BJT Amplifier
Common Emitter Amp (H.11)

20170207

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References

Based

[1] Floyd, Electronic Devices 7th ed
[2] Cook,

[2] en.wikipedia.org

R_1

R_C

C_3

V_{out}

C_1

V_{in}

R_2

R_E

C_2

R_L
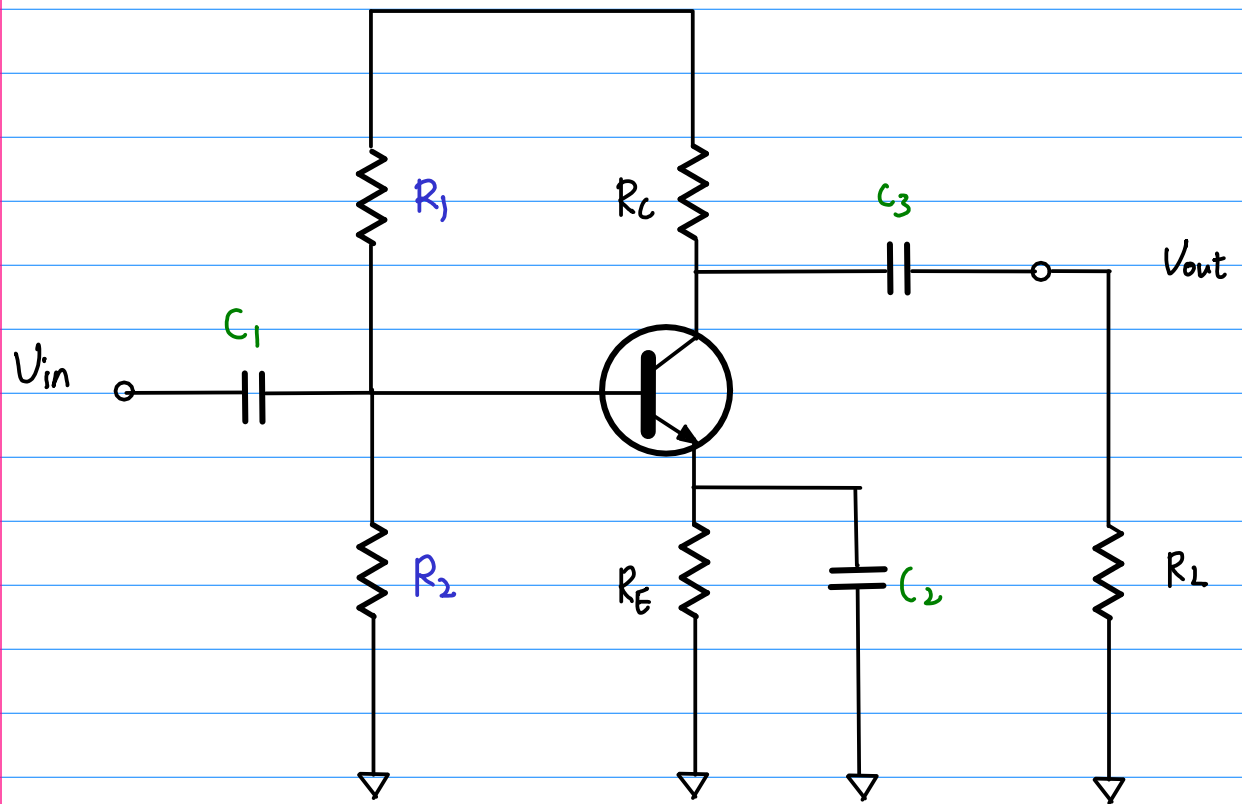
DC Analysis
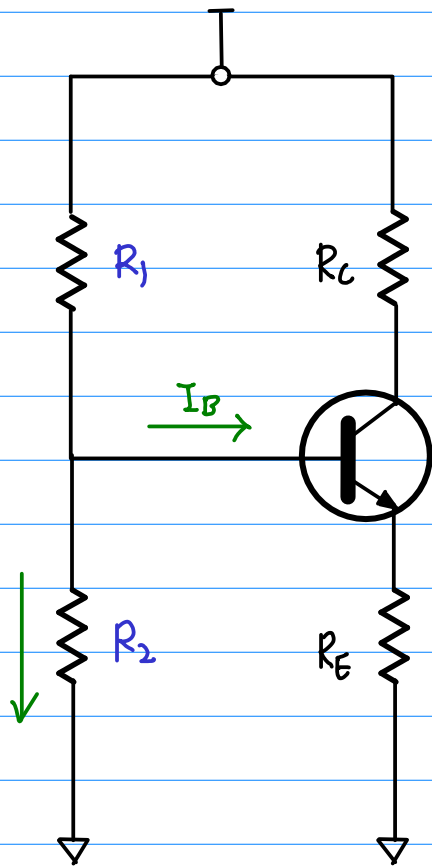
AC Ground

C_1, C_2, C_3 — effectively short

their values are selected

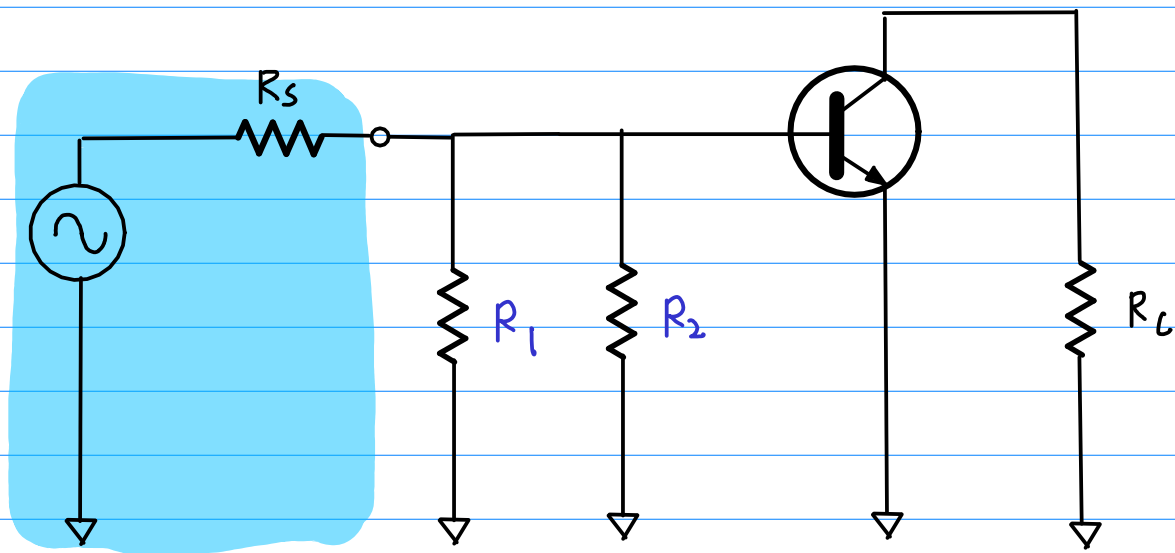s.t $\quad X_c = \dfrac{1}{j\omega c} \cong 0\,\Omega$

at the signal frequency (ω)

V_{cc}

dc source   ac ground

Top circuit labels:
R_1, R_C, C_3, V_{out}, C_1, V_{in}, R_2, R_E, C_2, R_L

Bottom circuit labels:
V_{out}, V_{in}, R_2, R_1, R_C, $|R_L$

AC Equivalent Circuit

R_1

R_2

R_C

R_S

R_1

R_2

R_C

ac Source

Circuit 1

R_S

B

c

R_1 R_2 E R_C

ac source

Circuit 2

R_S

B C

$R_{in(base)} \Rightarrow$

R_1 R_2 E R_C

Circuit 3

R_S

B

R_1 R_2 $R_{in(base)}$

R_S

B

R_1 R_2 $R_{in(base)}$

R_S

B

$R_1 \parallel R_2 \parallel R_{in(base)}$

Input Resistance

C

$\beta_{ac} I_b$

B

I_b

r_e'

E

C

$\beta_{ac} I_b$

B

I_b

r_e'

E

C

$\beta_{ac} I_b$

R_S B I_b

V_s

V_b

r_e'

E

C

$\beta_{ac} I_b$

B I_b

V_b

r_e'
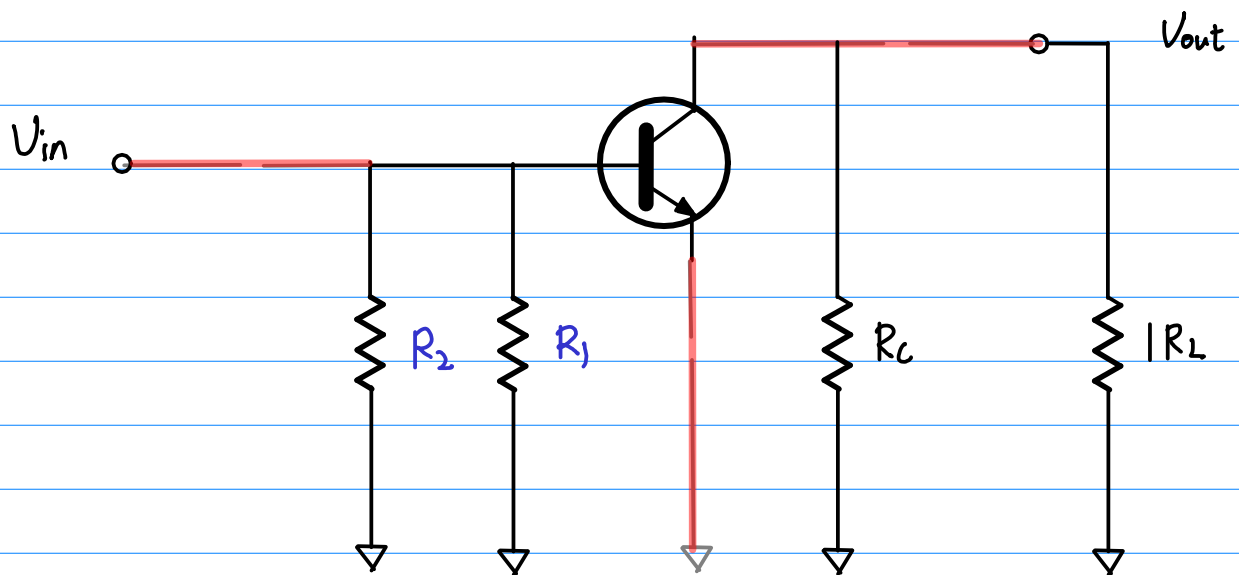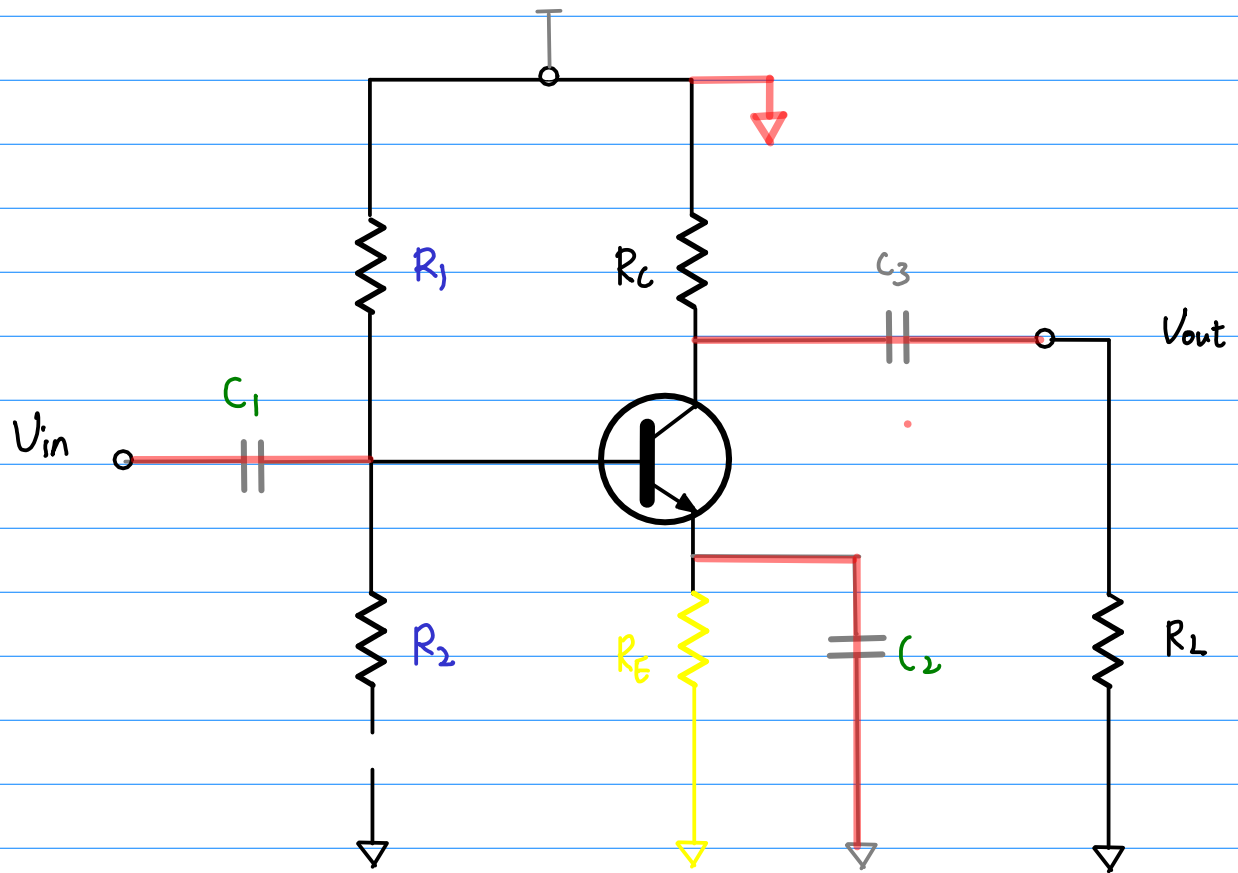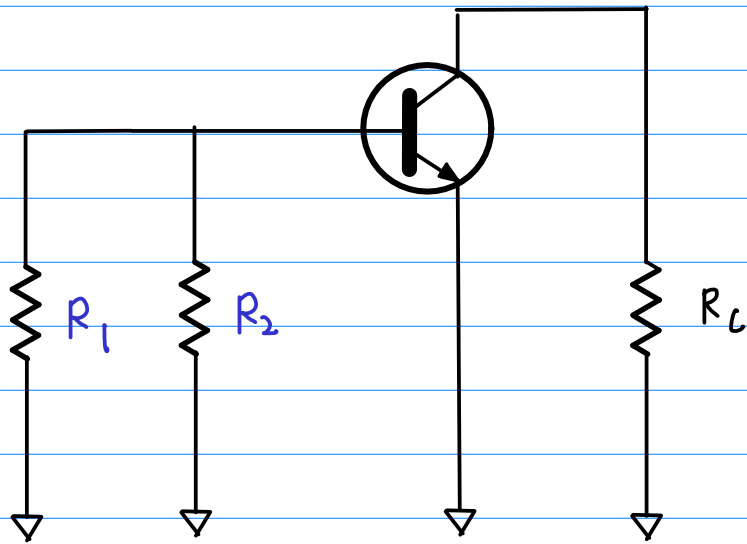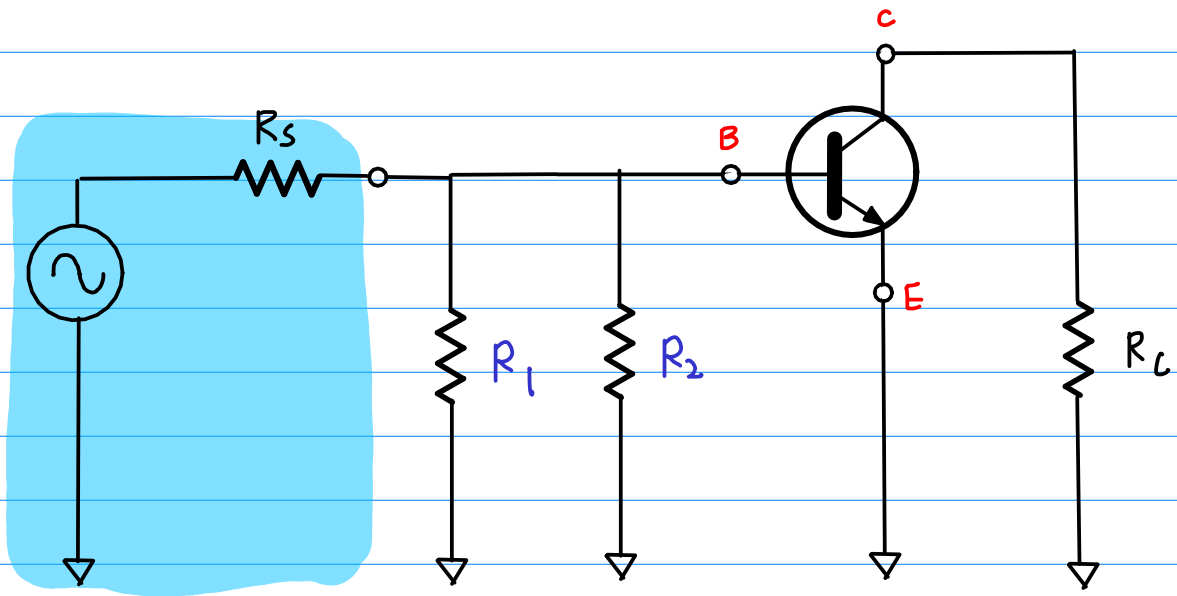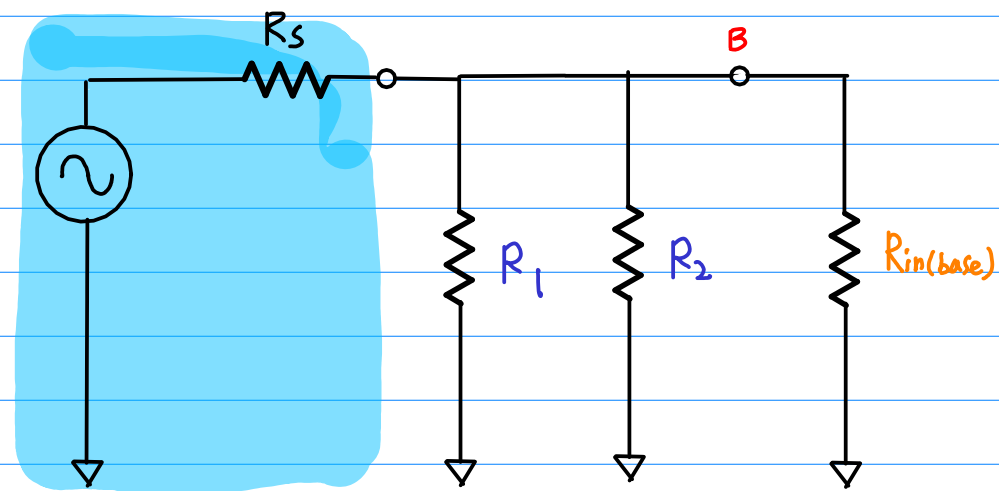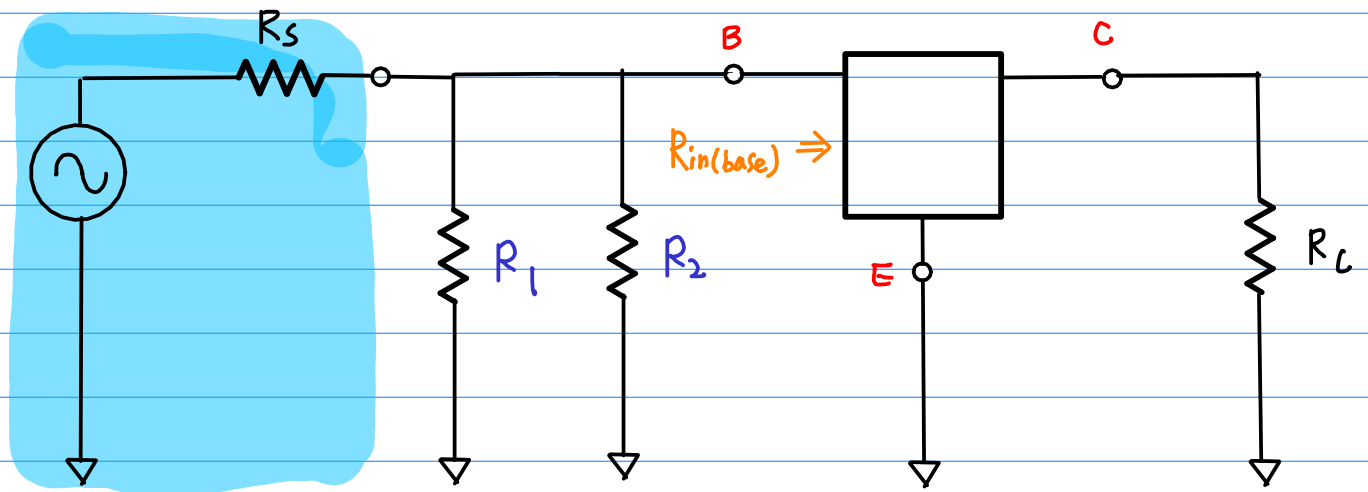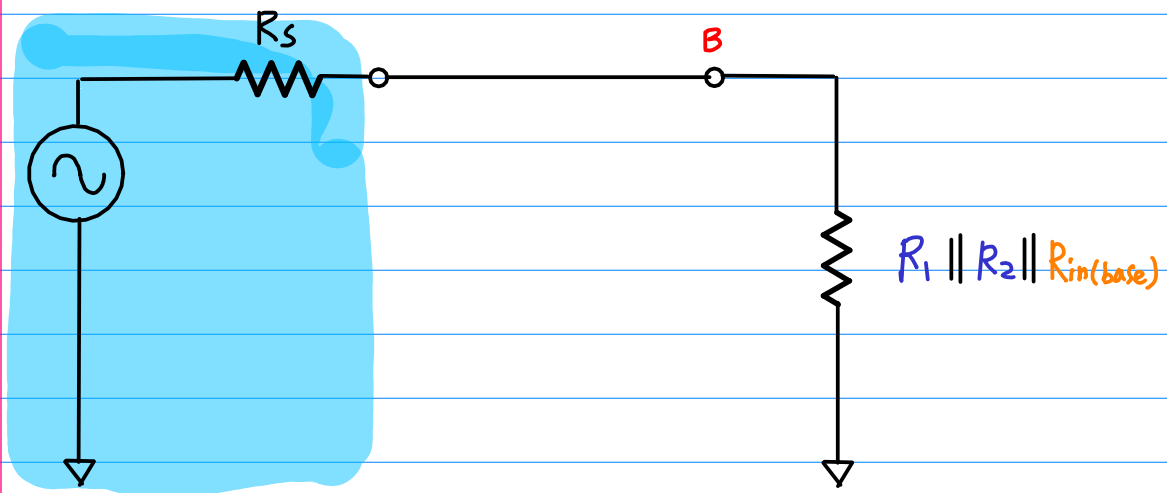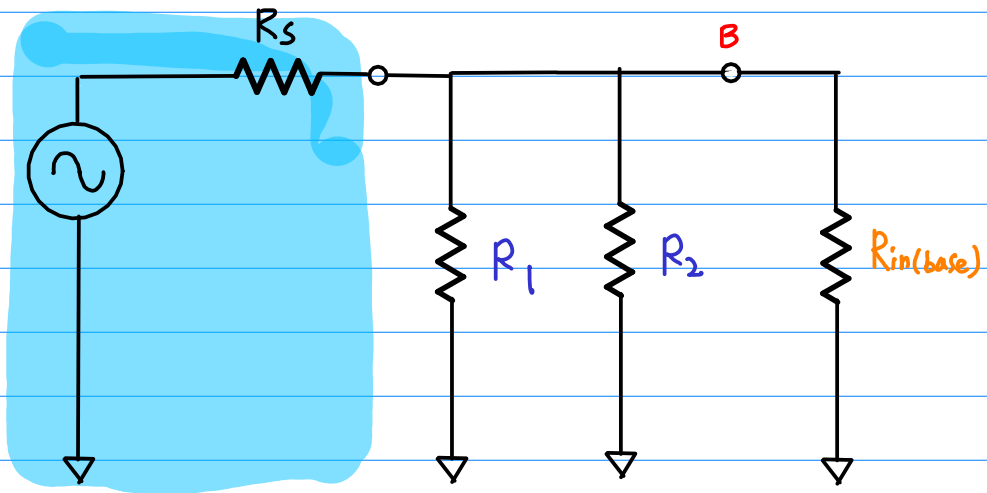
E
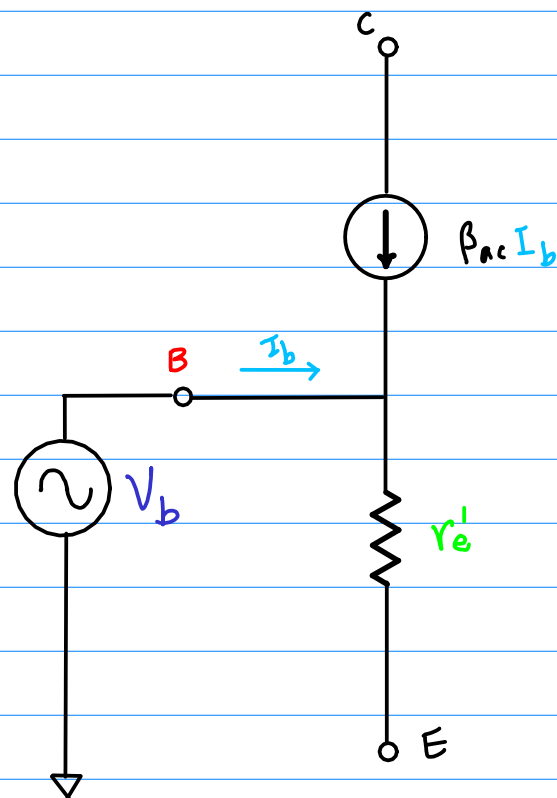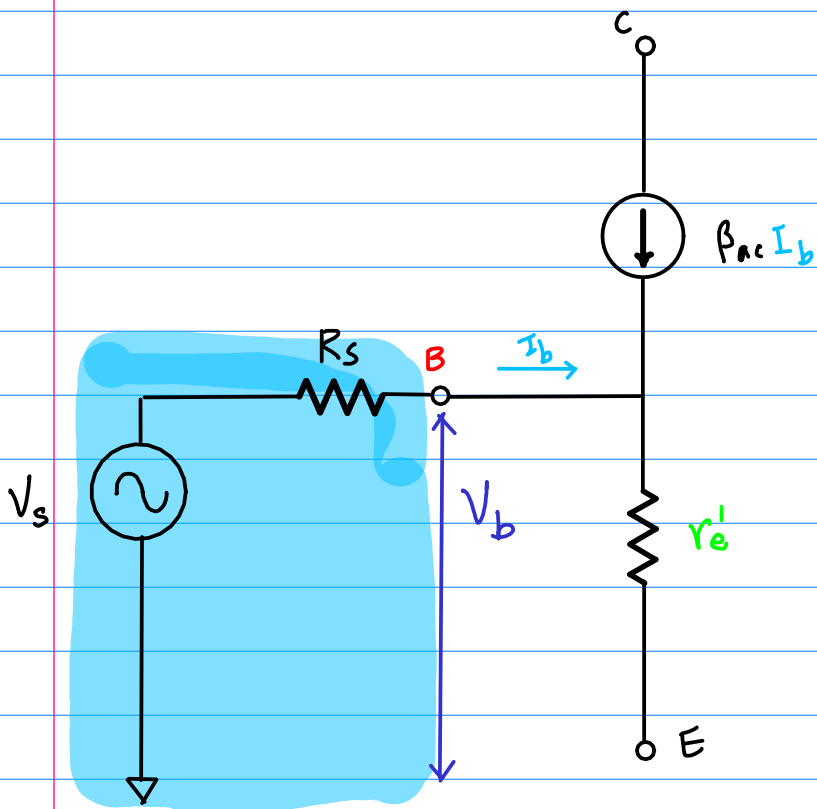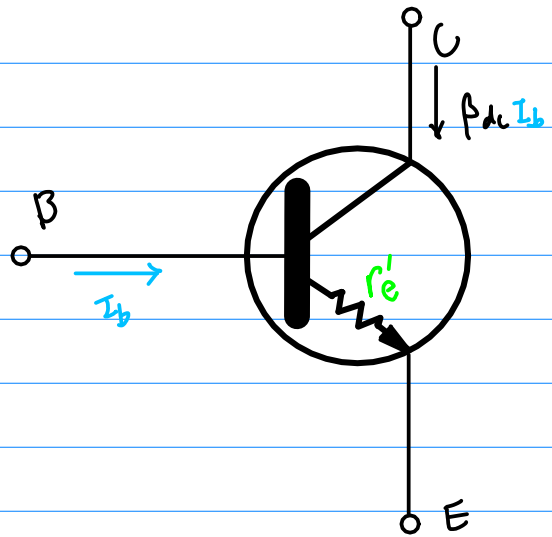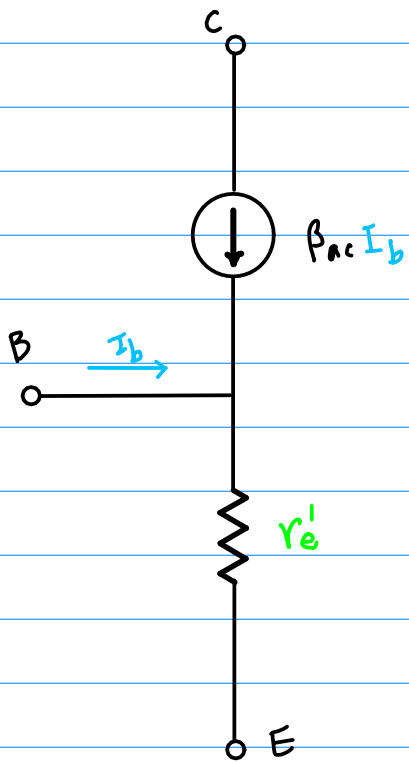
Output Resistance
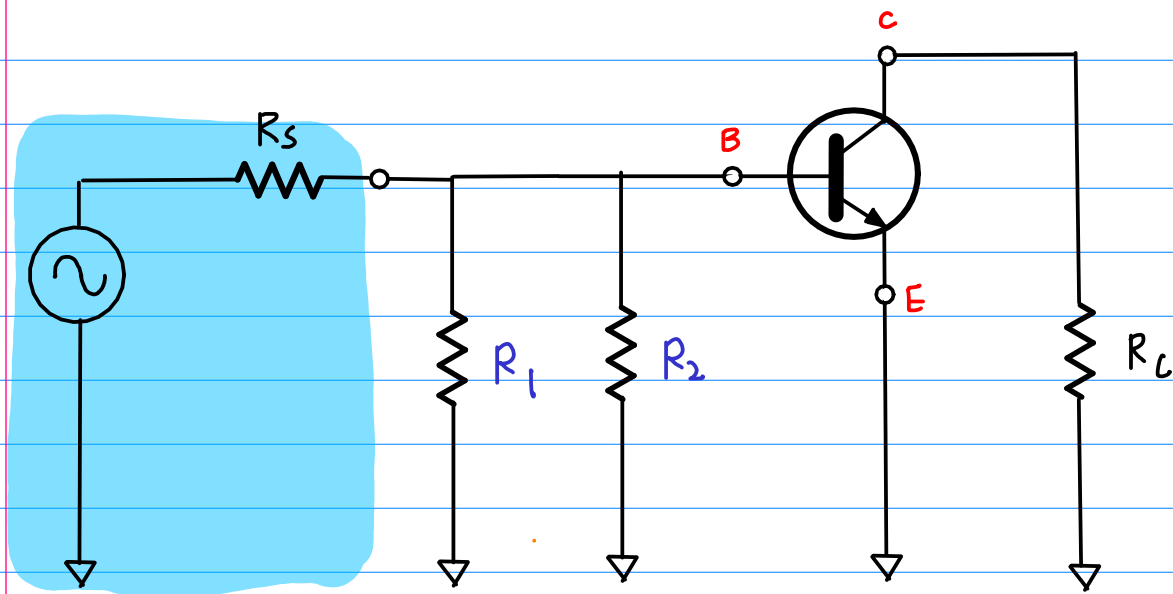
ac Source

$$R_{out\,(collector)} = r_c' \parallel R_c$$
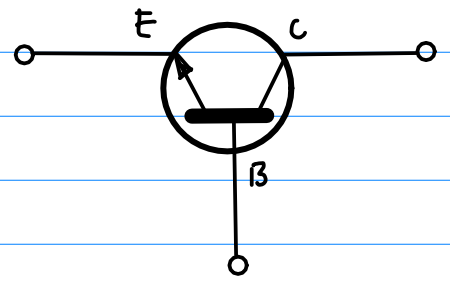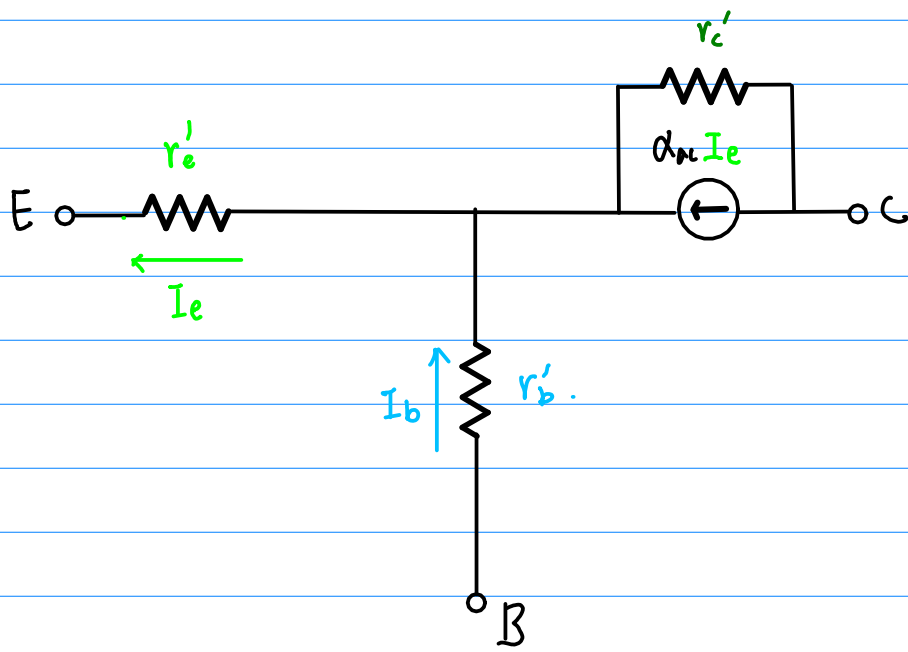$$\cong R_c \quad (r_c' \gg R_c)$$

Labels within figures:

R_S, R_1, R_2, R_C, B, C, E

$\Leftarrow R_{out(collector)}$
$= r_c'$

r_c'

r_e'

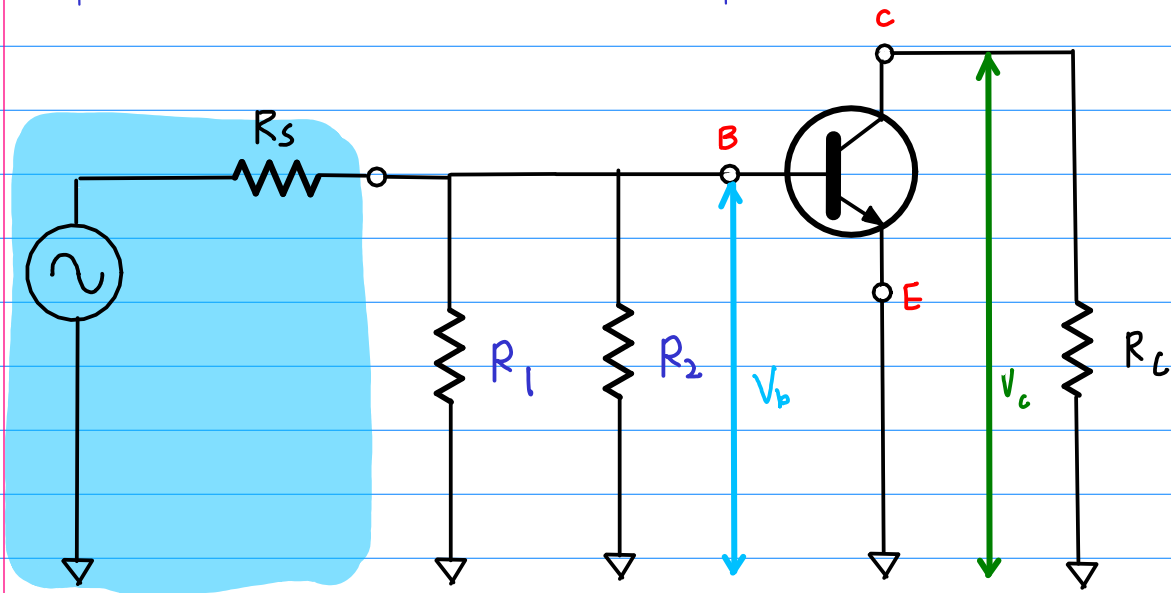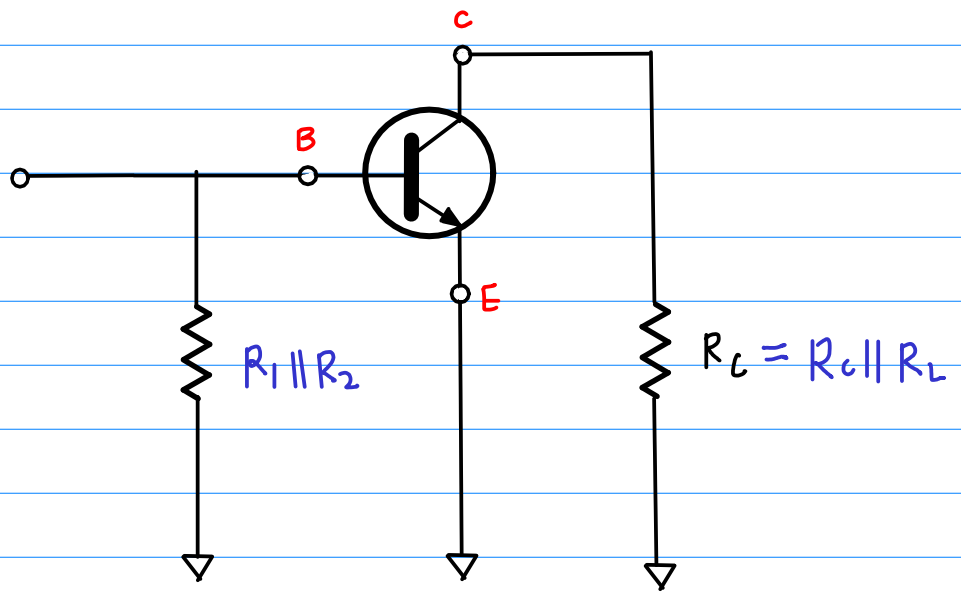$\alpha_N I_e$

E

I_e

I_b

r_b'

B

C

E

C

B
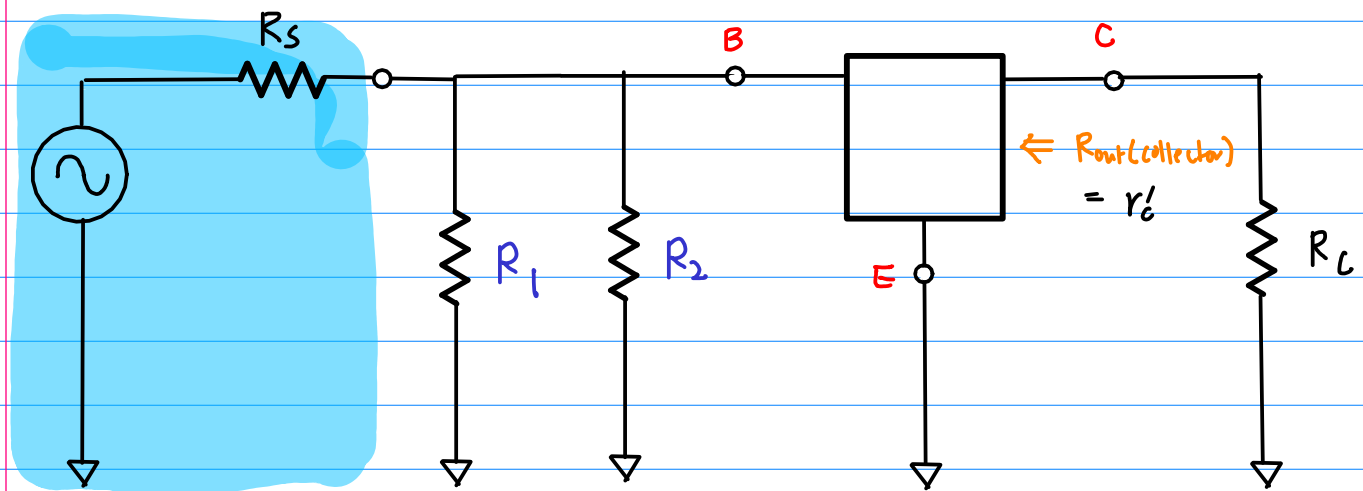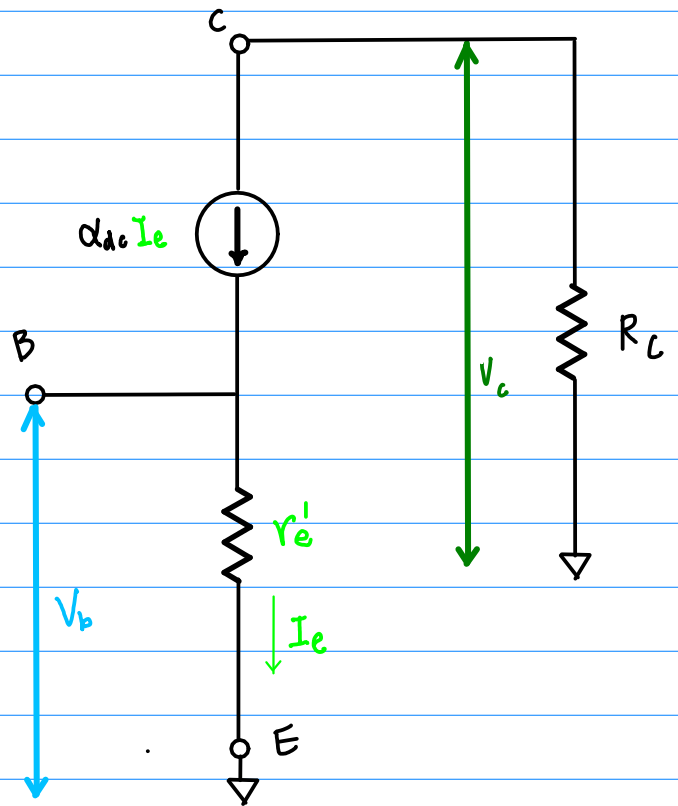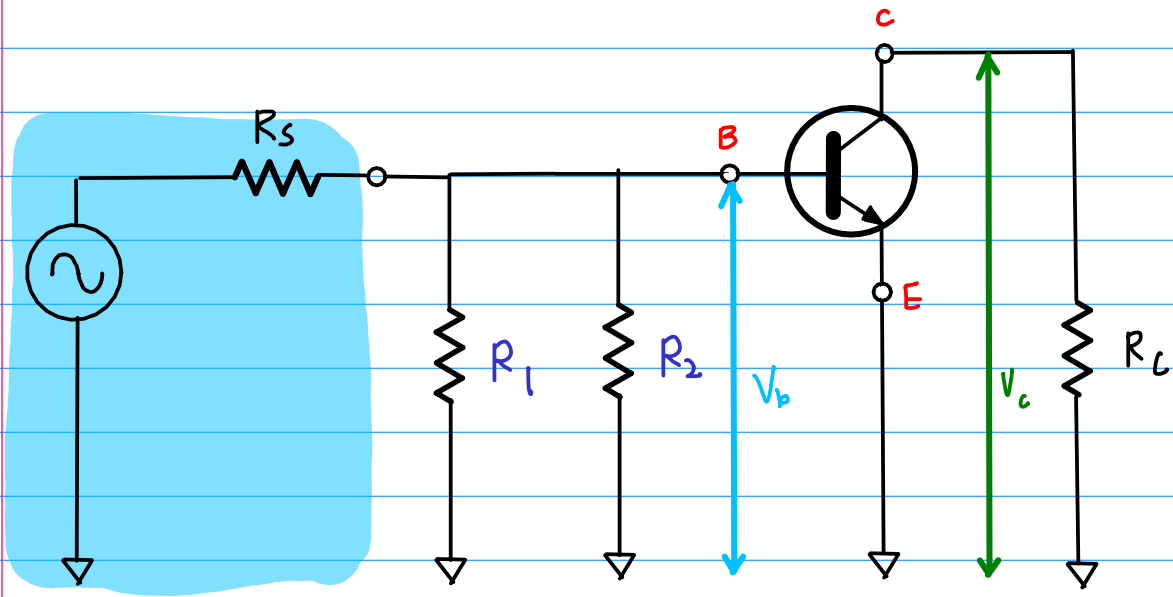
Voltage Gain

Overall Gain $V_c / V_s = V_b / V_s \times V_c / V_b$

attenuation V_b / V_s

R_s

B

c

E

R_1

R_2

V_b

V_c

R_c

amplifier gain
base-to-collector
V_c / V_b

Load Effect on the voltage Gain

R_1

R_C

C_3

C_1

V_{in}

V_{out}

R_2

R_E

C_2

R_L
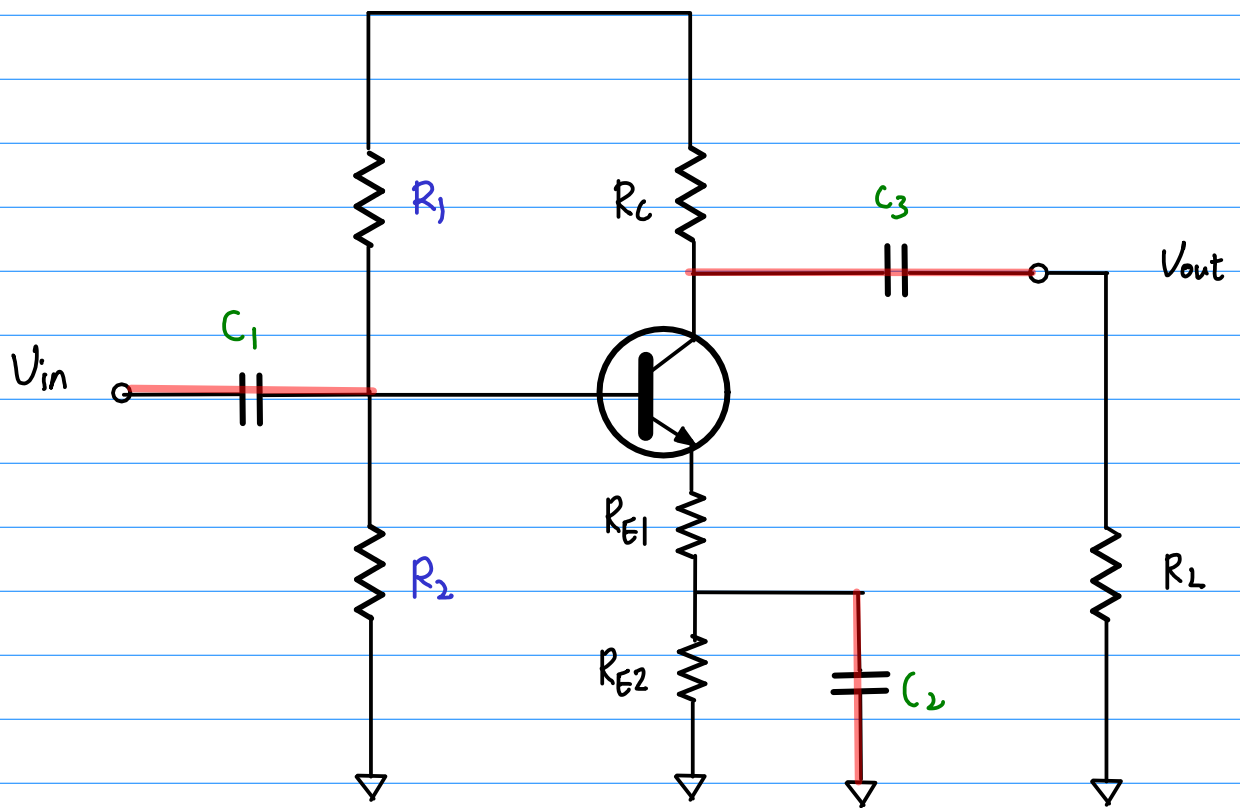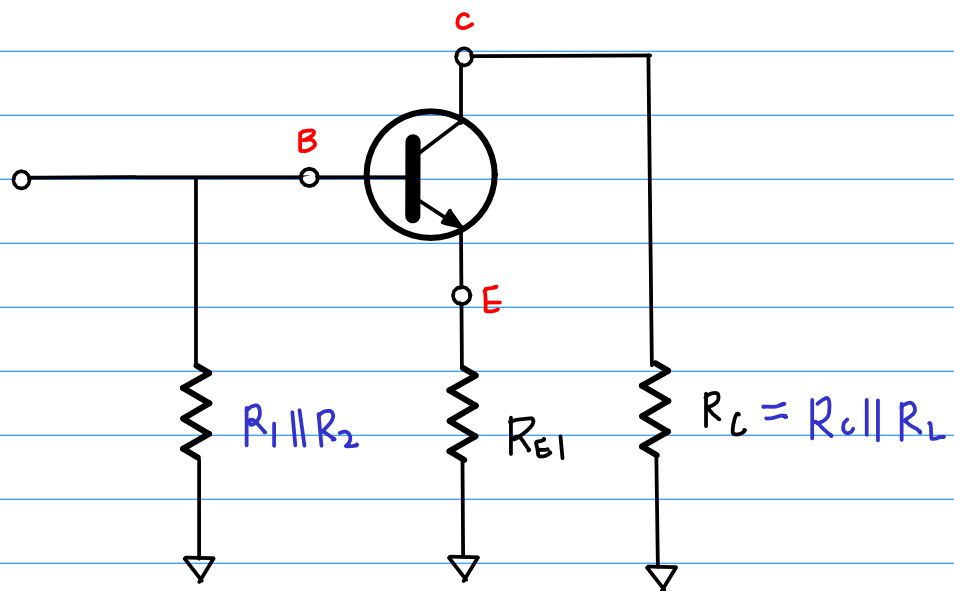
C

B

E

$R_1 \| R_2$

$R_C = R_C \| R_L$

R_1

R_C

C_3

V_{out}

C_1

V_{in}

R_2

R_{E1}

R_L

R_{E2}

C_2
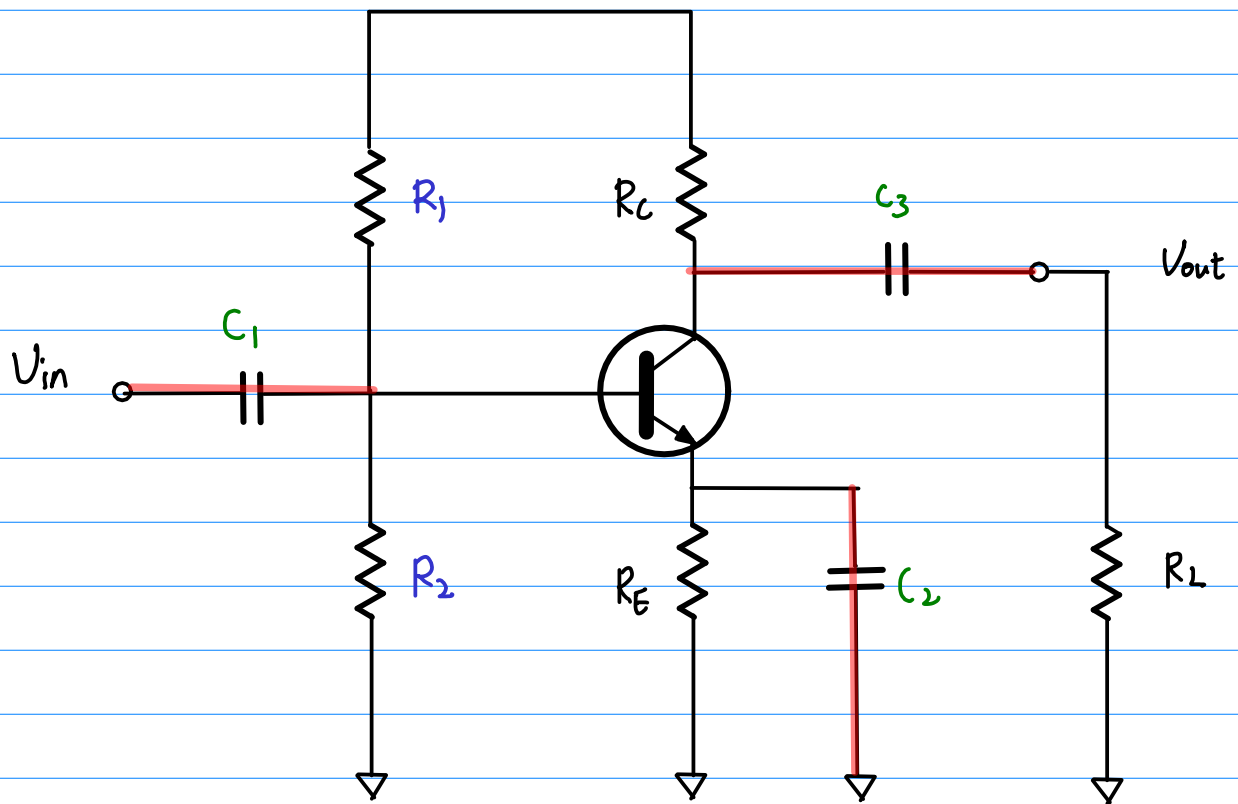
bypassed resistance to minimize
the effect of r'_e $\Rightarrow$ gain stability

C

B

E

$R_1 \| R_2$

R_{E1}

$R_C = R_C \| R_L$

Current Gain