類比電子電路實作

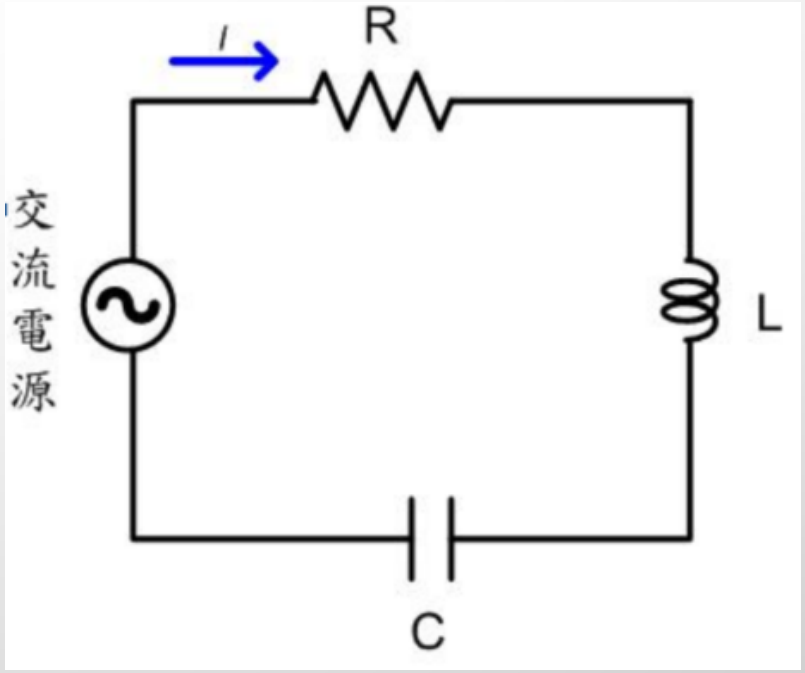
ANALOG ELECTRONIC CIRCUIT PRACTICES

2016 WEEK 4

RLC CIRCUIT

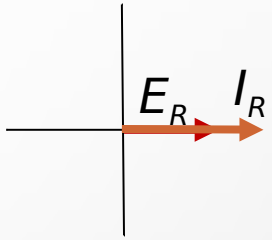
- RLC 串聯電路中，總電壓為 E，總電流為 I。

- 因為串聯電路，則電路上的電流相等
  - $I = I_R = I_L = I_C$



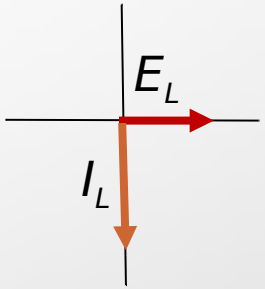
- 電阻器：電壓與電流同相，電阻為 R 。則電阻電壓表示式為

  $E_R = I_R R$



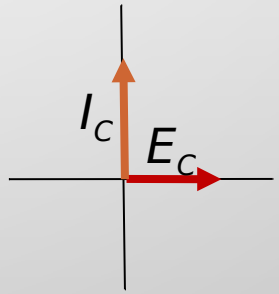
- 電感器：電壓超前電流 90° 相角，感抗為 X_L 。則電感電壓表示式為

  $E_L = I_L X_L$



- 電容器：電壓落後電流 90° 相角，容抗為 X_C 。則電容電壓表示式為

  $E_C = I_C X_C$



- 由於總電壓 E，為 E_R 及 E_L 及 E_C 三者的向量和。
- 且因 E_L 與與 E_C 反相，所以總電壓 E 即為 L_R 與 I (X_L-X_C) 之向量和

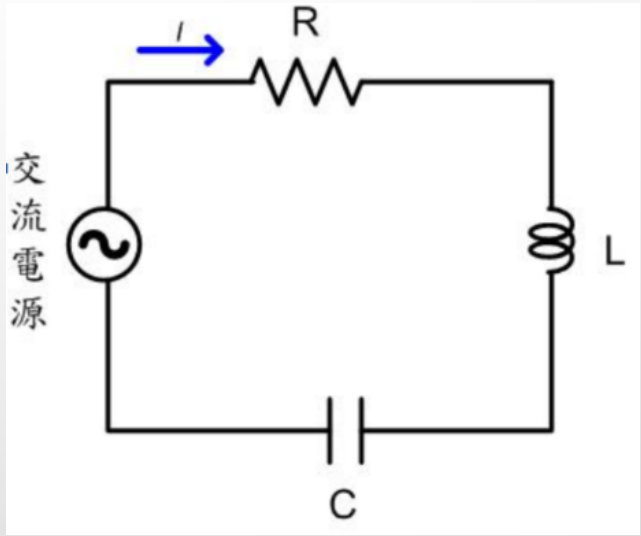
- 總電壓公式

$$E = \sqrt{(IR)^2 + (IX_L - IX_C)^2} = I\sqrt{R^2 + (X_L - X_C)^2} = I\,Z$$

共振頻率

- 當感抗相等容抗時，電流的振幅達到最大值，且與總電壓 E 同相，稱為共振現象。

- 此時的頻率稱為共振頻率



$$\because X_L = X_C$$

$$X_{L=}\omega L$$

$$X_C = \frac{1}{\omega C}$$

$$\therefore \omega L = \frac{1}{\omega C}$$

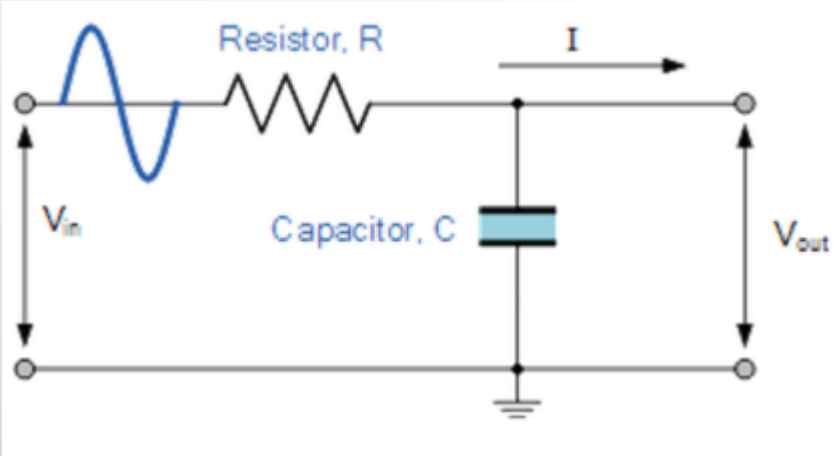
$$\omega^2 = \frac{1}{LC}$$

$$\omega = \frac{1}{\sqrt{LC}}$$

$$2\pi f = \frac{1}{\sqrt{LC}}$$

$$f = \frac{1}{2\pi\sqrt{LC}}$$

一階低通濾波器 (PASSIVE)



$$f_c = \frac{1}{2\pi RC}$$

$$\because X_C = \frac{1}{\omega C} = \frac{1}{2\pi fC}$$

$$Z = \sqrt{R^2 + X_C^2}$$

$$V_{out} = V_{in} \times \frac{X_C}{\sqrt{R^2 + X_C^2}} = V_{in} \frac{X_C}{Z}$$

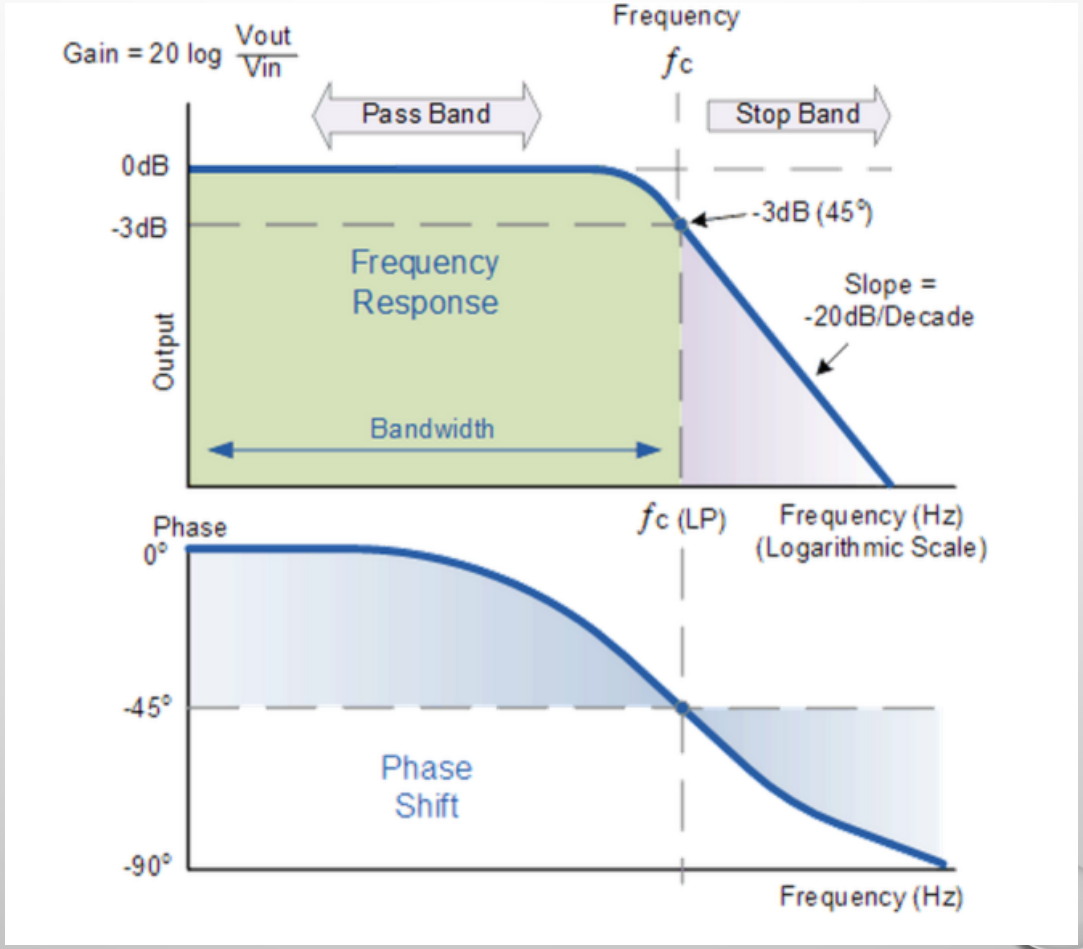
R= 4.7kΩ

C= 47nF

What is the Voltage Output at a Frequency of 100Hz?

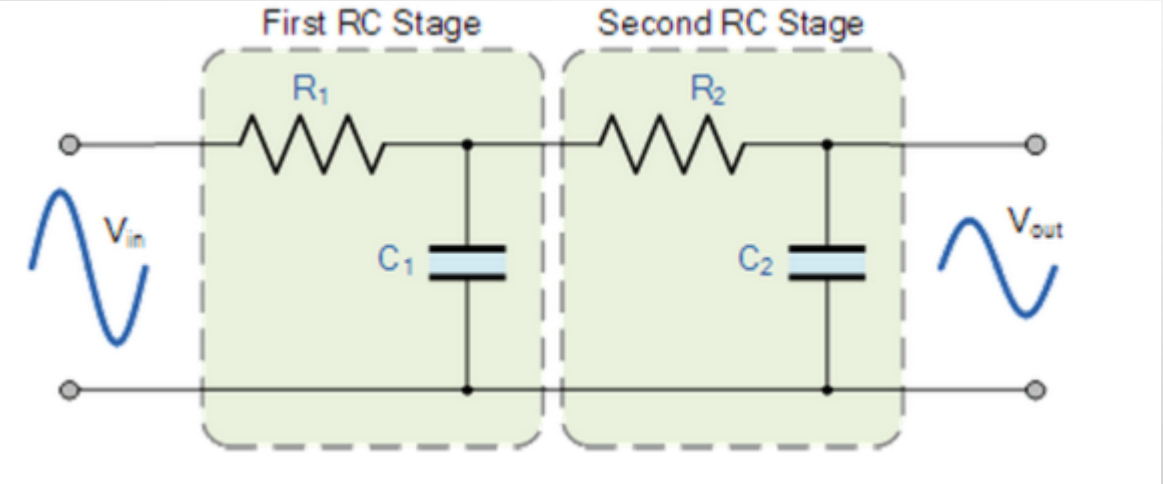
What is the Voltage Output at a Frequency of 10,000Hz?

FREQUENCY RESPONSE OF THE FIRST-ORDER LOW PASS FILTER



二階低通濾波器 (PASSIVE)

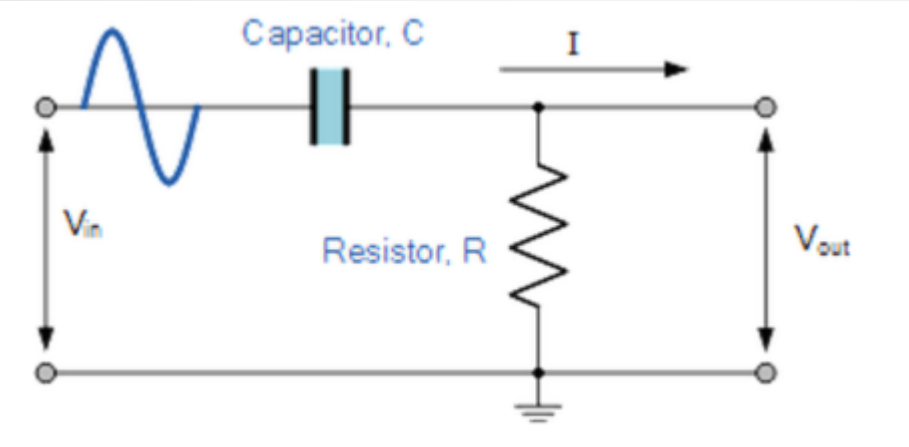
- The -20dB/decade (-6dB/octave) angle of the slope may not be enough to remove an unwanted signal then two stages of filtering can be used as shown.



$$f_c = \frac{1}{2\pi\sqrt{R_1 C_1 R_2 C_2}}$$

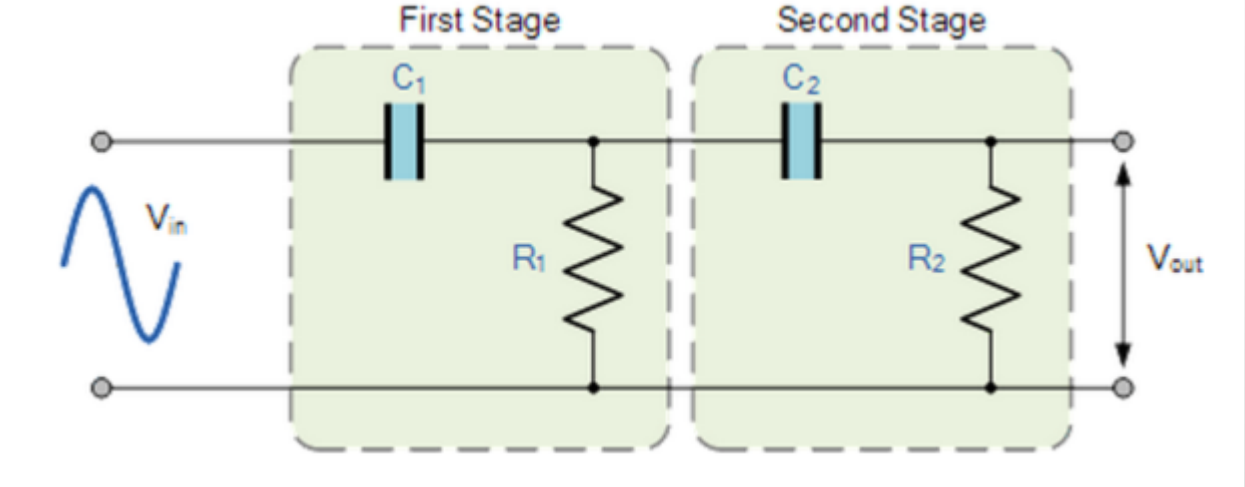
一階高通濾波器 (PASSIVE)

- Calculate the cut-off frequency (fc) for a simple **high pass filter** consisting of an 82pF capacitor connected in series with a 240kΩ resistor.



$$f_c = \frac{1}{2\pi RC}$$

二階高通濾波器 (PASSIVE)



$$f_c = \frac{1}{2\pi\sqrt{R_1 C_1 R_2 C_2}}$$