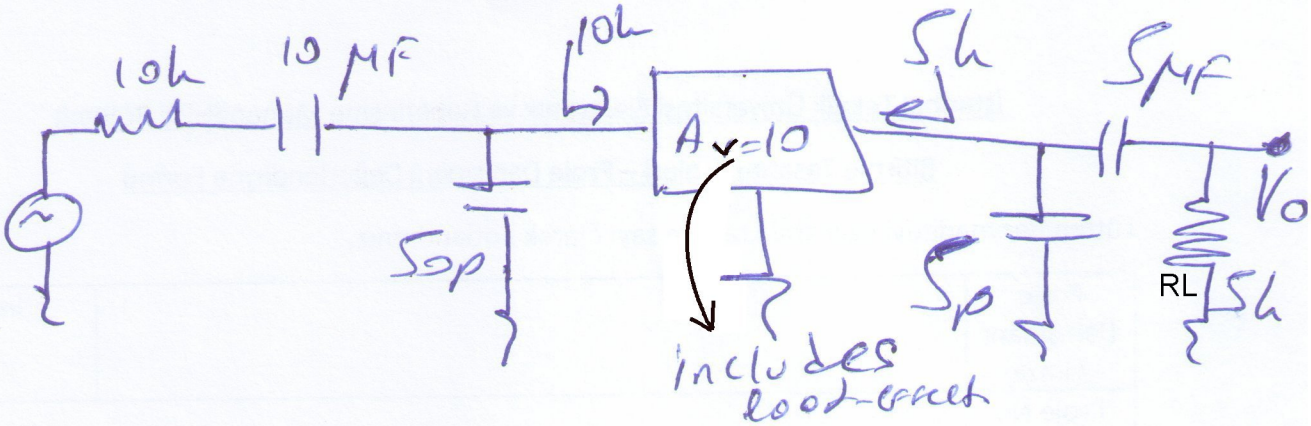
Summer 19 - MT1 - Solution

1)



a) Cutoff frequencies

Low frequency region

$$\omega_{L1} = \frac{1}{10MF.(10k+10k)} = 5 rd/sn$$

$$\omega_{L2} = \frac{1}{5MF(5k+5k)} = 20 rd/sn$$

$$f_{LC} \cong 4 Hz$$

High frequency region

$$\omega_{u1} = \frac{1}{5p.(10k//10k)} = 4M rd/sn$$

$$\omega_{u2} = \frac{1}{5p(5k//5k)} = 80M rd/sn$$

$$\omega_{uc} \cong 4M rd/sn$$

$$f_{uc} \cong 637kHz$$

b) Pulse response (VPam=20mV, td=10mSn)

$$t_r = \frac{0.35}{637k} \cong 0,6\mu Sn$$

$$f_1 = \frac{t_0}{\tau_1} \rightarrow \frac{1}{\omega_{L1}} = \frac{1}{500}$$

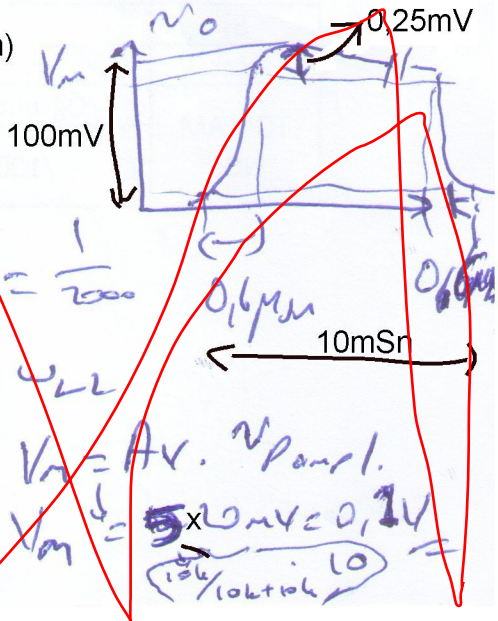
$$f_2 = \frac{t_0}{\tau_2} = \frac{1}{2000} \rightarrow \omega_{L2}$$

$$f \cong f_1 + f_2 = \frac{5}{2000}$$

$$V_m = A_v . V_{Pam1}$$

$$V_m = 5 \times 10mV = 0,1V$$

(10k/10k+10k = 1/2)



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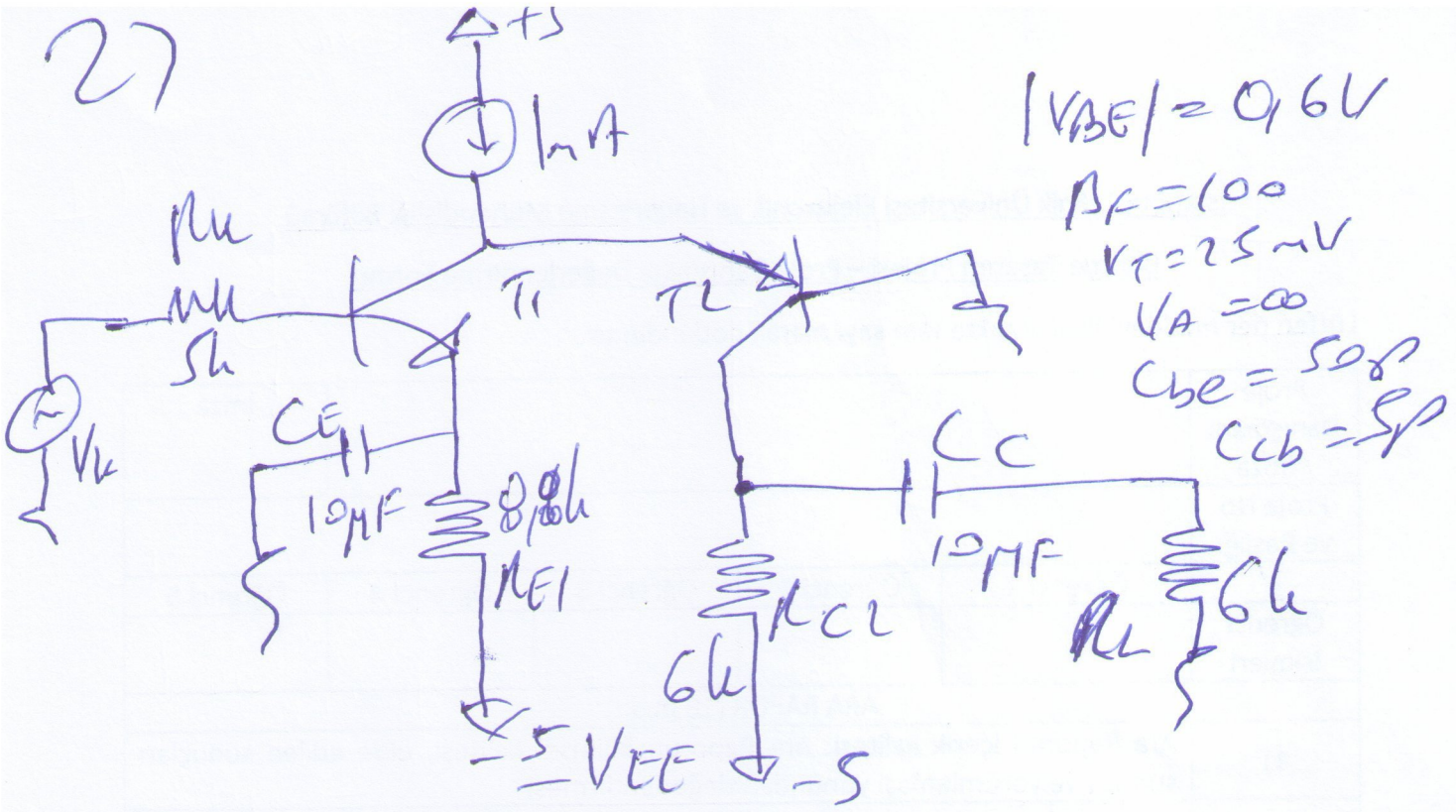


$|V_{BE}| = 0,6V$
$\beta_F = 100$
$V_T = 25mV$
$V_A = \infty$
$C_{be} = 50p$
$C_{cb} = 5p$

a) find the poles and the zero.

$$f_{ZEP} = \frac{1}{\left[8,8k \,//\, \left(\frac{1}{g_{m1}} + \frac{R_L}{\beta_F}\right)\right] \cdot C_E \cdot 2\pi}$$

$\frac{R_L}{\beta_F} \approx 100\Omega$ can be ignored

$$g_{m1} = \frac{I_{C1}}{V_T} \qquad I_{C1} = \beta_F \cdot I_{B1} = \frac{0 - V_{RL} - V_{BE} + V_{EE}}{R_{E1}}$$

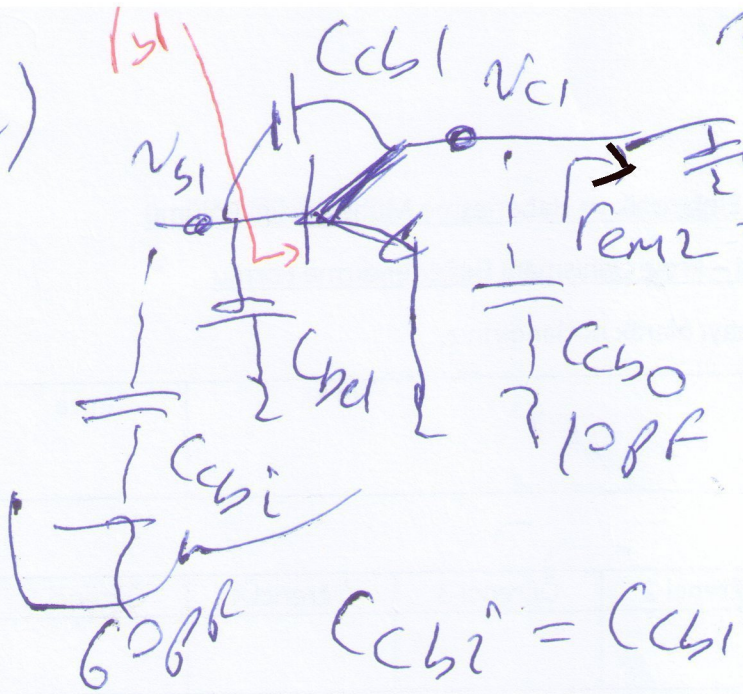
$$= \frac{0,5mA}{25mV} = 20mS \qquad = \frac{4,4V}{8,8k} = 0,5mA$$

$$f_{ZEP} \cong \frac{1}{2\pi \cdot 100 \cdot 10\mu F} = 1k/2\pi = 160Hz \rightarrow f_{LC}$$

$$f_{LE0} = \frac{1}{2\pi \, 8,8k \cdot 10\mu} \cong 2Hz$$

$$f_{LCc} = \frac{1}{2\pi (6k+6k) 10\mu} = 1,2Hz$$

2)



$\frac{V_{c1}}{V_{b1}} = -g_{m1} \cdot r_{em2} = -1$

$r_{em2} = \frac{1}{g_{m2}} = \frac{V_T}{I_{c2}} = 50\Omega$

$I_{mA} - 0,5_{mA} = 0,1_{mA}$

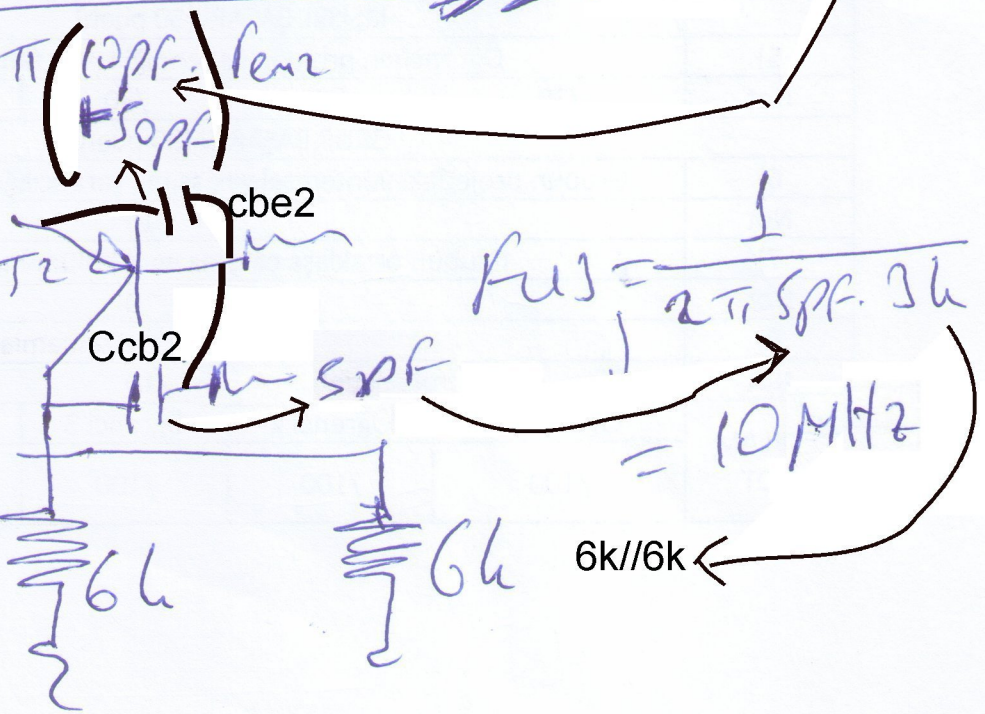
$C_{cbi} = C_{cb1}(1-(-1)) = 10pf$

$C_{cb0} = C_{cb1}(1-\frac{1}{-1}) = 10pf$

$f_{u1} = \frac{1}{2\pi \cdot 60pf \cdot (R_w // r_{b1})} \cong 1MHz$

$f_{b1} = \beta_f \cdot \frac{1}{g_{m1}} = 5k$

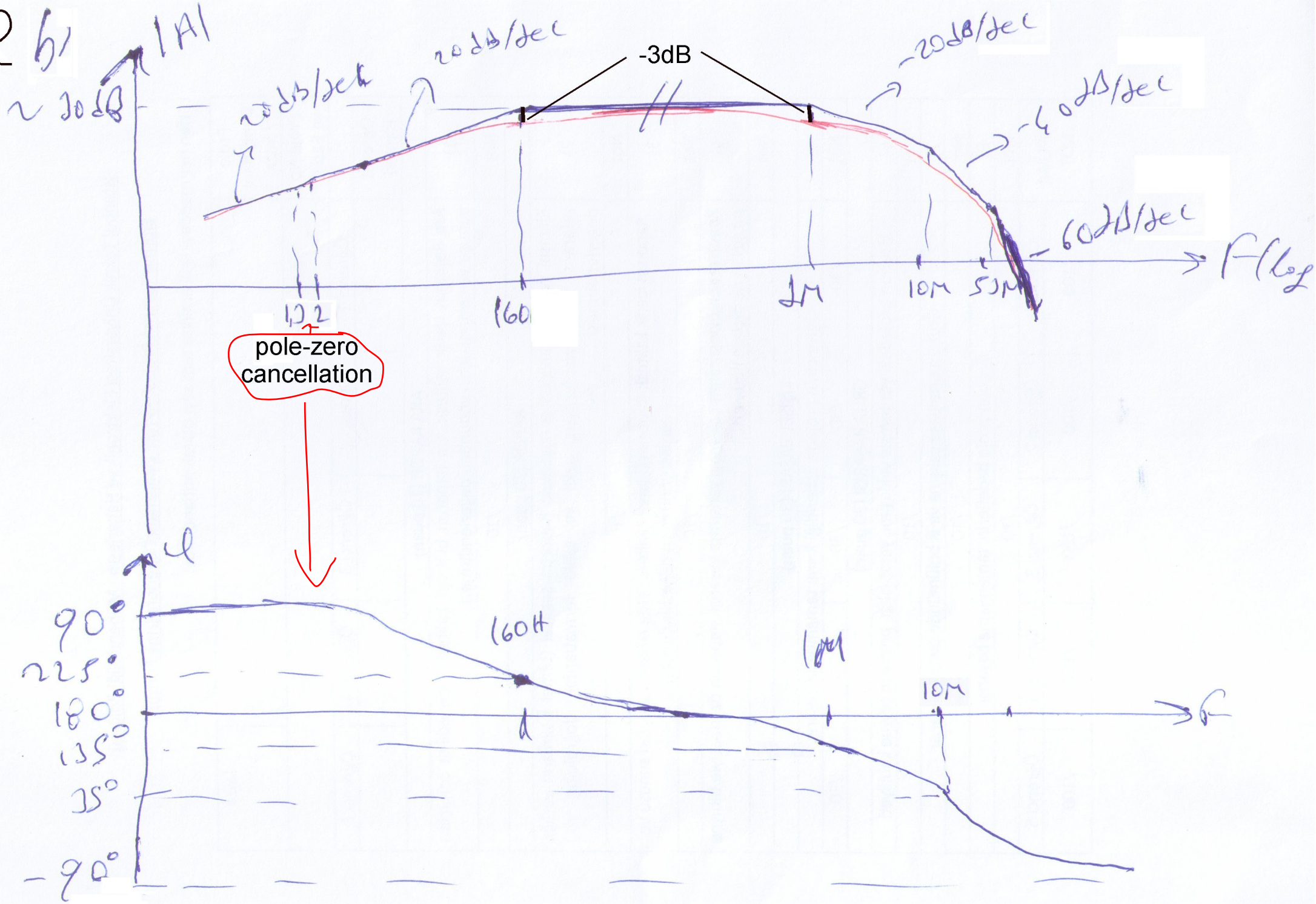
$f_{u2} = \frac{1}{2\pi (10pf \cdot r_{em2} + 50pf)} \cong$ ~~593~~ MHz



$f_{u1} = \frac{1}{2\pi \cdot 5pf \cdot 3k} = 10MHz$

$f_{uc} \cong f_{u1} = 1MHz$

2 b)


|A|
~ 30dB
20dB/dec
20dB/dec
-3dB
-20dB/dec
-40dB/dec
-60dB/dec
f (log)
1,2
160
1M
10M
50M
pole-zero
cancellation
φ
90°
225°
180°
135°
45°
-90°
160Hz
1MHz
10M
f