EECE 290, Problem solving

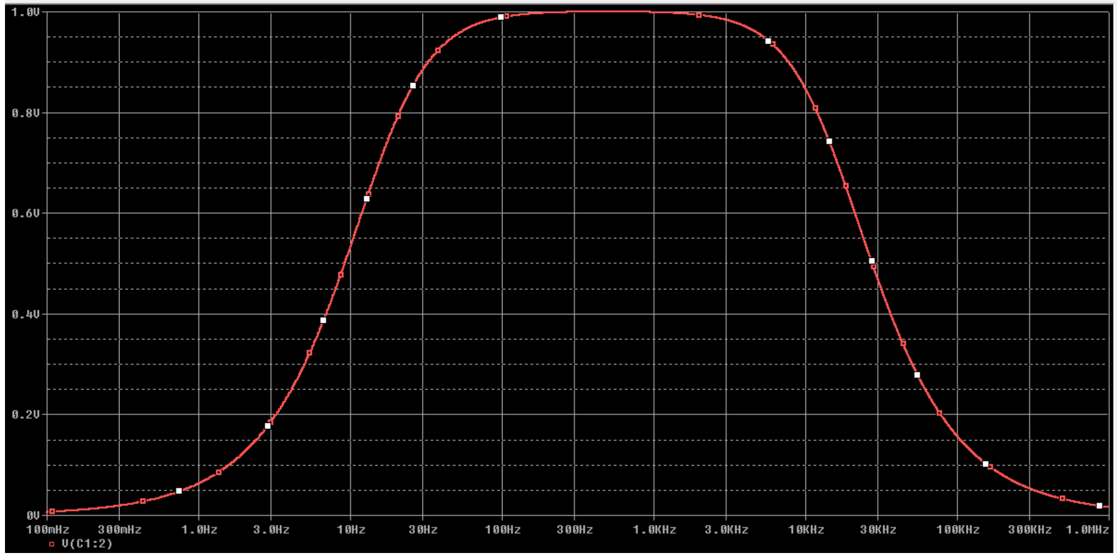
Session 10

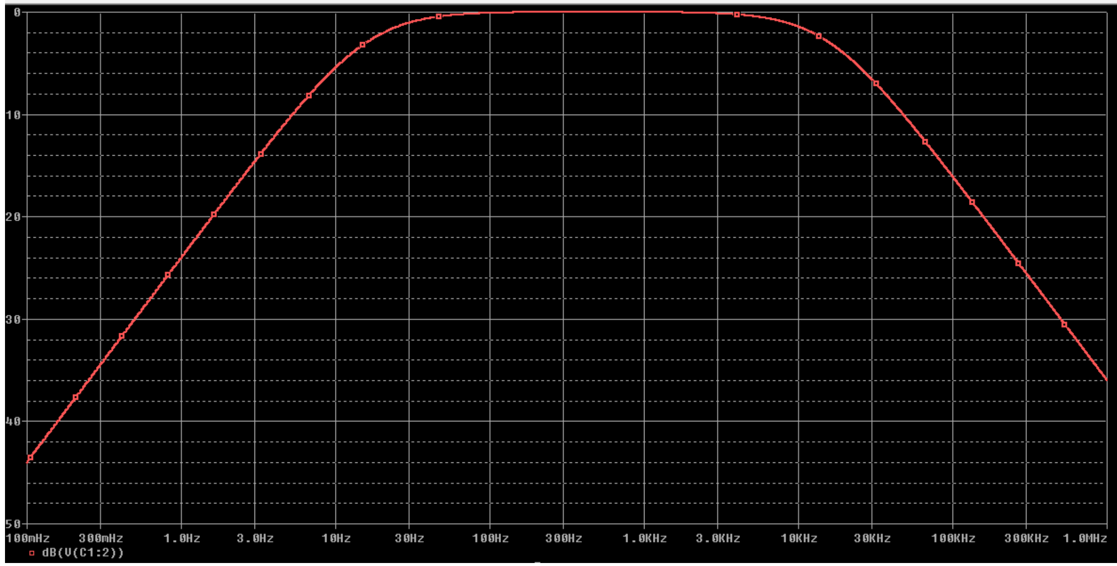
Use of dB's

$$A_{dB} = 20\log_{10}(\ |\ H(s)|) = 10\log_{10}(\ |\ H(s)\ |^2),\ \ |\ H\ (s)\ |\ = 10^{A_{dB}/20}$$

TableForm=

signal ratio	power ratio	dB
0.1	0.01	-20.0
0.141421	0.02	-17.0
0.2	0.04	-14.0
0.3	0.09	-10.5
0.5	0.25	-6.0
0.707107	0.5	-3.0
1.	1.	0.0
1.41421	2.	3.0
2.	4.	6.0
3.	9.	9.5
5.	25.	14.0
7.07107	50.	17.0
10.	100.	20.0





In cascaded circuits signal and power ratio’s are multiplied, dB-values are added.

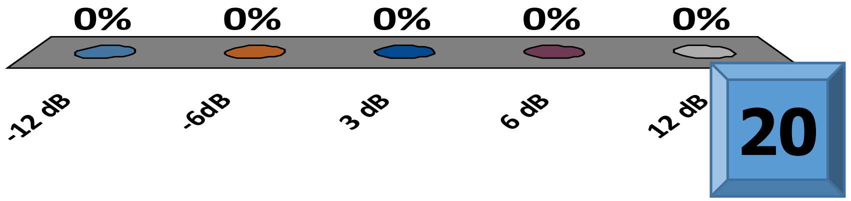
$$A_{dB} = 20\log_{10}(\,|\,H(s)|) = 10\log_{10}(\,|\,H(s)\,|^2),$$

TableForm=

signal ratio	power ratio	dB
0.1	0.01	-20.0
0.141421	0.02	-17.0
0.2	0.04	-14.0
0.3	0.09	-10.5
0.5	0.25	-6.0
0.707107	0.5	-3.0
1.	1.	0.0
1.41421	2.	3.0
2.	4.	6.0

A factor of 4 in signal voltages corresponds to?

A. -12 dB
B. -6dB
C. 3 dB
D. 6 dB
E. 12 dB



A factor of 1/1000 in powers corresponds to?

A. -60 dB

B. -30 dB

C. -15 dB

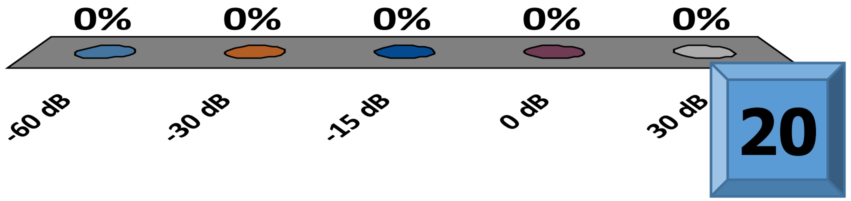
D. 0 dB

E. 30 dB

$$A_{dB} = 20\log_{10}(\,|\,H(s)|) = 10\log_{10}(\,|\,H(s)\,|^2),$$

TableForm=

signal ratio	power ratio	dB
0.1	0.01	-20.0
0.141421	0.02	-17.0
0.2	0.04	-14.0
0.3	0.09	-10.5
0.5	0.25	-6.0
0.707107	0.5	-3.0
1.	1.	0.0
1.41421	2.	3.0
2.	4.	6.0



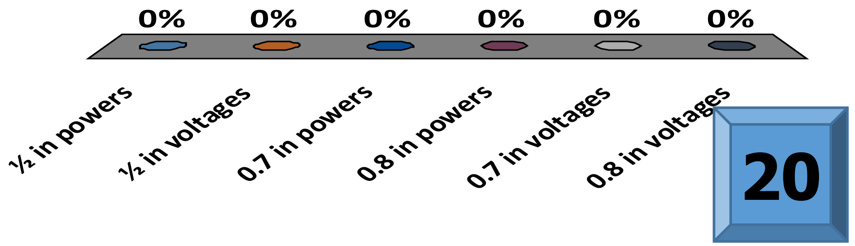
$$A_{dB} = 20\log_{10}(|H(s)|) = 10\log_{10}(|H(s)|^2),$$

TableForm=

signal ratio	power ratio	dB
0.1	0.01	-20.0
0.141421	0.02	-17.0
0.2	0.04	-14.0
0.3	0.09	-10.5
0.5	0.25	-6.0
0.707107	0.5	-3.0
1.	1.	0.0
1.41421	2.	3.0
2.	4.	6.0

- 2 dB corresponds to?

A. ½ in powers
B. ½ in voltages
C. 0.7 in powers
D. 0.8 in powers
E. 0.7 in voltages
F. 0.8 in voltages



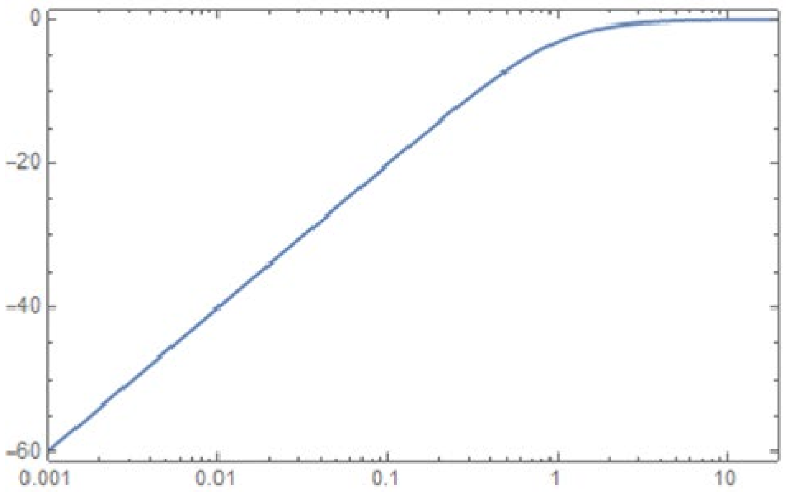
Scaling

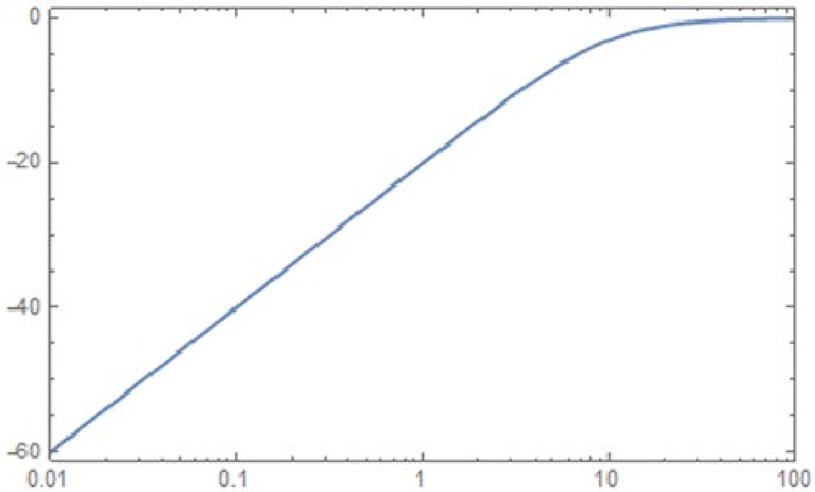
circuit parameter expressions

$R' = k_m R$

$L' = \frac{k_m}{k_f} L$

$C' = \frac{C}{k_m k_f}$





frequency expressions

$\omega' = k_f \omega$

$B' = k_f B$

$\omega_0' = k_f \omega_0$

$Q' = \frac{\omega_0'}{B'} = Q$

$\frac{1}{R' C'} = \frac{k_f}{R C}$

$\frac{R'}{L'} = k_f \frac{R}{L}$

$\frac{1}{\sqrt{L' C'}} = k_f \frac{1}{\sqrt{L C}}$

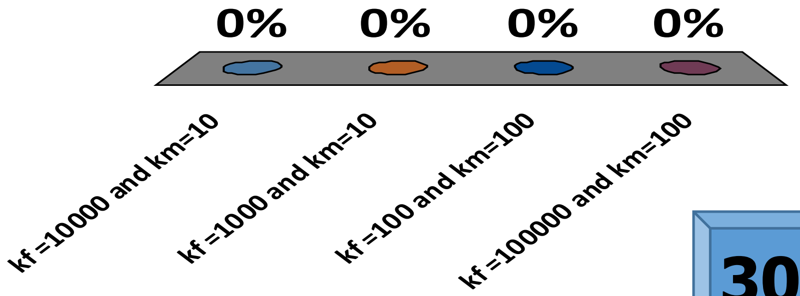
$j \omega' L' = j k_m \omega L$

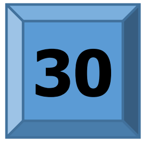
$\frac{1}{j \omega' C'} = \frac{k_m}{j \omega C}$

$$R' = k_m R, \qquad \omega' = k_f \omega, \qquad L' = \frac{k_m}{k_f} L, \qquad \text{and} \qquad C' = \frac{1}{k_m k_f} C$$

For the normalized *RL* filter having $\omega_c = 1$ rad/s, $L = 1$ H, and $R = 1\ \Omega$, it is required to have $\omega_c = 1$ krad/s and $L = 10$ mH. What are the values of k_f and k_m?

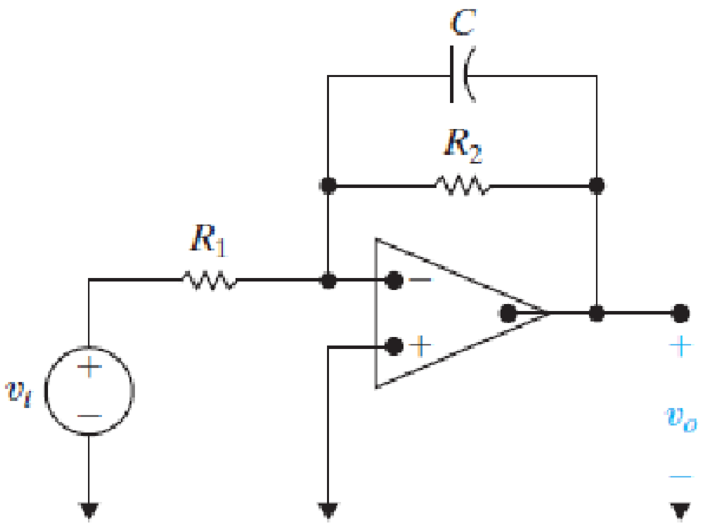
A. $k_f = 10000$ and $k_m = 10$
B. $k_f = 1000$ and $k_m = 10$
C. $k_f = 100$ and $k_m = 100$
D. $k_f = 100000$ and $k_m = 100$





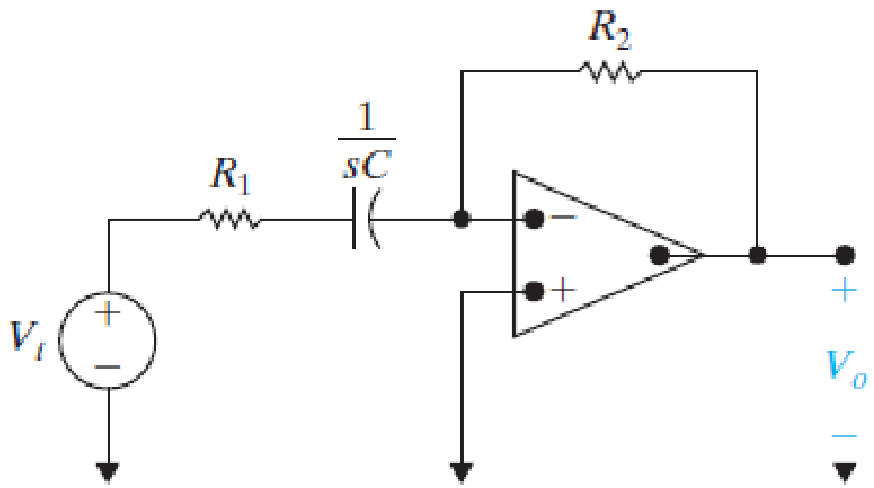
Active filters

- 1st order
  - Low-pass: $K\frac{\omega_c}{s+\omega_c}$



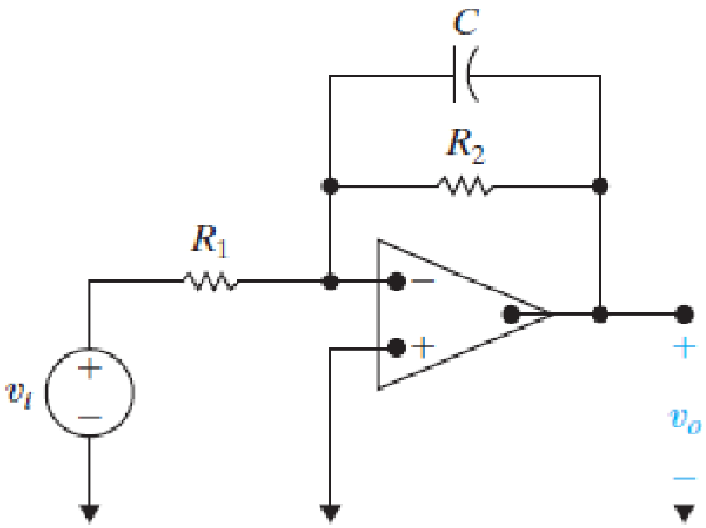
$\omega_c = \frac{1}{R_2 C}, K = \frac{R_2}{R_1}$

High-pass: $K\frac{s}{s+\omega_c}$



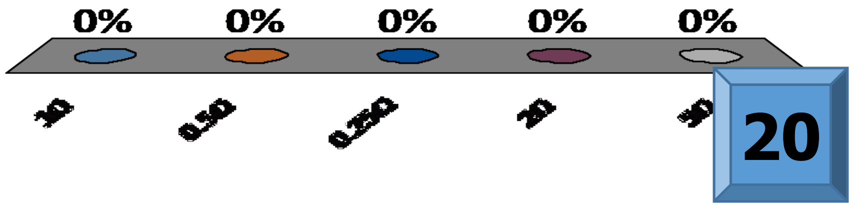
$\omega_c = \frac{1}{R_1 C}, K = \frac{R_2}{R_1}$

C=1F, R_2=1Ω, passband gain =12 dB, What is value of R_1?

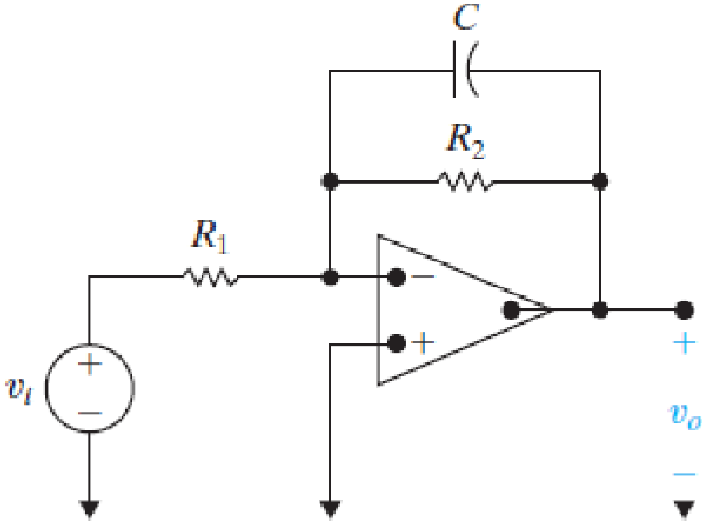


0.707107	0.5	-3.0
1.	1.	0.0
1.41421	2.	3.0
2.	4.	6.0
3.	9.	9.5

A. 1Ω
B. 0.5Ω
C. 0.25Ω
D. 2Ω
E. 5Ω



C'=1μF, ω_c'=10krad/s What is value of k_m?

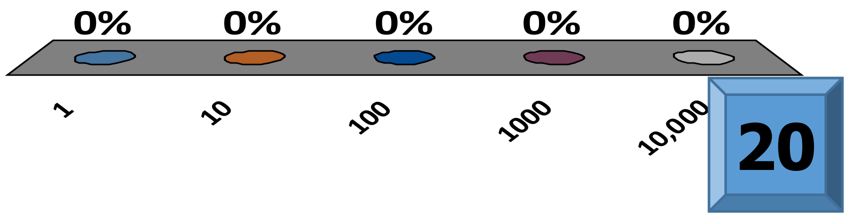


$$R' = k_m R$$

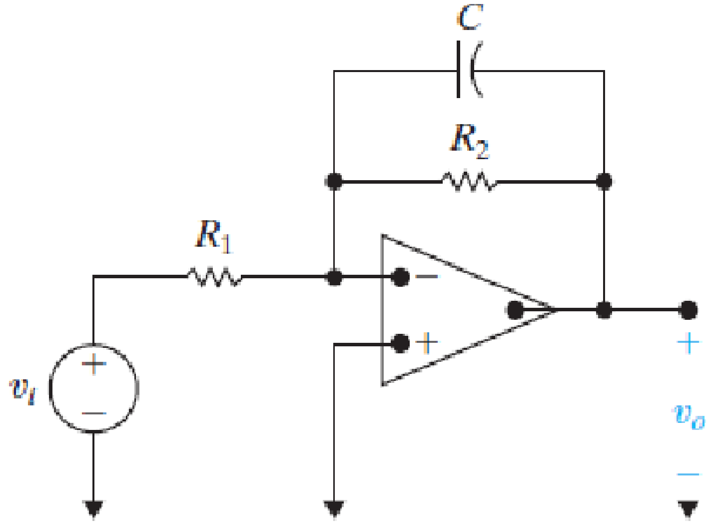
$$L' = \frac{k_m}{k_f} L$$

$$C' = \frac{C}{k_m k_f}$$

A. 1
B. 10
C. 100
D. 1000
E. 10,000



C'=1μF,
ω_c'=10krad/s
What is value of R_1'?

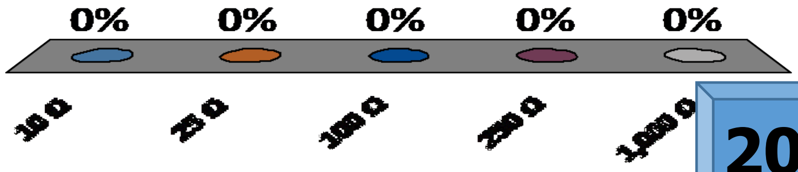


$$R' = k_m R$$

$$L' = \frac{k_m}{k_f} L$$

$$C' = \frac{C}{k_m k_f}$$

A. 10 Ω
B. 25 Ω
C. 100 Ω
D. 250 Ω
E. 1,000 Ω



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