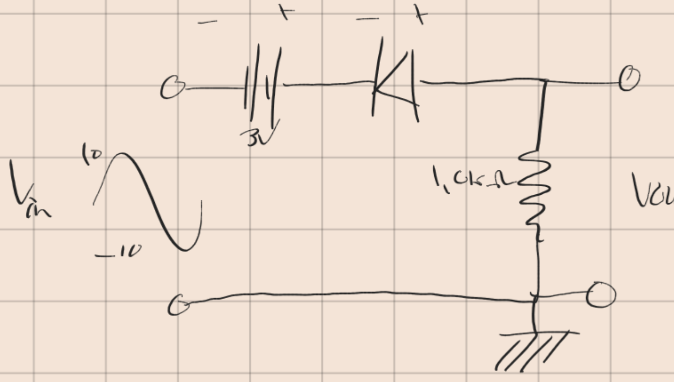
1.



RB on positive ½cycle.

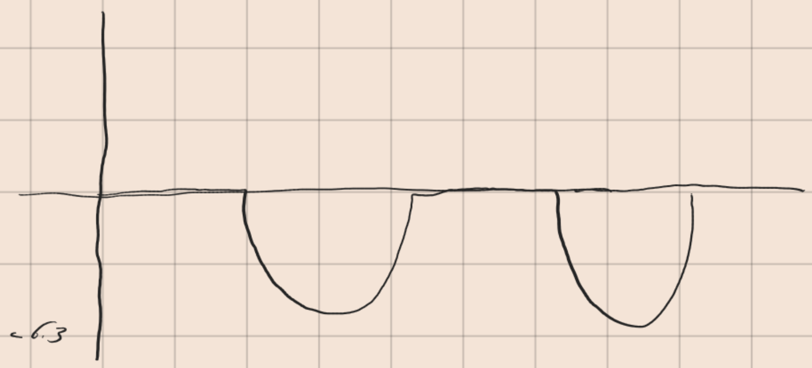
$V_{out} = 0$

FB on -ve ½cycle.

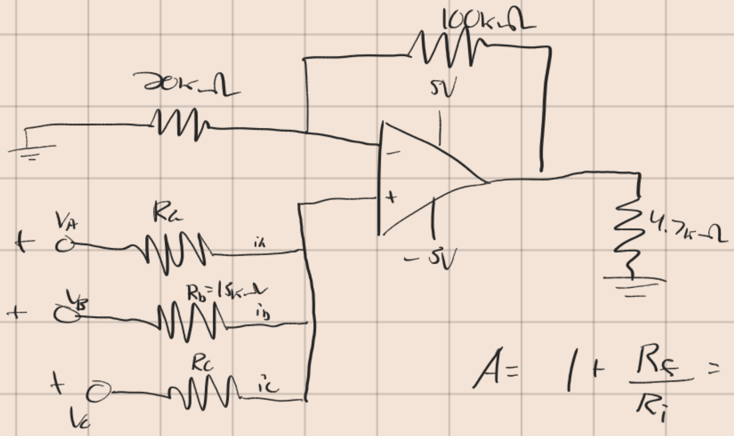
$-V_{in} + V_{out} - 0.7 - 3 = 0$

$V_{out} = V_{in} + 3.7$

$= -10 + 3.7 = -6.3V.$



2.



$V_o = v_a + 2V_b + 3V_c$

a) R_a & R_c?

$A = 1 + \frac{R_f}{R_i} = 1 + 5 = 6. \quad V_o = 6V_{in}$

$6V_{in} = V_a + 2V_b + 3V_c$

$V_{in} - V_a + 2(V_{in} - V_b) + 3(V_{in} - V_c) = 0 \; /30$

$\frac{V_{in} - V_a}{30k\Omega} + \frac{(V_{in} - V_b)}{15k\Omega} + \frac{(V_{in} - V_c)}{10k\Omega} = 0$

$R_a = 30k\Omega$

$R_b = 15k\Omega$

$R_c = 10k\Omega$

b) $i_a, i_b, i_c = ?$ $V_a = 0.7V$ $V_b = 0.4V$, $V_c = 1.1V$

$V_o = 0.7 + 0.8 + 3.3 = 4.8V.$

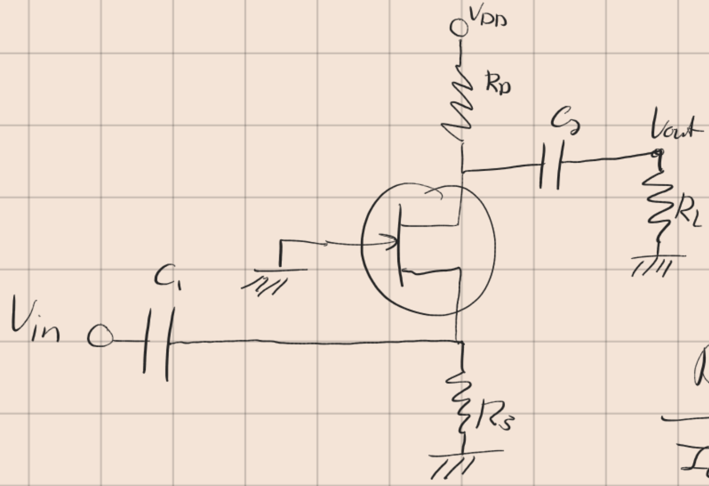
$V_{in} = \frac{4.8}{6} = 0.8V.$

$i_a = \frac{V_{in} - V_a}{30k\Omega} = 3.33\mu A$

$i_b = 13.3\mu A$

$i_c = 10\mu A.$

3.



$g_m = 2800\mu S$ $V_{DD} = 8V.$

$R_D = 10k\Omega$ $R_S = 2.2k\Omega$

$R_L = 10k\Omega$ $C_1 = 10\mu F$ $C_2 = 10\mu F$

DC analysis.

$I_G = 0,\ V_G = 0.$ $V_{GS} = -V_S = -I_D R_S$

$V_D = V_{DD} - I_D R_D.$ $I_D = I_{DSS}.$

$V_{DS} = V_D - V_S$

$= V_{DD} - I_D(R_D + R_S)$

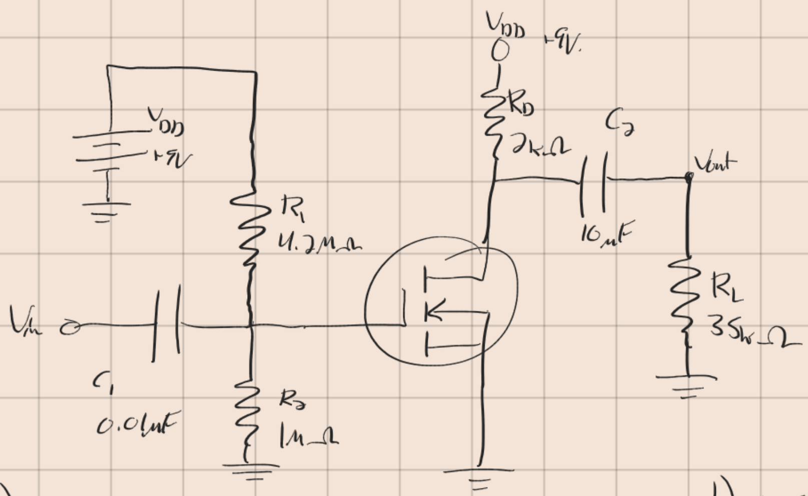
$A = g_m R_d = g_m R_D || R_L = 14.$

Total input R $R_{in} = \left(\frac{1}{g_m}\right) || R_S$

$= 307.3\Omega$

input R at source $R_{in(source)} = \frac{1}{g_m} = 357.1\Omega$

4.



Voltage Divider Bias.

$V_{GS(th)} = 1.6V.$

$g_m = 30mS.$ $I_{D(on)} = 180mA. @ V_{GS} = 2.5V.$

$V_{in} = 50mV$

a) $V_{GS}?$ $V_{GS} = V_G.$

$\Rightarrow V_G = 9\left(\frac{1}{5.2}\right) = 1.731V.$

$V_{GS} = 1.73V.$

b) $I_D = K(V_{GS} - V_{GS(th)})^2$

$K = \frac{I_{D(on)}}{(V_{GS} - V_{GS(th)})^2} = \frac{0.180}{(2.5-1.6)^2} = 0.222$

$I_D = 0.222(1.73 - 1.6)^2 = 3.756\,mA.$

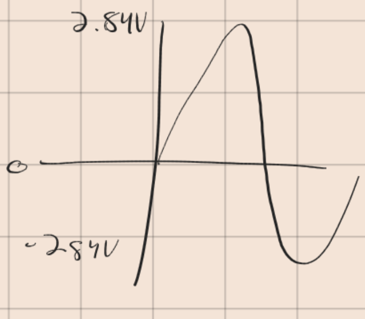
$I_D = 3.76\,mA$

c) $V_{DS} = V_{DD} - I_D R_D = 9 - (3.76)(2) = 1.49V.$

$V_{DS} = 1.49V.$

$A = g_m R_d = g_m R_D || R_L = 56.756 = 56.8$

$V_{out} = V_{in}(56.8) = 2.84V.$



5.

$V_{cc} = 12V.$

$R_o = 16\,\Omega$

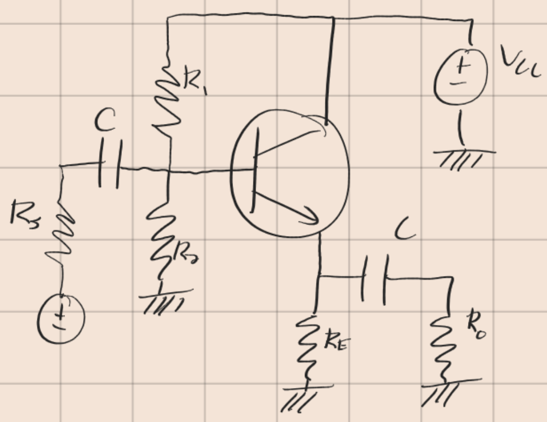
$R_1 = 82k\Omega$

$R_2 = 22k\Omega$

$R_s = 0.7k\Omega$

$R_E = 0.5k\Omega$

$\beta = 130$



C is open circuit

$V_{CEQ} = ? = V_{CQ} - V_{EQ} = V_{cc} - I_{CQ} R_E$

$I_{CQ} = \beta_{DC} I_{BQ}$

$V_{Th} = V_{cc}\left(\frac{R_2}{R_1+R_2}\right) = 12\left(\frac{22}{104}\right) = 2.54V.$

$R_{Th} = R_1 \| R_2 = 17.3k\Omega$

$V_{Th} - I_{BQ} R_{Th} - V_{BE} - I_{CQ} R_E = 0$

$I_{BQ} = \frac{V_{Th} - V_{BE}}{R_{Th} + \beta_{DC} R_E} = \frac{2.54 - 0.7}{17.3k\Omega + 130(500)} = 22.4\mu A.$

$I_{CQ} = \beta_{DC} I_{BQ} = 2.91mA.$

$\hookrightarrow V_{CEQ} = 12 - (2.91mA)(500) = 10.55V.$ $\quad \underline{V_{CEQ} = 10.5V.}$

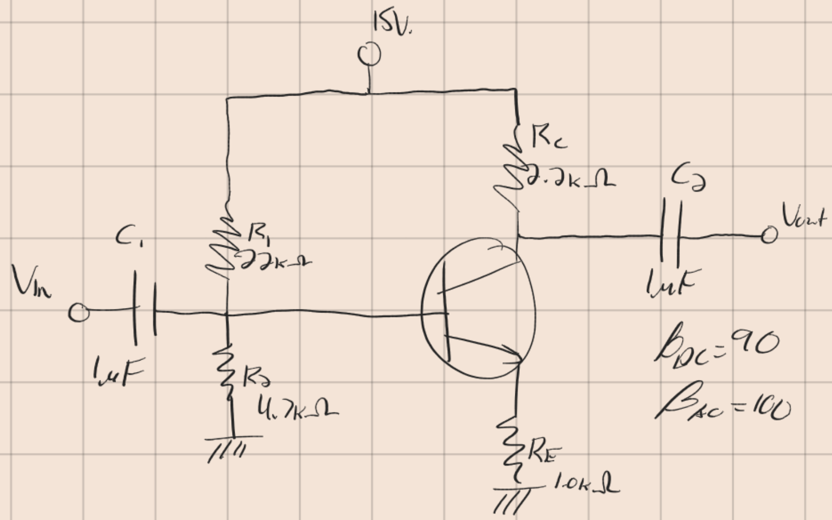
6.

a) $I_C, V_{CE}?$

$V_{Th} = 15\left(\frac{4.7}{26.7}\right) = 2.64V.$

$R_{Th} = R_1 \| R_2$

$= 3.87k\Omega$



$V_{Th} - I_B R_{Th} - V_{BE} - I_C R_E = 0$

$I_B = \frac{V_{Th} - V_{BE}}{R_{Th} + R_E \beta_{DC}}$

$= 20.7\mu A$

$I_C = \beta_{DC} I_B = 1.86mA.$

$V_{CE} = V_C - V_E$

$= 15 - 2200 I_C - I_C(1000)$

$= 9.05V.$

$(9.05V, 1.86mA)$

b) $A_v = \dfrac{R_c}{r_e' + R_E}$ $r_e' = \dfrac{25mV}{I_E} = \dfrac{25mV}{I_c} = 13.44$

$A_v = \dfrac{2200}{13.44 + 1000} = \underline{2.17}$

c) $R_{in(base)} = \beta_{ac} r_e' = 1344\ \Omega$

$R_{in(total)} = R_1 || R_2 || R_{in(base)} = 997.7\Omega$

d) $R_{out} \approx R_c = 2200\ \Omega$

e) $\underline{1st\ Stage}$ $R_s = 1.0k\ \Omega$

$\hookrightarrow$ $\text{Attenuation} = \dfrac{997.7}{1000 + 997.7} = 0.499$

$A_{v_1}' = (\text{Attenuation})(A_v) = 1.08$

2nd stage.

$\text{Attenuation} = \dfrac{997.7}{2200 + 997.7} = 0.312$

$A_{v_2} = \dfrac{R_c}{r_e' + R_E} = \dfrac{R_c || R_L}{r_e' + R_E} = 1.64$

$A_{v_2}' = (A_{v_2})(0.312) = \underline{0.5117}$

$A_v' = A_{v_1}' A_{v_2}' = 0.5526$

$\underline{A_v' = 0.553}$