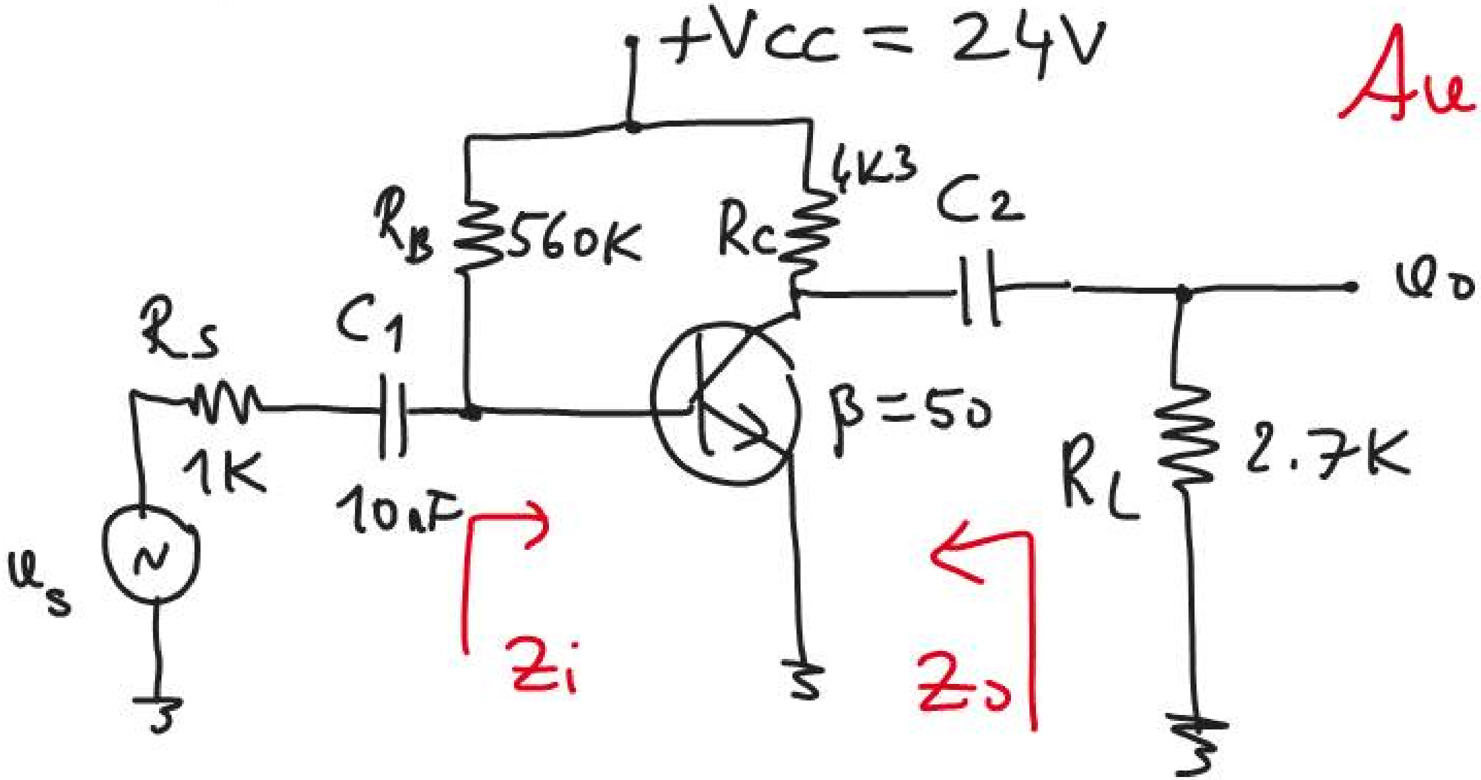
17.05.2012

©

BJT Amplifiers

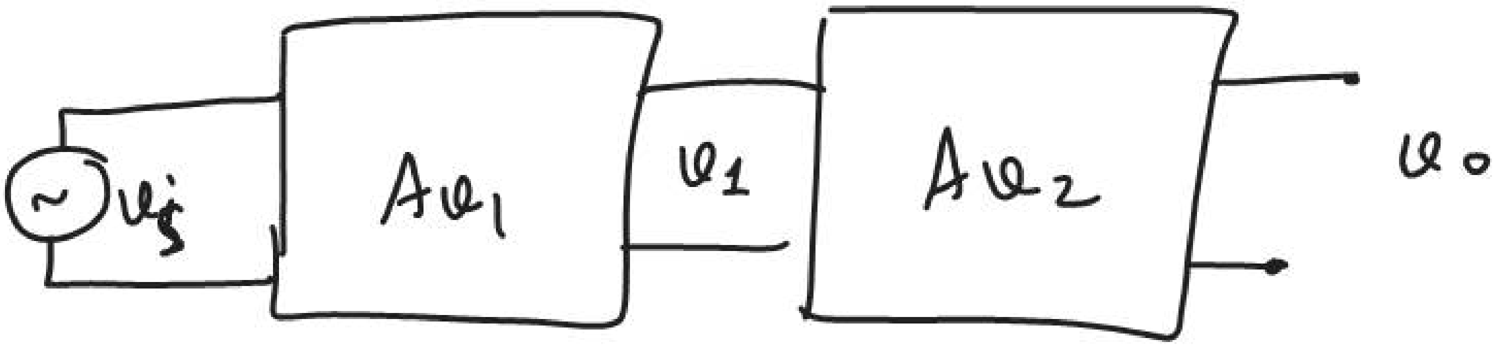
Effects of source and load resistances.

Example: Chapter 5, Problem 39



$$A_v = \frac{v_o}{v_s}$$

More than one amplifiers in <u>cascaded</u> configuration.



$$\frac{v_o}{v_s} = ?$$

$$A_{v1} = \frac{v_1}{v_s} \qquad A_{v2} = \frac{v_o}{v_1}$$

$$\frac{v_o}{v_s} = \frac{v_o}{v_1} \cdot \frac{v_1}{v_s} = A_{v2} \cdot A_{v1}$$

$$\boxed{A_{vT} = A_{v1} \cdot A_{v2}}$$

Overall Voltage Gain

$$\log A_T = \log (A_{v1} \cdot A_{v2})$$

$$\log A_T = \log A_{v1} + \log A_{v2}$$

Decibell

$$P = VI = V \cdot \frac{V}{R} = \frac{V^2}{R} = I^2 R$$

$$dB = 10 \lg \frac{P_2}{P_1}$$

P_2, P_1 powers (watt)

$$dB = 10 \lg \frac{V_2^2 / R}{V_1^2 / R}$$

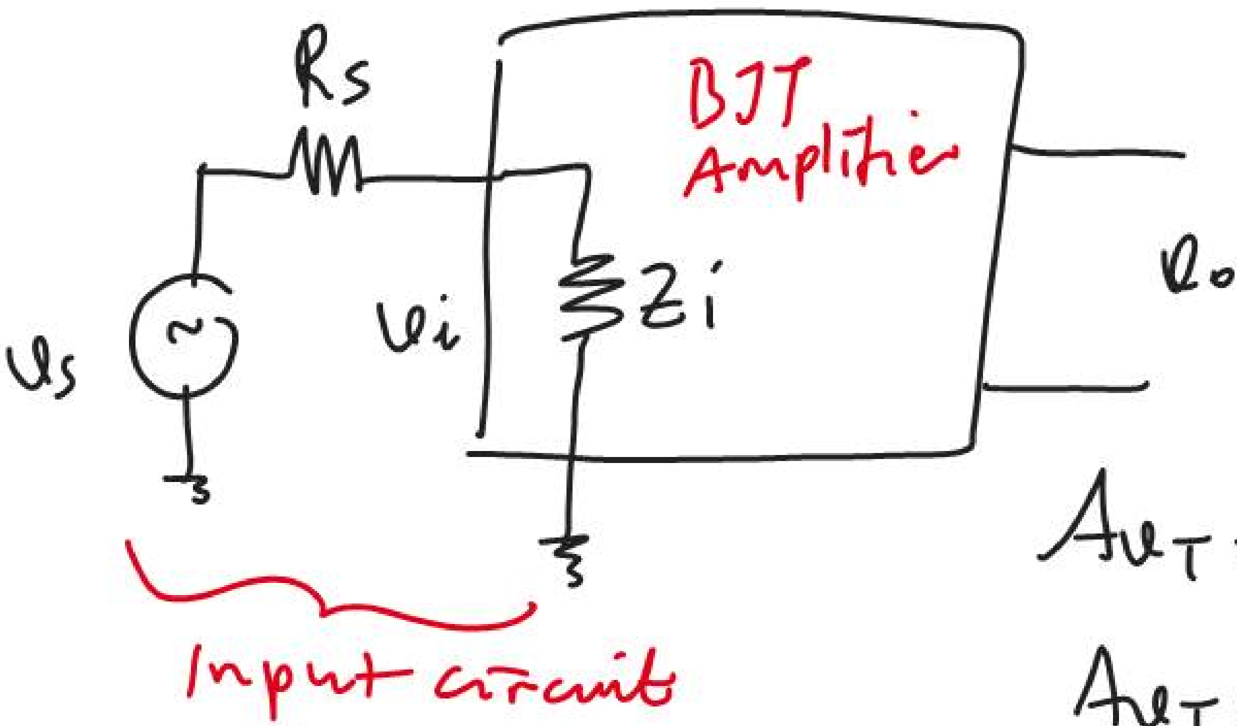
$$dB = 10 \lg \left(\frac{V_2}{V_1}\right)^2$$

$$\boxed{dB = 20 \lg \frac{V_2}{V_1}}$$

$$Av_T = Av_1 \cdot Av_2$$

$$20 \lg Av_T = 20 \lg Av_1 + 20 \lg Av_2$$

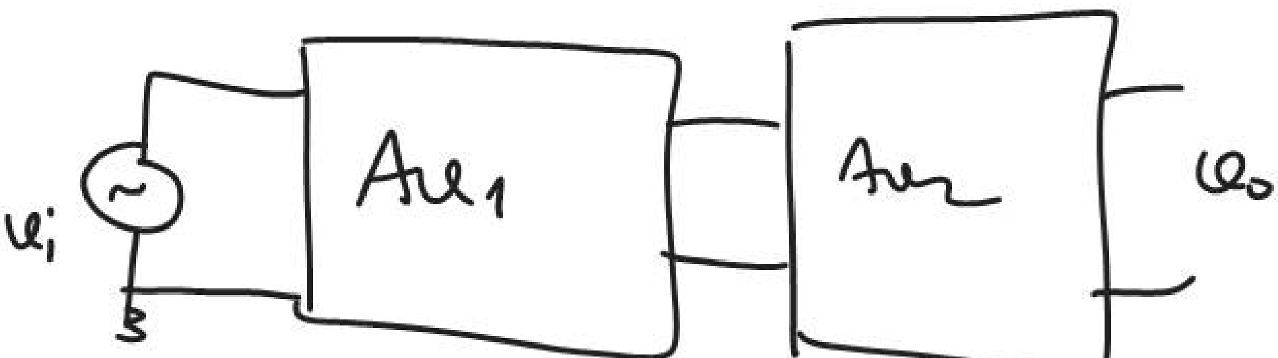
$$\boxed{Av_T dB = Av_1 dB + Av_2 dB}$$



$$A_{v_T} = A_{v_1} \cdot A_{v_2}$$

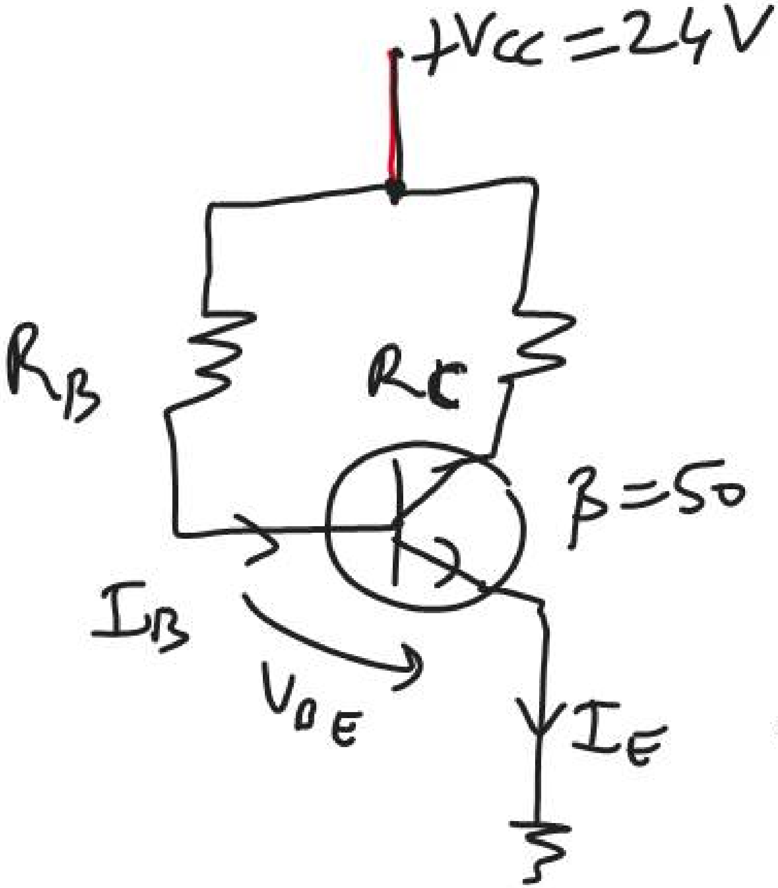
$$A_{v_T} = \left(\frac{Z_i}{Z_i+R_s}\right) A_{v_2}$$

↓ BJT Av



$$A_{v_1} = \frac{v_i}{v_s} = \frac{Z_i}{Z_i+R_s}$$

DC Analysis



INPUT KVL

$$V_{CC} - I_B R_B - V_{BE} = 0$$

$$I_B = \frac{V_{CC} - V_{BE}}{R_B} = \frac{24 - 0.7}{560 \times 10^3}$$

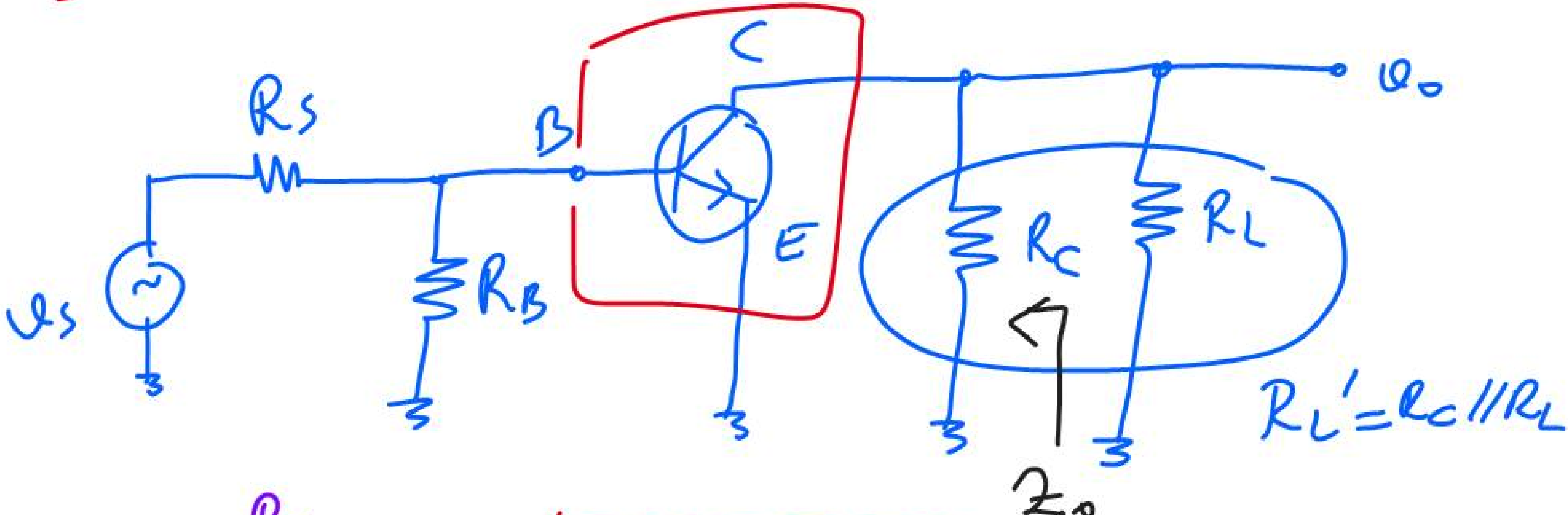
$$I_B = 0.41 \times 10^{-4} = 41 \times 10^{-6} A = 41 \mu A$$

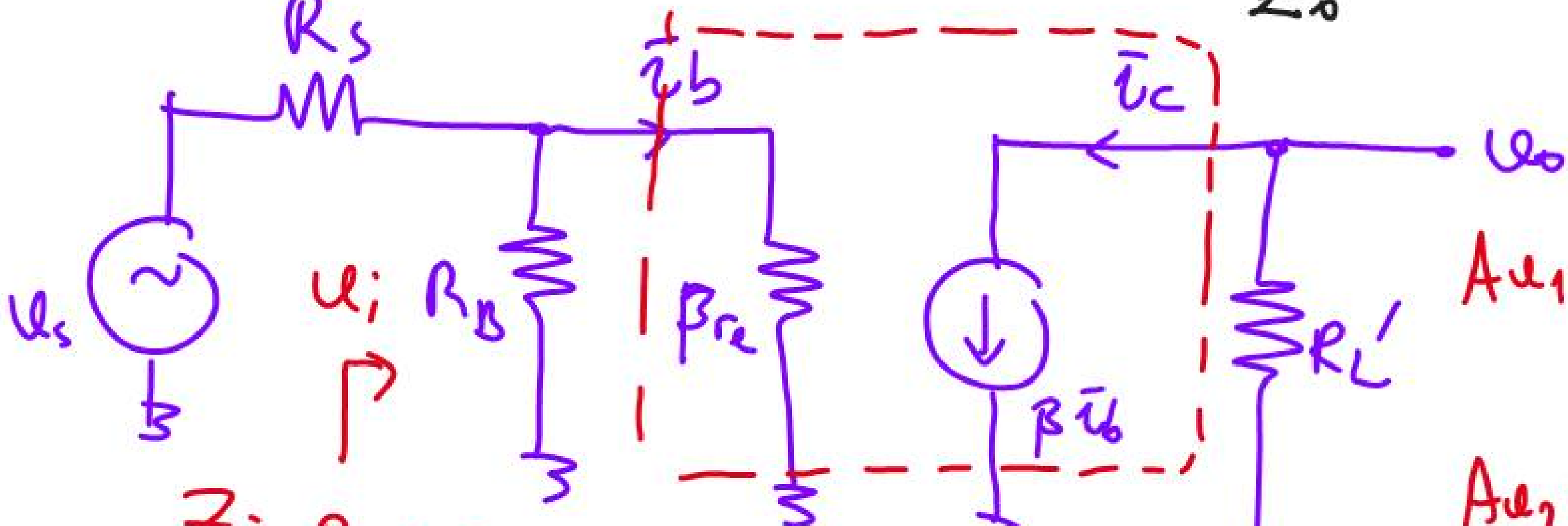
$$I_E = (\beta + 1) I_B = 51 \times 41 \times 10^{-6}$$

$$I_E \cong 2 \times 10^{-3} A \cong 2 mA$$

$$r_e = \frac{V_T}{I_E} = \frac{26 \times 10^{-3}}{2 \times 10^{-3}} = 13 \Omega$$

AC Analysis





$$A_{v_1} = \frac{v_i}{v_s} = \frac{Z_i}{Z_i + R_s}$$

$$A_{v_2} = -\frac{R_L'}{r_e} = \frac{v_o}{v_i}$$

$$Z_i = R_B // \beta r_e = \frac{560\times10^3 \times 51 \times 13}{560\times10^3 + 51\times13} \simeq 660\,\Omega$$

$$A_{v1} \cong \frac{660}{10^3 + 660} \cong 0.4$$

$$A_{v2} = -\frac{R_L'}{r_e} \cong -\frac{1.7 \times 10^3}{13}$$

$$A_{v2} \cong -130$$

$$A_{vT} = \frac{v_o}{v_s} = 0.4 \times (-130)$$

$$A_{vT} \cong -52$$

$$R_L' = \frac{4.3 \times 10^3 \times 2.7 \times 10^3}{(4.3 + 2.7) \times 10^3}$$

$$R_L' \cong 1.7 \times 10^3 \, \Omega$$

$$Z_o \cong R_C \cong 4.3 \, K\Omega$$

Q.E.D.

Ex 2