

ECE 321 - Quiz #3 - Name _____

Filters, Common Emitter Amplifiers. April 25, 2019

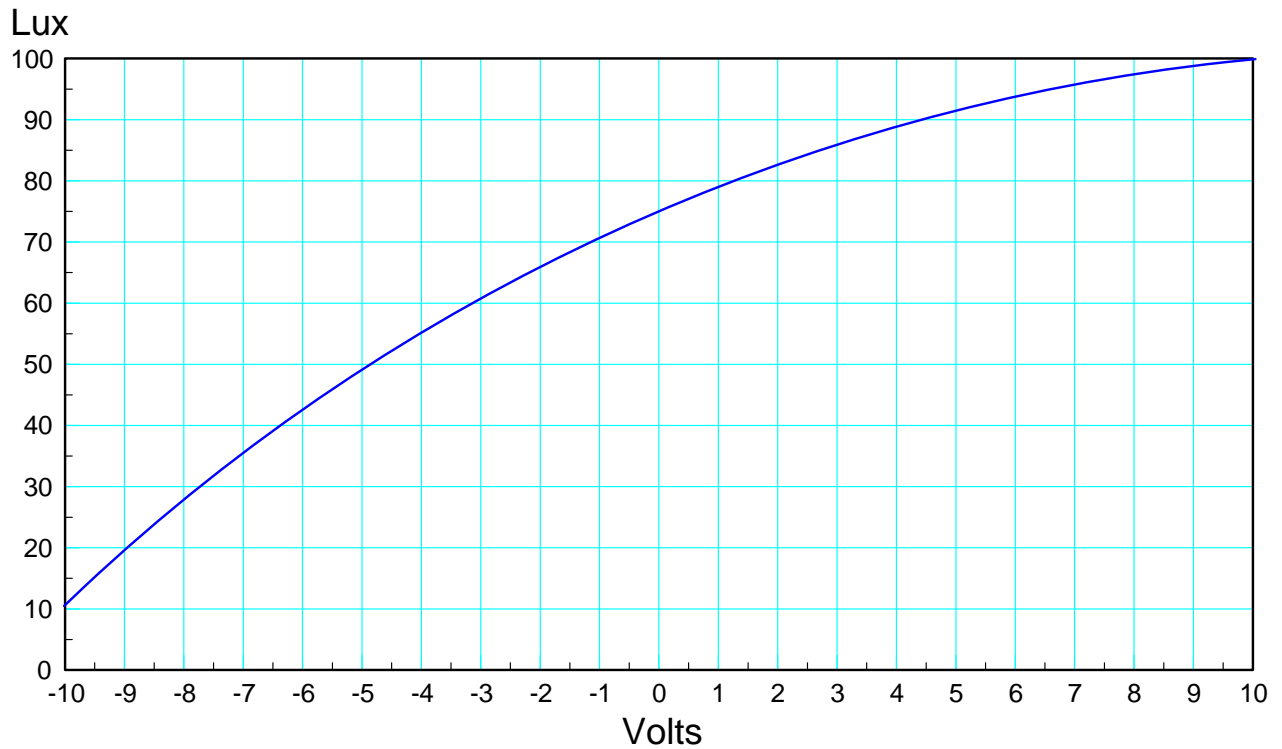
1) Calibration. Assume a circuit is built which outputs -10V to +10V as light changes from 10 Lux to 100 Lux.

- Determine a calibration function of the form

$$Lux \approx aV + b$$

- What is the light level (actual and estimated) when $V = 5.0V$?

Lux = aV + b		Lux when V = 5.00V	
a	b	Actual Lux	Estimated Lux from curve fit



2) X and Y are related by the following filter

$$Y = \left(\frac{5}{s^2 + 3s + 2} \right) X = \left(\frac{5}{(s+1)(s+2)} \right) X$$

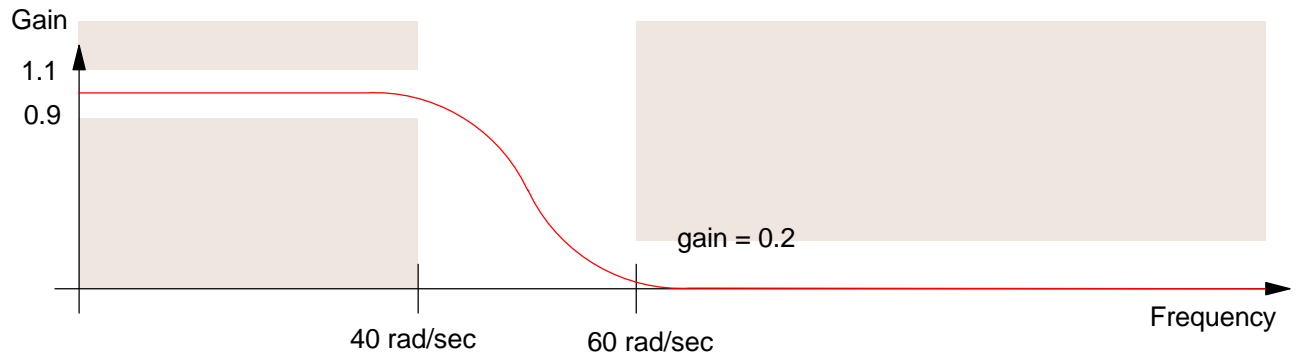
a) What is the differential equation relating X and Y?

b) Find $y(t)$ assuming

$$x(t) = 10 + 15 \cos(3t)$$

3) A filter is to meet the following requirements

- $0.9 < \text{Gain} < 1.1$ for frequencies below 40 rad/sec
- $\text{Gain} < 0.2$ for frequencies above 60 rad/sec



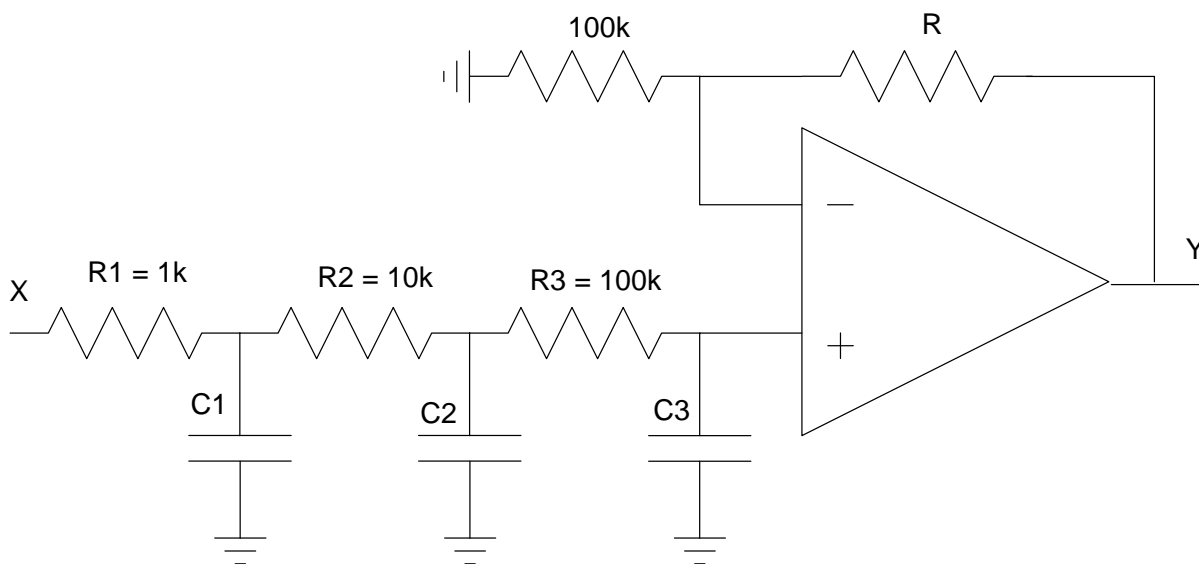
a) How many poles does this filter need?

b) Give the transfer function for a Butterworth low-pass filter which meets these requirements (note: the corner frequency might need adjusting)

4) Find R and C so that the following filter has the transfer function of

$$Y = \left(\frac{1000}{(s+4)(s+6)(s+8)} \right) X$$

C1	C2	C3	R



$$Y \approx \left(\frac{1 + \frac{R}{100k}}{(R_1 C_1 s + 1)(R_2 C_2 s + 1)(R_3 C_3 s + 1)} \right) X$$

5) The transfer function for a 4th-order Chebychev low-pass filter with a corner at 100 rad/sec is

$$Y = \left(\frac{72^2 \cdot 111^2}{(s+72\angle 38.5^\circ)(s+72\angle -38.5^\circ)(s+111\angle 77.8^\circ)(s+111\angle -77.8^\circ)} \right) X$$

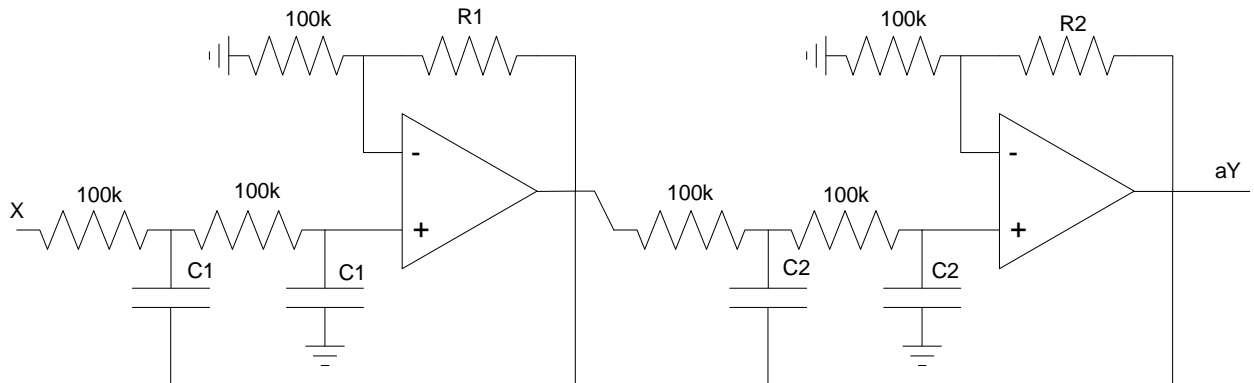
Find R and C to implement this filter

C1	R1	C2	R2

Note: The transfer function for the first stage is

$$\left(\frac{k \left(\frac{1}{RC} \right)^2}{s^2 + \left(\frac{3-k}{RC} \right) s + \left(\frac{1}{RC} \right)^2} \right) \quad k = 1 + \frac{R_1}{100,000}$$

$$3 - k = 2 \cos \theta$$



Bonus: Which is more:

- The number of Democrats who have announced that they are running for President in 2020, or
- The number of Godzilla movies that have been made?