

The background of the slide is a light gray gradient. It is decorated with numerous realistic water droplets of various sizes. Some droplets are large and prominent, while others are small and scattered. They are primarily located in the top-left and bottom-right corners, with a few smaller ones in the center and top-right areas. The droplets have a glossy, reflective surface with highlights and shadows, giving them a three-dimensional appearance.

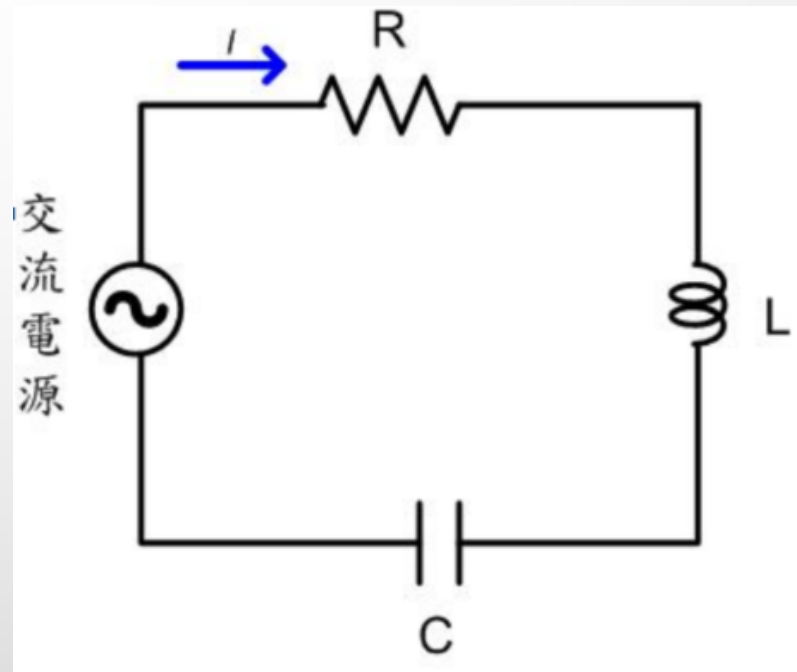
類比電子電路實作

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

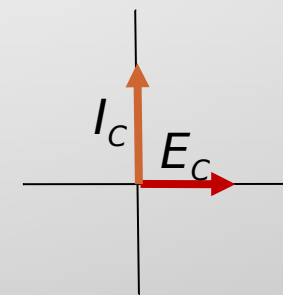
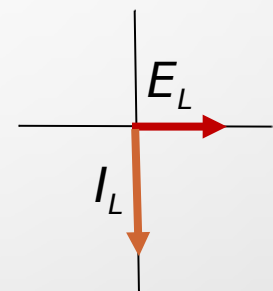
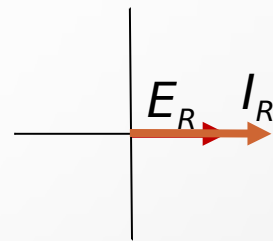
$$E_R = I_R R$$

- 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

$$E_C = I_C X_C$$

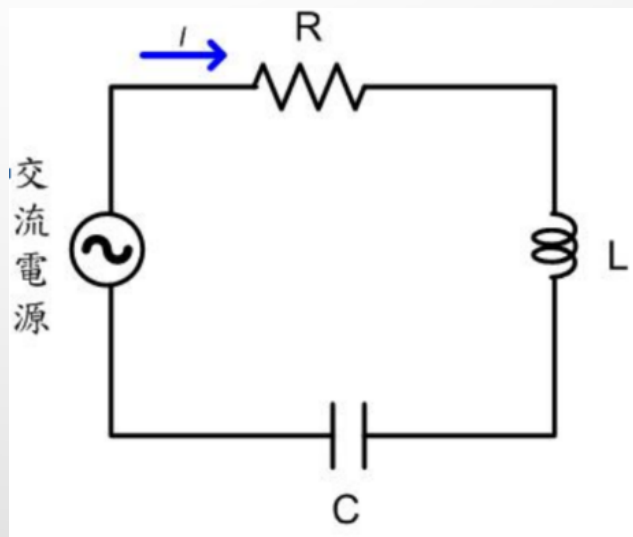


- 由於總電壓 E ，為 E_R 及 E_L 及 E_C 三者的向量和。
- 且因 E_L 與與 E_C 反相，所以總電壓 E 即為 L_R 與 $I(X_L - X_C)$ 之向量和
- 總電壓公式

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

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



$$\because X_L = X_C$$

$$X_L = \omega L$$

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

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

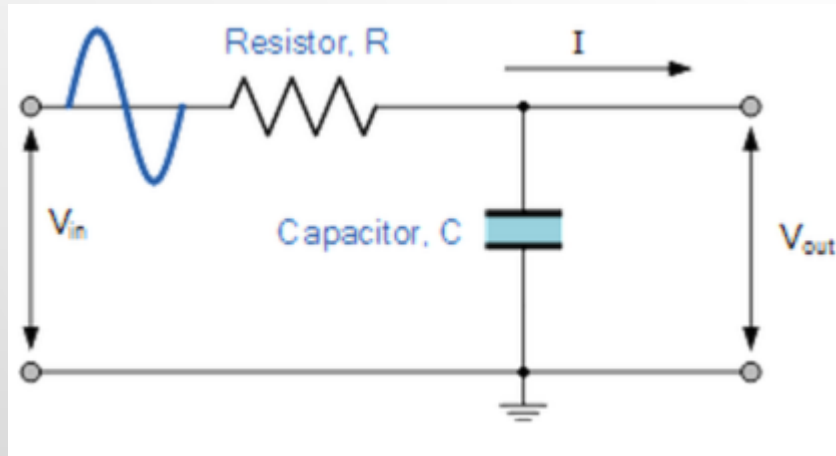
$$\omega^2 = \frac{1}{LC}$$

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

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

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

一階低通濾波器 (PASSIVE)



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

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

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

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

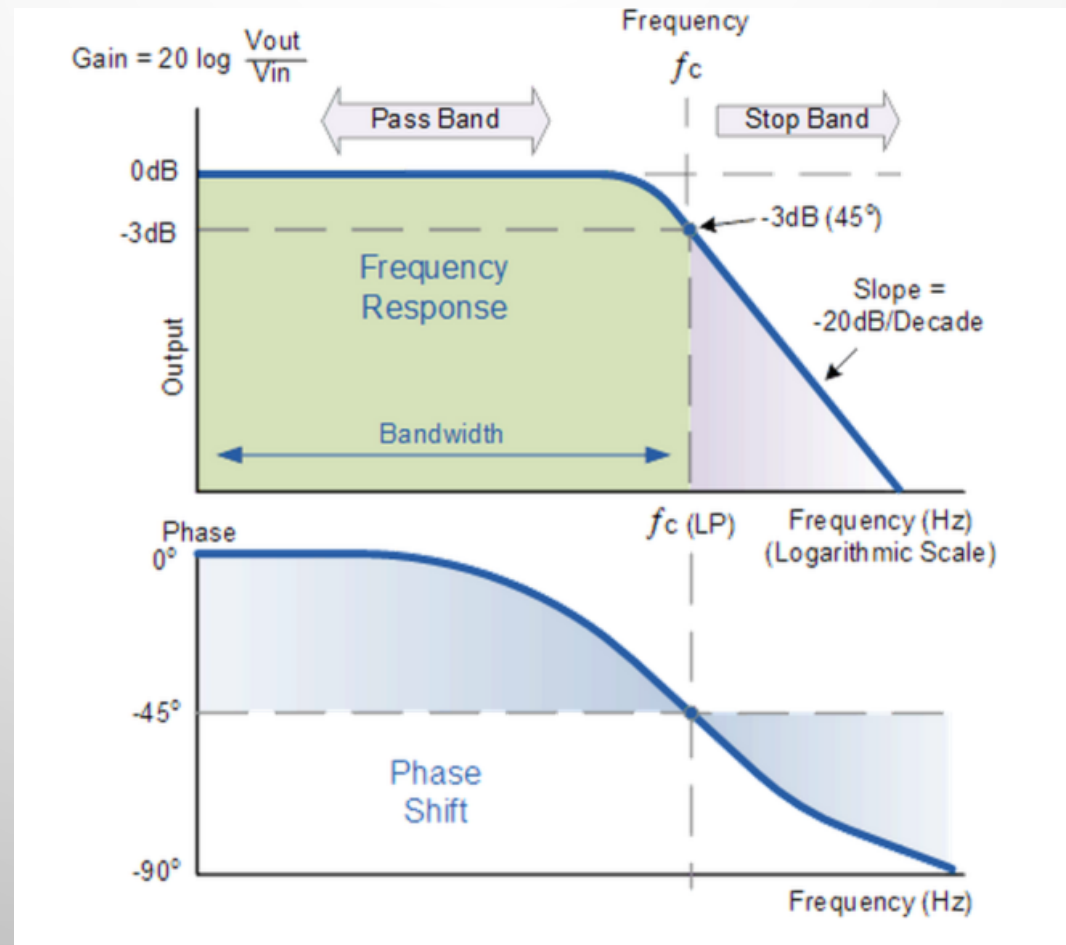
$R = 4.7\text{k}\Omega$

$C = 47\text{nF}$

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

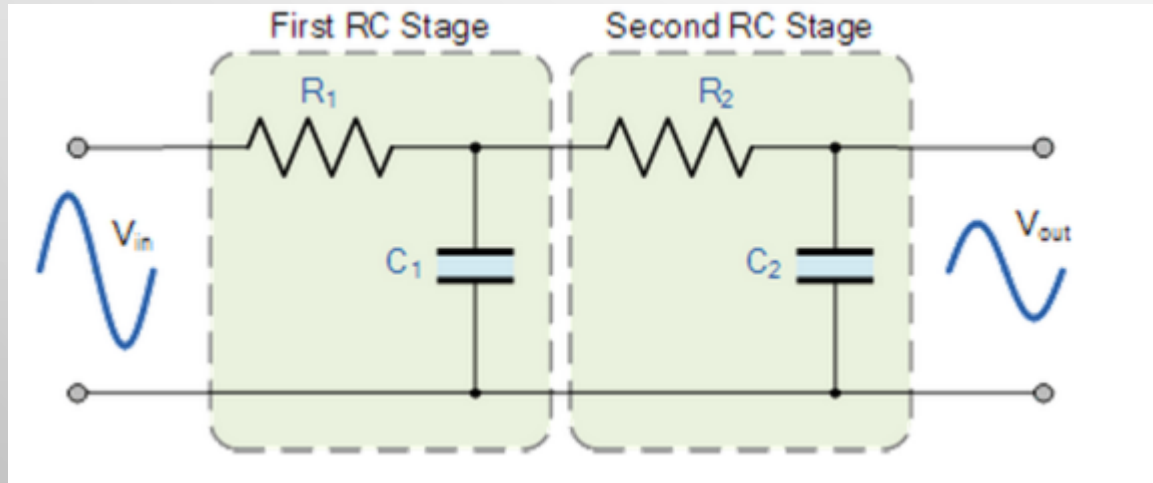
What is the Voltage Output at a Frequency of 10,000Hz?

FREQUENCY RESPONSE OF THE FIRST-ORDER LOW PASS FILTER



二階低通濾波器 (PASSIVE)

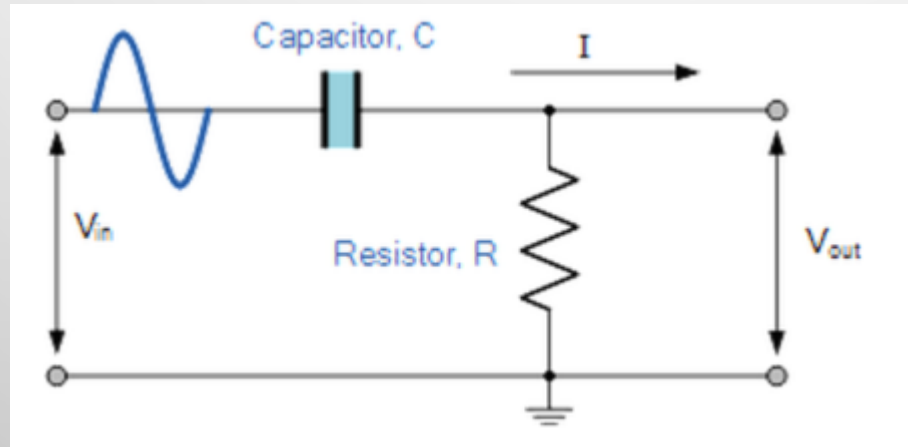
- The -20dB/decade (-6dB/octave) angle of the slope may not be enough to remove an unwanted signal then two stages of filtering can be used as shown.



$$f_c = \frac{1}{2\pi\sqrt{R_1C_1R_2C_2}}$$

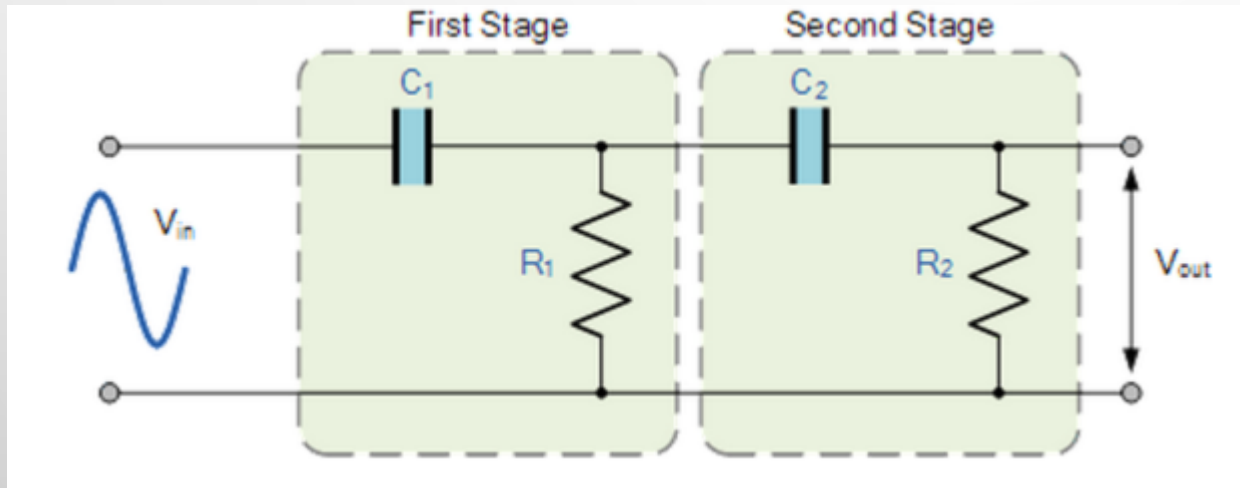
一階高通濾波器 (PASSIVE)

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



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

二階高通濾波器 (PASSIVE)



$$f_c = \frac{1}{2\pi\sqrt{R_1C_1R_2C_2}}$$