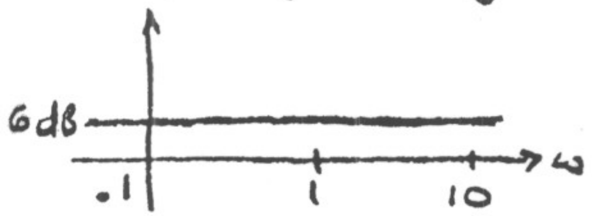
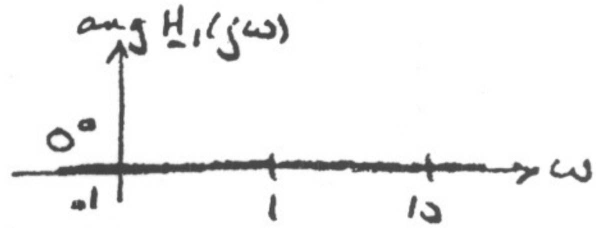
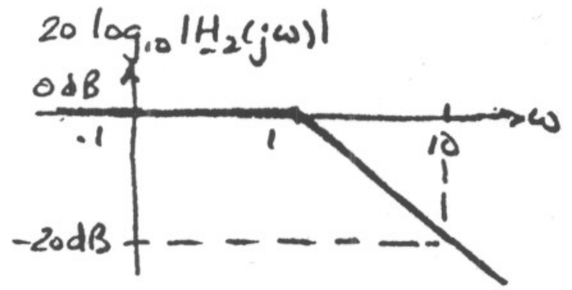
$\boxed{5.19}$ $\underline{H}_1(j\omega) = 2 \Rightarrow |\underline{H}_1(j\omega)| = 2$ $\quad$ ang $\underline{H}_1(j\omega) = 0°$

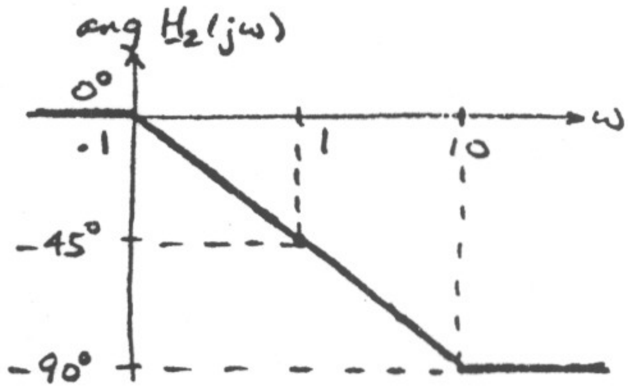
$20 \log_{10} \underline{H}_1(j\omega) = 20 \log_{10} 2 = 6\,dB$





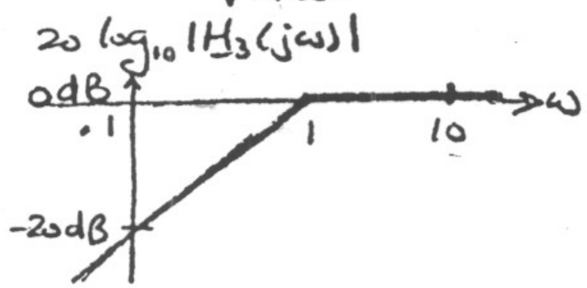
$\underline{H}_2(j\omega) = \dfrac{1}{1+j\omega} \Rightarrow |\underline{H}_2(j\omega)| = \dfrac{1}{\sqrt{1+\omega^2}}$ $\quad$ ang $\underline{H}_2(j\omega) = -\tan^{-1}\omega$

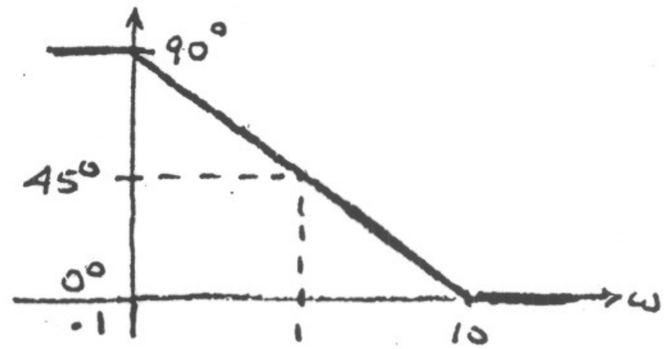




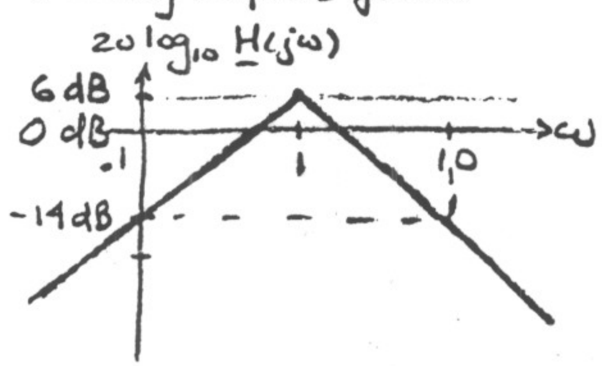
$\underline{H}_3(j\omega) = \dfrac{j\omega}{1+j\omega}$

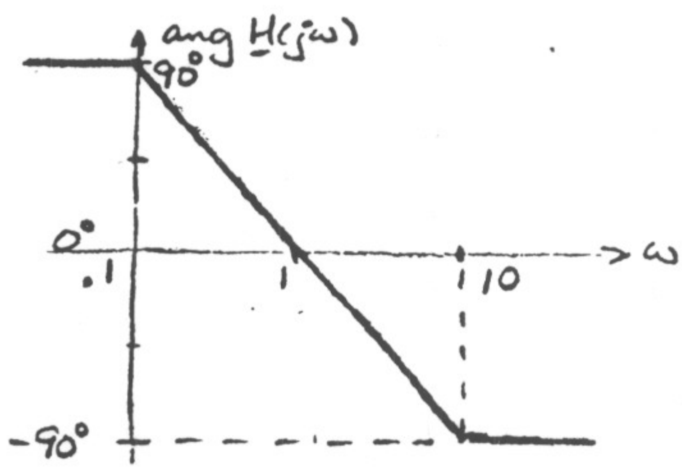
$|\underline{H}_3(j\omega)| = \dfrac{\omega}{\sqrt{1+\omega^2}}$ $\quad$ ang $\underline{H}_3(j\omega) = 90° - \tan^{-1}\omega$





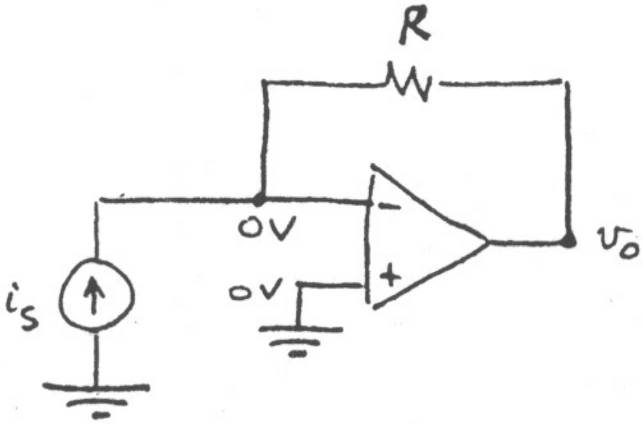
Adding the plots yields





This is a bandpass filter.

2.27 (a)

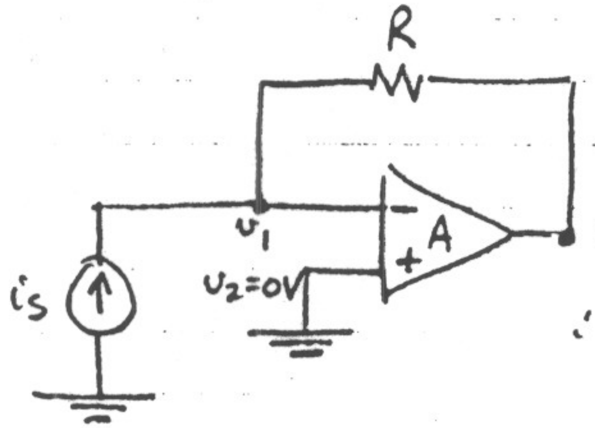


By KCL at the inverting input of the op amp,

$$i_s + \frac{v_o}{R} = 0$$

$$i_s = -\frac{v_o}{R} \Rightarrow \underline{\underline{v_o = -Ri_s}}$$

(b)



$$v_o = A(v_2 - v_1) = -Av_1$$

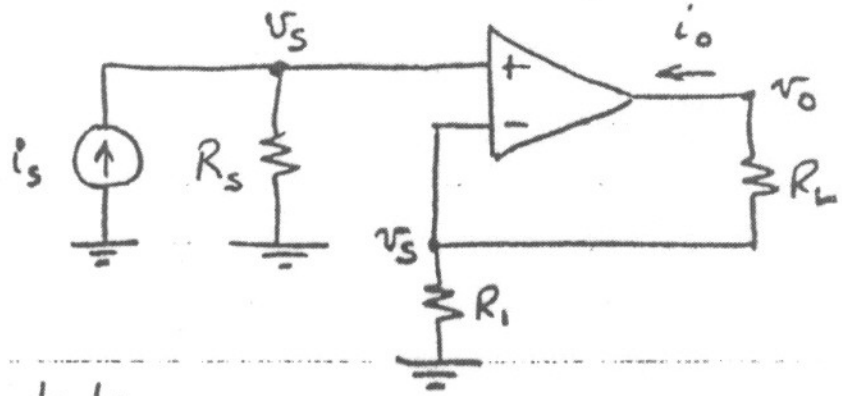
$$\therefore v_1 = -\frac{v_o}{A}$$

By KCL at node v_1,

$$i_s = \frac{v_1 - v_o}{R} = \frac{-\frac{v_o}{A} - v_o}{R} = -\frac{v_o + Av_o}{AR} = -\frac{1+A}{AR}v_o$$

$$\therefore \underline{\underline{v_o = -\frac{AR}{1+A}i_s}}$$

2.29



(a)

By Ohm's law,

$$v_S = R_S i_S$$

By KCL at the inverting input of the op amp,

$$\frac{v_S}{R_1} + \frac{v_S - v_o}{R_L} = 0$$

$$R_L v_S + R_1 v_S - R_1 v_o = 0$$

$$(R_1 + R_L) v_S = R_1 v_o$$

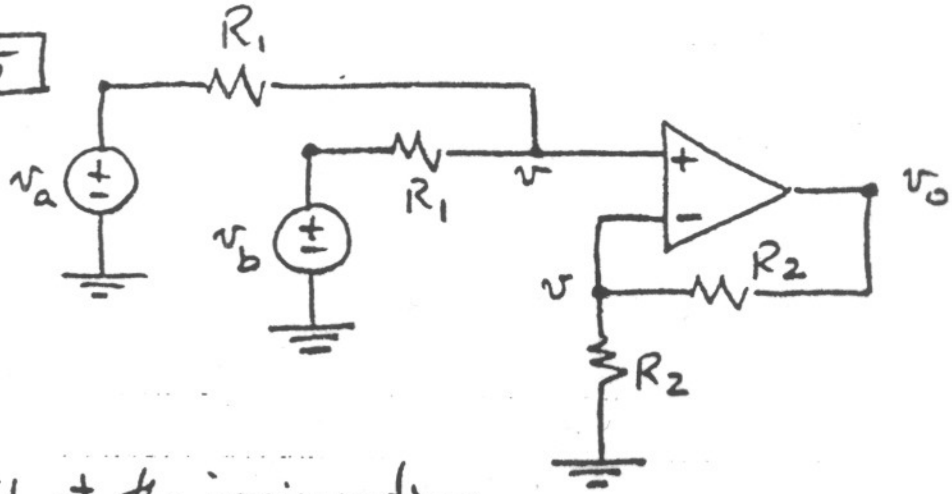
$$v_o = \frac{(R_1 + R_L) v_S}{R_1} = \frac{(R_1 + R_L) R_S i_S}{R_1} = \left(\frac{R_L}{R_1} + 1\right) R_S i_S$$

(b)

By Ohm's law,

$$i_o = -\frac{v_S}{R_1} = -\frac{R_S i_S}{R_1} = -\frac{R_S}{R_1} i_S$$

$\boxed{2.35}$



By KCL at the noninverting input of the op amp,

$$\frac{v - v_a}{R_1} + \frac{v - v_b}{R_1} = 0$$

$$v - v_a + v - v_b = 0$$

$$2v = v_a + v_b$$

By KCL at the inverting input of the op amp,

$$\frac{v}{R_2} + \frac{v - v_o}{R_2} = 0$$

$$v + v - v_o = 0$$

$$2v = v_o$$

$$\therefore \; \underline{\underline{v_o = v_a + v_b}}$$