2.11：V_{I2}与V_{I3}运算

$$V_I' = -\left(\frac{10k}{5k}V_{I2} + \frac{10k}{100k}V_{I3}\right)$$
$$= -\left(2V_{I2} + \frac{1}{10}V_{I3}\right)$$

V_{I1}与V_I'运算

$$V_O = -\left(\frac{100k}{20k}V_{I1} + \frac{100k}{100k}V_I'\right)$$
$$= -5V_{I1} + 2V_{I2} + \frac{1}{10}V_{I2}$$

2.12 (1) $V_{o1} = -\frac{R_4}{R_1}V_{s1} + \left(1+\frac{R_4}{R_1}\right) \times \frac{R_3}{R_2+R_3}V_{s2}$

$$V_o = -\frac{1}{C}\int_0^t \left(\frac{V_{s3}}{R_6} + \frac{V_{o1}}{R_5}\right)dt$$

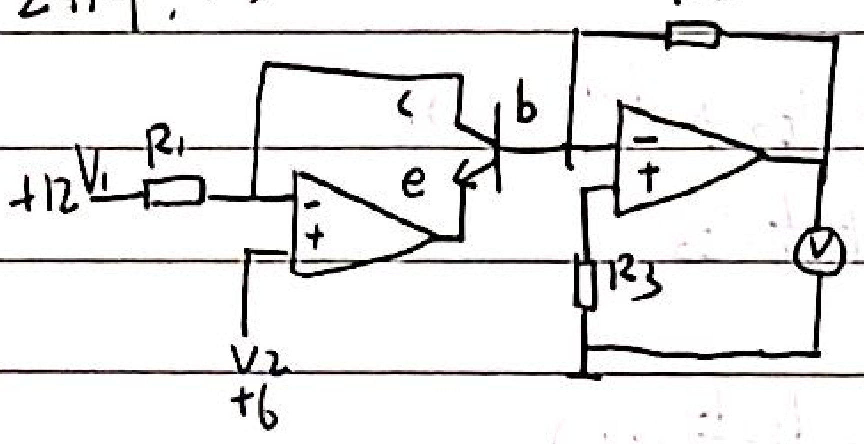
(2) 此时，$V_{o1} = V_{s2} - V_{s1}$

$$V_o = -\frac{1}{RC}\int_0^t (V_{s3} + V_{s2} - V_{s1})dt$$

2.13 V_{s1}与V_{s2}运算

$$V_{o1} = -\frac{R_4}{R_1}V_{s1} + \left(1+\frac{R_4}{R_1}\right)\frac{R_3}{R_2+R_3}V_{s2}$$
$$= -2V_{s1} + 1.5V_{s2} = 1V$$
$$V_o = -\frac{1}{C}\int_0^t \left(\frac{V_{o1}}{R_5} + \frac{V_{s3}}{R_6}\right)dt$$
$$= -100\int_0^t \left(V_{o1} + \frac{V_{s3}}{2}\right)dt$$
$$= -100\int_0^t 3\,dt = -10V$$
$$3t = 0.1$$
$$t = \frac{1}{30}s$$

2.14.(1)



(1) $V_b = V_{N2} = V_{P2} = 0V$

$V_{be} = 0.7$, $V_e = -0.7V$

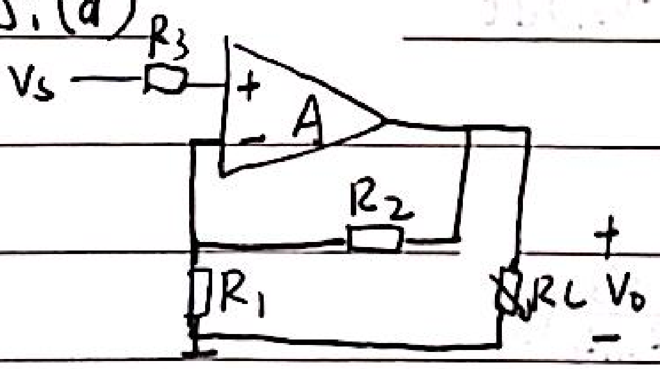
$V_c = V_{N1} = V_{N2} = V_2 = 6V$

(2) 由题意知

$$I_c = \frac{V_1 - V_c}{R_1} = 1mA$$

$$I_B = \frac{V_0 - V_b}{R_2} = 20\mu A \qquad \beta = \frac{I_c}{I_B} = 50$$

2.15.(d)



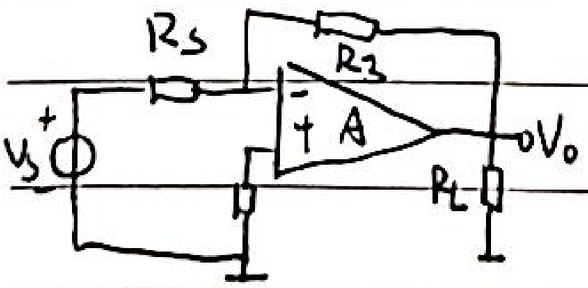
相当于同相比例输入

$A_{vf} = (1+\frac{R_2}{R_1})$

$R_{if} = \infty$

$R_{of} = 0$

(e) 相当于反相比例输入

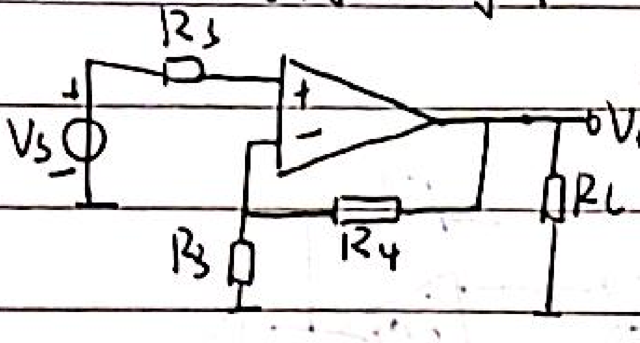


$A_{vf} = -\frac{R_3}{R_s}$

$R_{if} = R_s$

$R_{of} = 0$

(f) 相当于同相输入

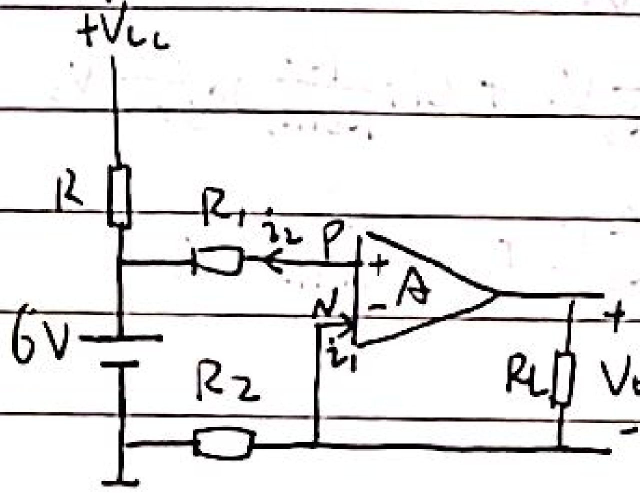


$A_{vf}=(1+\frac{R_4}{R_3})$

$R_{if}=\infty$

$R_{of}=0$

2.17



由虚短,虚断

$i_2=0, i_1=0$

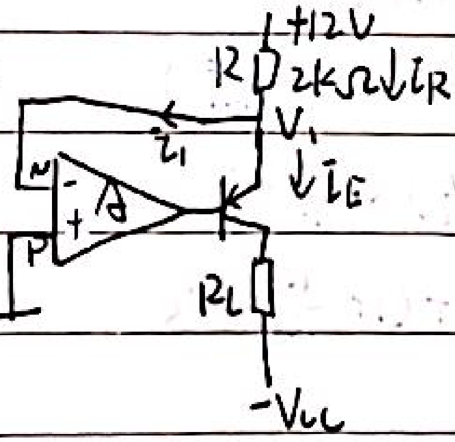
$V_P=V_N$

有 $I_L=I_{R2}=\frac{V_N}{R_2}$

$V_N=V_P=i_2R_1+V_Z=V_Z=6V$

故 $I_L=0.6mA$

2.18



(1) 由虚短,虚断

$i_1=0$ 无分流,

而 $V_N=V_P=0$

$V_1=V_N=0$

故 $I_R=\frac{V_{CC}}{R}=6mA$

无 i_1 分流, $I_E=I_R=6mA$

$I_L=I_C\approx I_E=6mA$

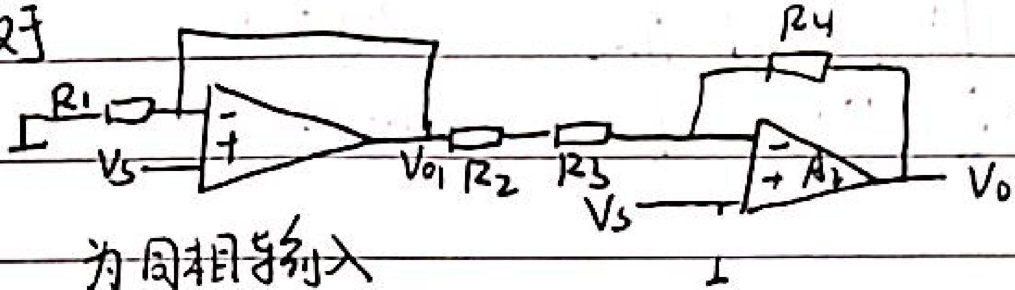
(2) 无关系, 如果没有负电源, $V_1=0$, 没有电源提供直流偏置, 发射结无法正偏, 三极管不能正常工作

(3) 当三极管饱和时, $V_{CES}=0V$. $V_{CES}+I_CR_L=V_{CC}$ $R_L=2k\Omega$

2.20. 当V_S在正半波时

D_2截止断路，D_1通路

A_1等效于



为同相输入

$$V_{o1}=V_S\times(1+\frac{0}{R_1})=V_S$$

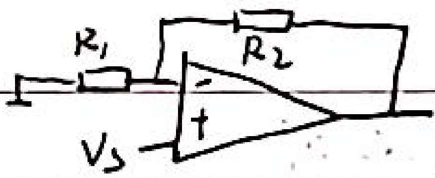
右侧有 $V_o=-\frac{R_4}{R_2+R_3}V_{o1}+(1+\frac{R_4}{R_2+R_3})\times\frac{\infty}{0+\infty}V_S$

$$=-\frac{R_4}{R_2+R_3}V_S+(1+\frac{R_4}{R_2+R_3})V_S$$

$$=V_S$$

当V_S在负半波，

D_1通路，D_2截止断路



同相输入

$$V_{o1}=V_S\times(1+\frac{R_2}{R_1})$$

右侧 $V_o=-\frac{R_4}{R_3}V_{o1}+(1+\frac{R_4}{R_3})\times\frac{\infty}{0+\infty}V_S$

$$=-\frac{R_4}{R_3}(1+\frac{R_2}{R_1})V_S+(1+\frac{R_4}{R_3})V_S$$

$$V_o=\begin{cases}V_S, & V_S>0\\ -\frac{R_4}{R_3}(1+\frac{R_2}{R_1})V_S+(1+\frac{R_4}{R_3})V_S, & V_S<0\end{cases}$$

当 $R_1=R_2=R_3$ $R_4=2R_3$

$V_S<0$时 $V_o=-2\times2V_S+(1+2)V_S=-V_S$

$$V_o=\begin{cases}V_S, & V_S>0\\ -V_S, & V_S<0\end{cases}$$

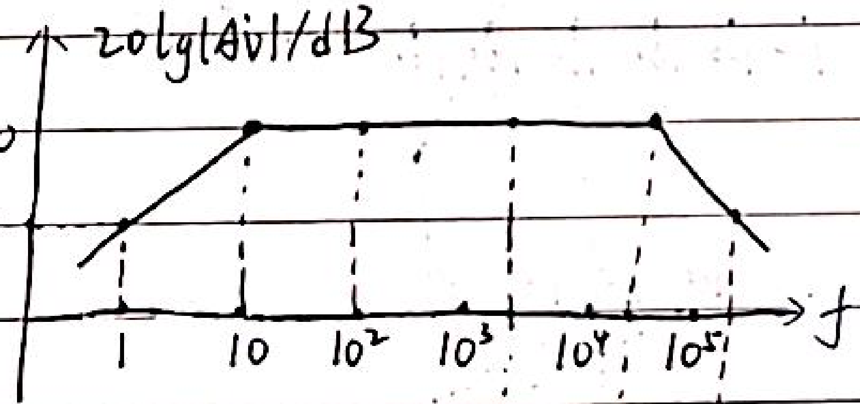
全波整流，使输入信号取绝对值

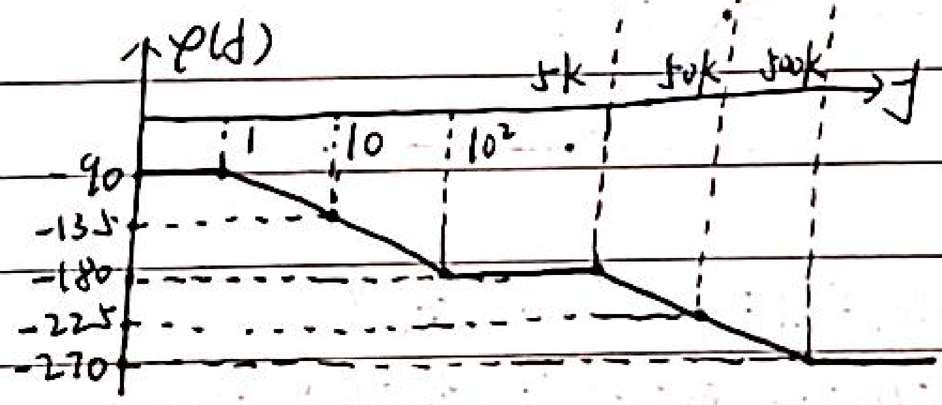
1.28, $\dot{A}_v = -100 \cdot \frac{j\frac{f}{10Hz}}{1+j\frac{f}{10Hz}} \cdot \frac{1}{1+j\frac{f}{50kHz}}$

$f_L = 10Hz$. $f_H = 50kHz$

$20\lg|\dot{A}_v| = 40 + 20\lg\frac{f}{10} - 20\lg\sqrt{1+(\frac{f}{10})^2} - 20\lg\sqrt{1+(\frac{f}{50k})^2}$

$\varphi(f) = -180° + 90° - \arctan\frac{f}{10} - \arctan\frac{f}{50k}$

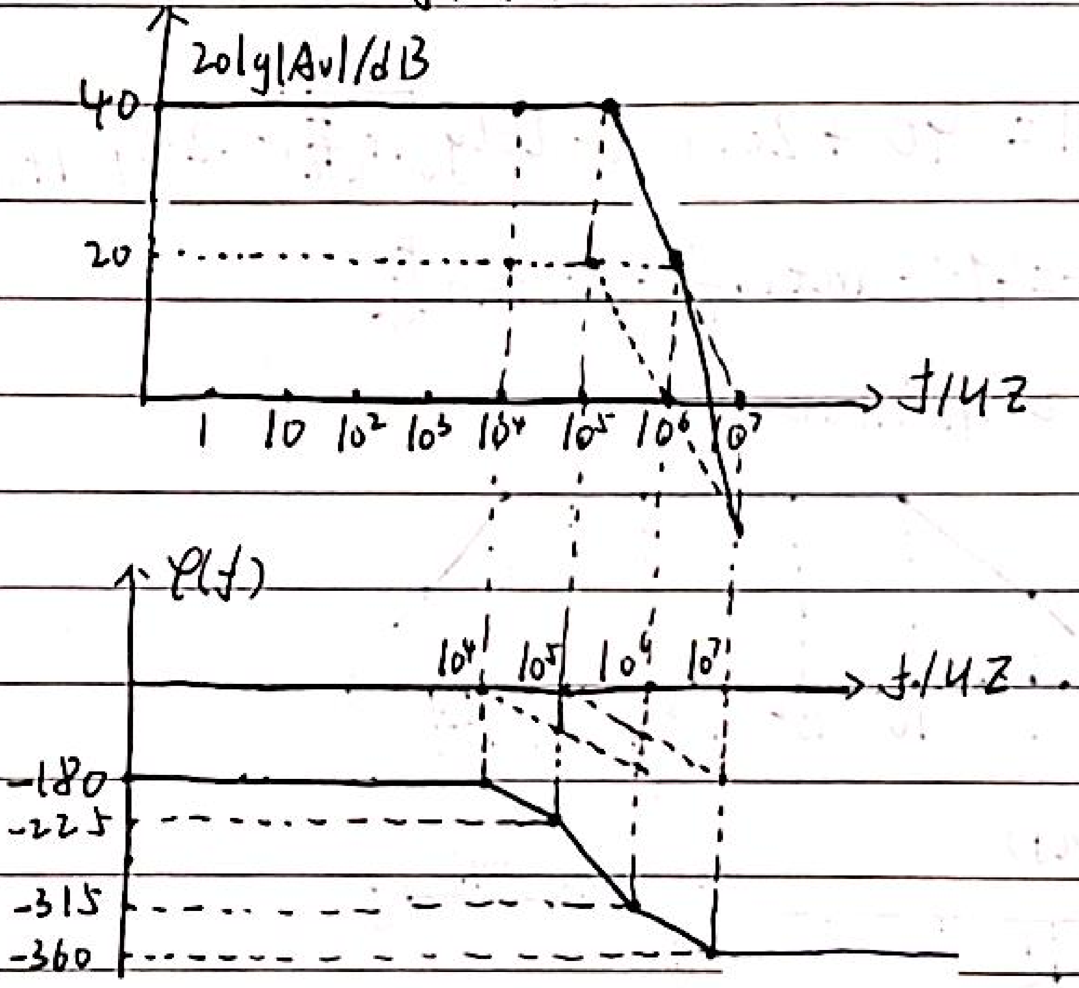




1.29. $20\lg|\dot{A}_v| = 40 - 20\lg\frac{f}{100k} - 20\lg\frac{f}{1M}$

$f_{H1}=100kHz$ $f_{H2}=1MHz$，相差较大取小值

$f_H=f_{H1}=100kHz$

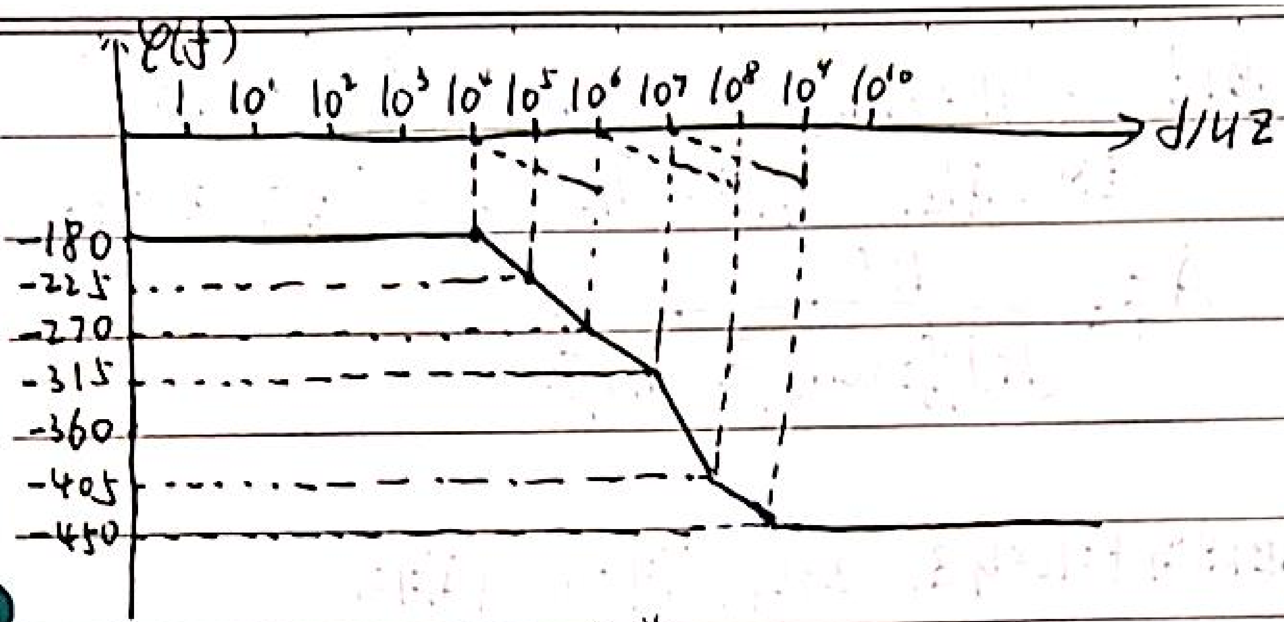


1.30 (1) 由图知 ~~Avm~~ $20\lg|A_{vm}|=80$ $A_{vm}=-10^4$

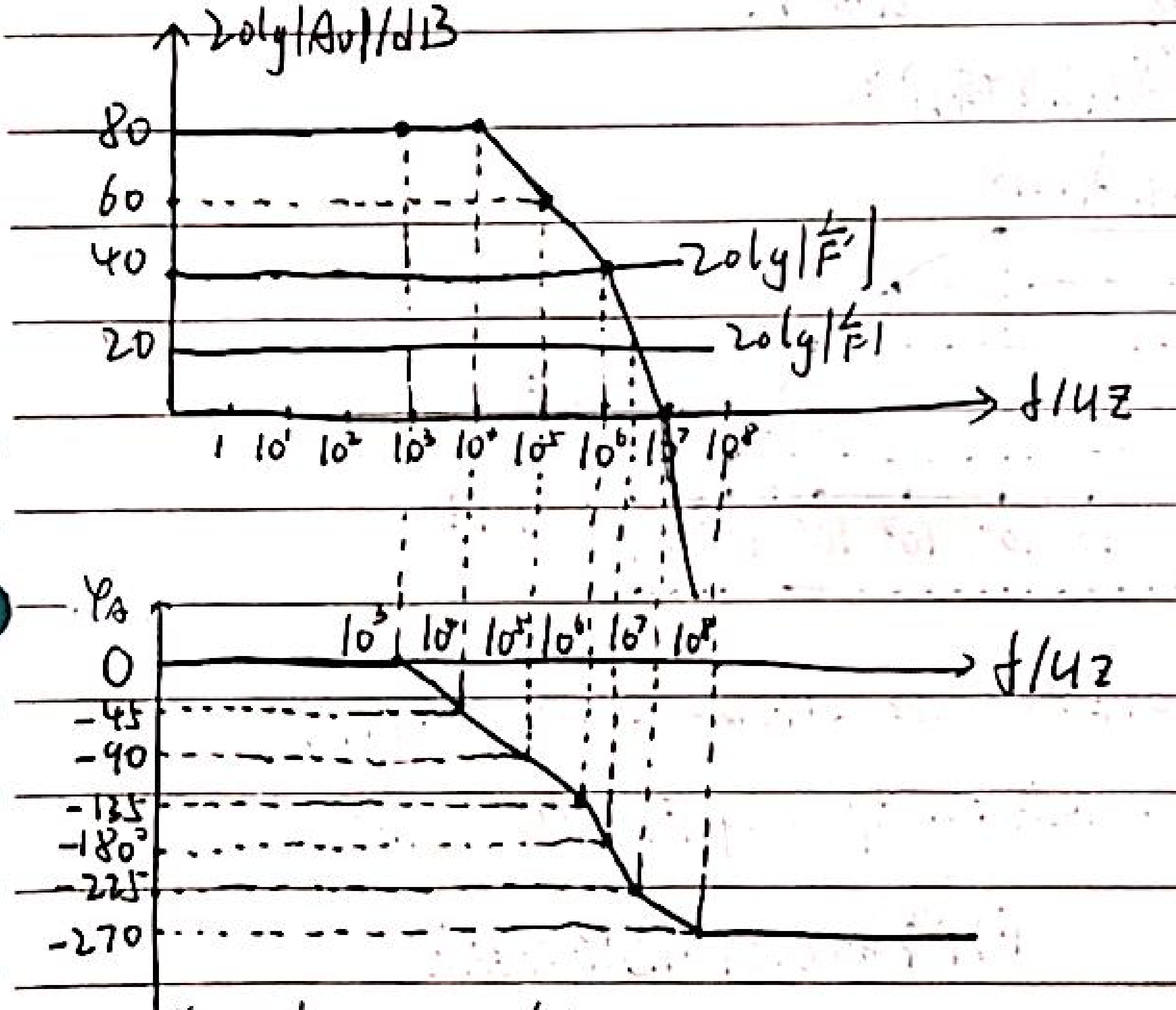
只有高频特性，两个上限频率分别为100kHz，10MHz，100MHz

故 $\dot{A}_v = \dfrac{-10^4}{(1+j\frac{f}{100k})(1+j\frac{f}{10M})(1+j\frac{f}{100M})}$

(2) $\varphi(f) = 180° - \arctan\frac{f}{100k} - \arctan\frac{f}{10M} - \arctan\frac{f}{100M}$



2.21. (1) $A_{od}=\dfrac{10^4}{(1+j\frac{f}{10k})(1+j\frac{f}{1m})(1+j\frac{f}{10m})}$



(2) 作反馈线 $20\lg|\frac{1}{F}|$, 对应 $\Delta\varphi_A+\Delta\varphi_F=-180°$ 时

在幅频曲线上对应交点为20, 即 $20\lg|\frac{1}{F}|=20$, $F=0.1$

(3) 留 $\varphi_m=45°$, 临界时 $\Delta\varphi_A+\Delta\varphi_F=-135°$.

作反馈线, 对应交点为40, 即 $20\lg|\frac{1}{F}|=40$, $F'=0.01$

2.22.(1) 由图 $20\lg|A_{odm}F|=80$ $|A_{odm}F|=10^4$ $A_{odm}=10^5$

全为负实根, $f_{p1}=10^2Hz$, $f_{p2}=10^4Hz$, $f_{p3}=10^5Hz$

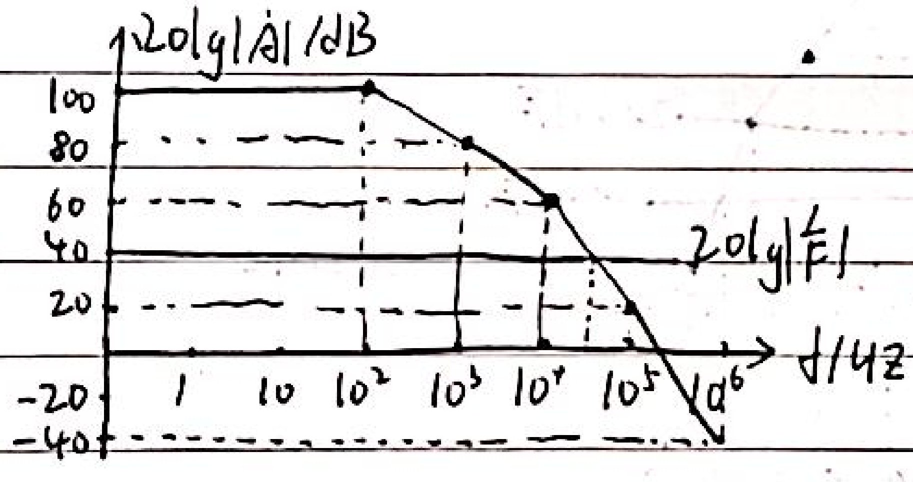
$$A=\frac{10^5}{(1+j\frac{f}{10^2})(1+j\frac{f}{10^4})(1+j\frac{f}{10^5})}$$

(2) 由图当 $f=10^5Hz$, $20\lg|AF|=0$ $|AF|=1$

此时 $|\varphi_A+\varphi_F|=|-205°|>180°$

会自激

(3) A的幅频波特图为



当 $\varphi_A+\varphi_F=-180°$时, 对应的白端线 $20\lg|\frac{1}{F}|$

对应为40, 即 $20\lg|\frac{1}{F}|=40$, $F=0.01$

F下降到0.01,临界稳定