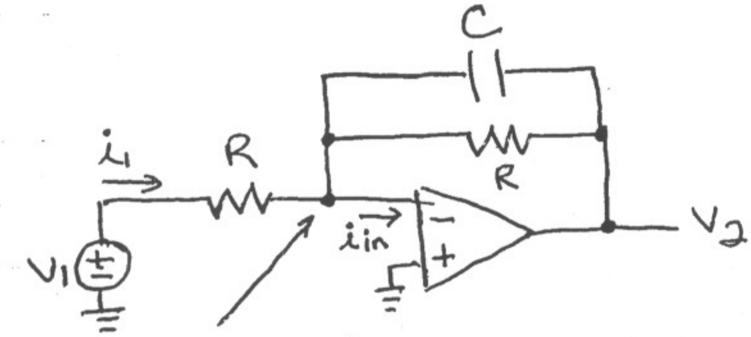
(5.3)



operates at 0 volts because the opamp is ideal and the feedback is negative

$i_1 = \frac{V_1}{R}$ and $i_{in} = 0$ (ideal op amp)

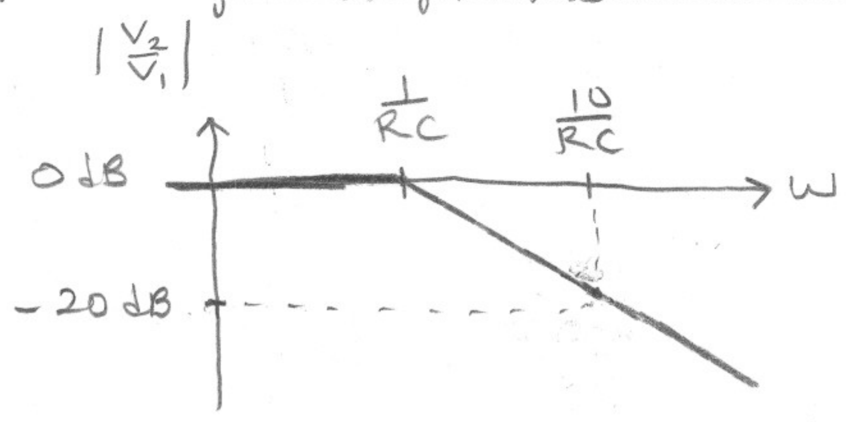
So $V_2 = -i_1 \dfrac{R\left(\frac{1}{j\omega C}\right)}{R + \frac{1}{j\omega C}} = -\dfrac{V_1}{R}\,\dfrac{R}{1+j\omega CR} = -\dfrac{V_1}{1+j\omega CR}$

$\dfrac{V_2}{V_1} = -\dfrac{1}{1+j\omega CR}$

$\left|\dfrac{V_2}{V_1}\right| = \dfrac{1}{\sqrt{1+\omega^2C^2R^2}}$

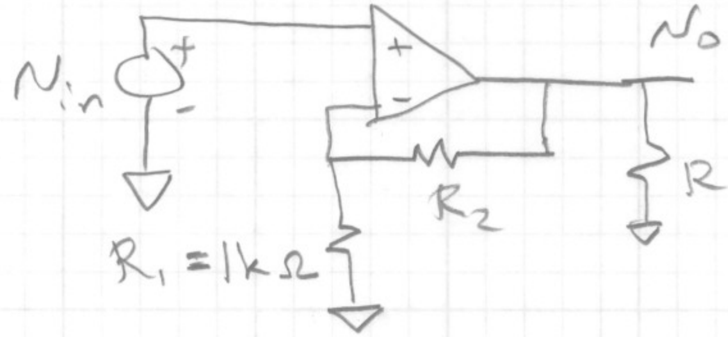
$\frac{1}{RC}$ = break or cutoff freq. = $\boxed{\text{Half power frequency is } \frac{1}{RC}}$

Approx Mag. or Ampl Plot:



$\boxed{\text{This is a low-pass filter.}}$

(10,45) following lecture:



unity-gain bandwidth = gain-bandwidth product

$$= 2\pi f_T = 2\pi(1\,MHz) = 2\pi(1m)\ \frac{rad}{sec}$$

a) $R_2 = 9k\Omega \Rightarrow$ gain $= 1 + \frac{R_2}{R_1} = 1 + 9 = 10$

$$\overset{10}{\overset{\shortparallel}{\text{gain}}} \times \text{bandwidth} = 2\pi(1m)\ \frac{rad}{sec}$$

in $\frac{rad}{sec}$: bandwidth $= 2\pi\left(\frac{1m}{10}\right) = (0.1m)\,2\pi\ \frac{rad}{sec}$

bandwidth (in Hz) $= 0.1\,MHz = 100\,kHz$

b) $R_2 = 1M\Omega \Rightarrow$ gain $= 1 + \frac{1m}{1k} = 1001$

$$\overset{1001}{\overset{\shortparallel}{\text{gain}}} \times \text{bandwidth} = 2\pi(1m)\ \frac{rad}{sec}$$

in $\frac{rad}{sec}$: bandwidth $= 2\pi \cdot \frac{1m}{1001} \simeq 2\pi(1kHz)\ \frac{rad}{sec}$

bandwidth (in Hz) $\approx 1kHz$

Add leading 0 (sign bit) for pos. number:

$\boxed{11.2}$ (a) $(011011)_2 = 1\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0 = 16+8+2+1 = \underline{\underline{(27)_{10}}}$

(b) $(0101011)_2 = 1\times2^5 + 0\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0 = 32+8+2+1 = \underline{\underline{(43)_{10}}}$

(c) $(0.11011)_2 = 1\times2^{-1} + 1\times2^{-2} + 0\times2^{-3} + 1\times2^{-4} + 1\times2^{-5} = \frac{1}{2} + \frac{1}{4} + \frac{1}{16} + \frac{1}{32}$

$= \frac{16+8+2+1}{32} = \frac{27}{32}$

$= \underline{\underline{(0.84375)_{10}}}$

(d) $(0.10101)_2 = 1\times2^{-1} + 0\times2^{-2} + 1\times2^{-3} + 0\times2^{-4} + 1\times2^{-5} = \frac{1}{2} + \frac{1}{8} + \frac{1}{32} = \frac{16+4+1}{32} = \frac{21}{32}$

$= \underline{\underline{(0.65625)_{10}}}$

(e) $(010100.011)_2 = 1\times2^4 + 1\times2^2 + 1\times2^{-2} + 1\times2^{-3} = 16+4+\frac{1}{4}+\frac{1}{8} = \underline{\underline{(20.375)_{10}}}$

(f) $(010011.101)_2 = 1\times2^4 + 1\times2^1 + 1\times2^0 + 1\times2^{-1} + 1\times2^{-3} = 16+2+1+\frac{1}{2}+\frac{1}{8} = \underline{\underline{(19.625)_{10}}}$

$\boxed{11.3}$ (a)

$$\begin{array}{ccccccc} & 1 & 0 & 1 & 0 & 1 & 1 \\ 0 &)1 &)2 &)5 &)10 &)21 & (43(2 \end{array}$$

$(43)_{10} = \underline{\underline{(0101011)_2}}$

(b)

$$\begin{array}{cccccc} & 1 & 1 & 0 & 1 & 1 \\ 0 & (1 & (3 & (6 & (13 & (27(2 \end{array}$$

$(27)_{10} = \underline{\underline{(011011)_2}}$

(c) $0.84375 \times 2 = 1.6875 \Rightarrow a_{-1} = 1$

$0.6875 \times 2 = 1.375 \Rightarrow a_{-2} = 1$

$0.375 \times 2 = 0.75 \Rightarrow a_{-3} = 0$

$0.75 \times 2 = 1.5 \Rightarrow a_{-4} = 1$

$0.5 \times 2 = 1.0 \Rightarrow a_{-5} = 1$

$(0.84375)_{10} = \underline{\underline{(0.11011)_2}}$

(d) $0.65625 \times 2 = 1.3125 \Rightarrow a_{-1} = 1$

$0.3125 \times 2 = 0.625 \Rightarrow a_{-2} = 0$

$0.625 \times 2 = 1.25 \Rightarrow a_{-3} = 1$

$0.25 \times 2 = 0.5 \Rightarrow a_{-4} = 0$

$0.5 \times 2 = 1.0 \Rightarrow a_{-5} = 1$

$(0.65625)_{10} = \underline{\underline{(0.10101)_2}}$

11.10 consider n, m as positive

a)

$$\begin{array}{rl} 00101100 & \leftarrow n \text{ (w/ sign bit added + extended)} \\ +\ 00010100 & \leftarrow m \\ \hline 01000000 & \leftarrow \text{sum} \end{array}$$

$[(n = 44_{10}) + (m = 20_{10}) = 64_{10}]$

b)

$$\begin{array}{rl} 001110.01 & \leftarrow n \\ +\ 001001.11 & \leftarrow m \\ \hline 011000.00 & \leftarrow \text{sum} \end{array}$$

$[(n = 14.25_{10}) + (m = 9.75) = 24.0_{10}]$

c)

$$\begin{array}{rl} 000101.011 & \leftarrow n \\ +\ 001101.010 & \leftarrow m \\ \hline 010010.101 & \leftarrow \text{sum} \end{array}$$

$[(n = 5.375_{10}) + (13.25_{10}) = 18.625_{10}]$

d)

$$\begin{array}{rl} 00011001 & \leftarrow n \\ +\ 00101110 & \leftarrow m \\ \hline 01000111 & \leftarrow \text{sum} \end{array}$$

$[(n = 25_{10}) + (m = 46_{10}) = 71_{10}]$

11.15. consider n, m positive → add 2's complement to subtract:

a)

Find 2's compl. of m = 0010100

1101011 ← 1's comp

+1

1101100 ← 2's comp. = −m

$$\left.\begin{array}{r} 00101100 \leftarrow n \\ +\ 11101100 \leftarrow -m \end{array}\right\}\ \text{sign extended}$$

1|00011000 → $\boxed{00011000}$ = n − m

MSB carry − ignore

$[44_{10} - 20_{10} = 24_{10}]$ ✓

b) 2's compl of m: 001001.11

110110.00 ← 1's comp.

+ 1

110110.01 ← 2's comp.

001110.01 ← n

+ 110110.01 ← −m

1|000100.10 → $\boxed{000100.10}$

MSB carry − ignore

$[14.25_{10} - 9.75_{10} = 4.5_{10}]$ ✓