

## Physics Level 3

# Electricity

### DC Circuits

What you need to know

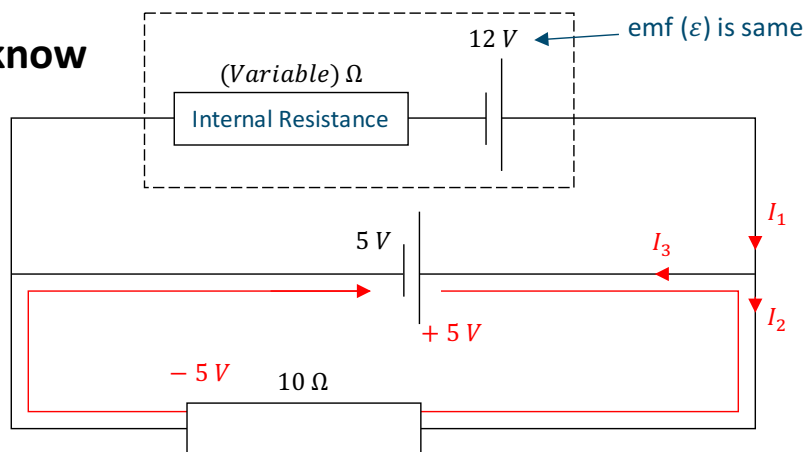
$$V = IR$$

**Kirchhoff's current law:**

The current entering a junction, must equal the current leaving a junction

**Kirchhoff's voltage law:**

Voltages around a closed loop must add to zero



# Video Summaries

## Capacitors – Part 1

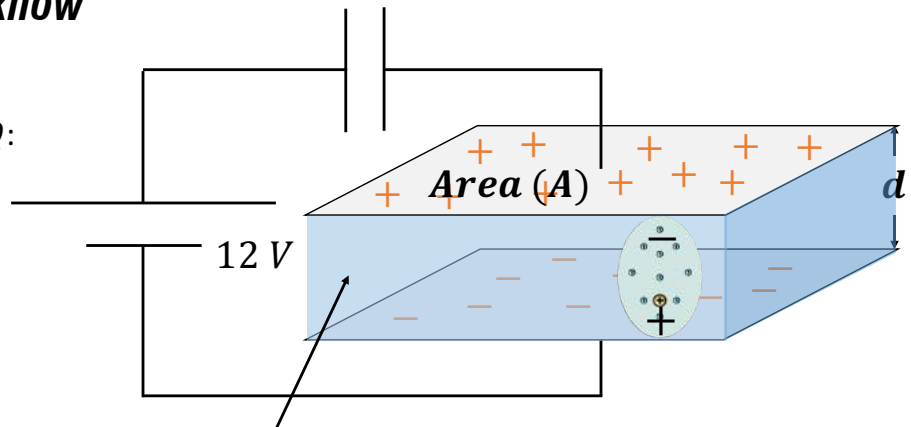
### What you need to know

Capacitance,  $C$ , is the ability to hold charge,  $Q$ :

$$C = \frac{\epsilon_0 \epsilon_r A}{d}$$

$$Q = CV$$

$$E = \frac{1}{2} QV$$



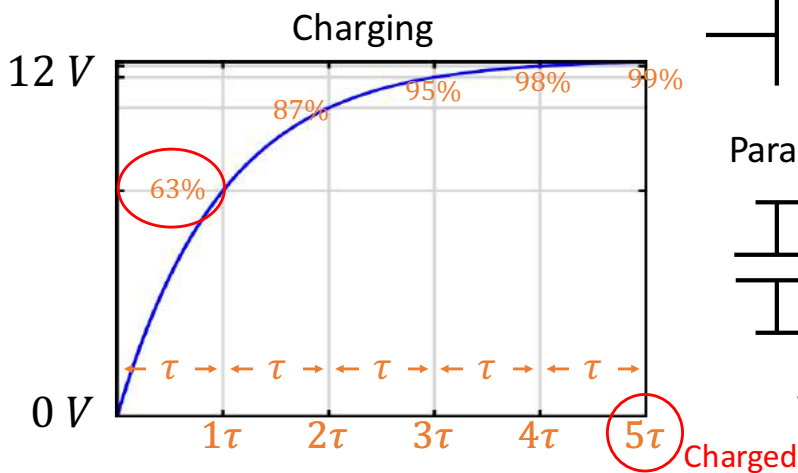
**Dielectric** is an insulating (non-conducting) layer between plates

[www.learncoach.co.nz](http://www.learncoach.co.nz)

**learnCOACH**  
study smarter

## Capacitors – Part 2

### What you need to know



Series: lowers capacitance

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \dots$$

Parallel: increases capacitance

$$C_T = C_1 + C_2 + \dots$$

Time Constant:  $\tau = RC$

[www.learncoach.co.nz](http://www.learncoach.co.nz)

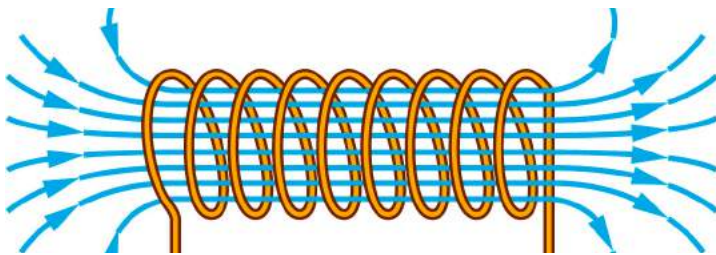
**learnCOACH**  
study smarter

# Video Summaries

## Inductors – Part 1

### What you need to know

An inductor opposes change



$$\varepsilon = -\frac{\Delta\phi}{\Delta t} \quad \phi = BA$$

$$\varepsilon = -L \frac{\Delta I}{\Delta t} \quad E = \frac{1}{2} L I^2$$

$\varepsilon$  = opposing voltage (V)

$\phi$  = Flux (Wb)

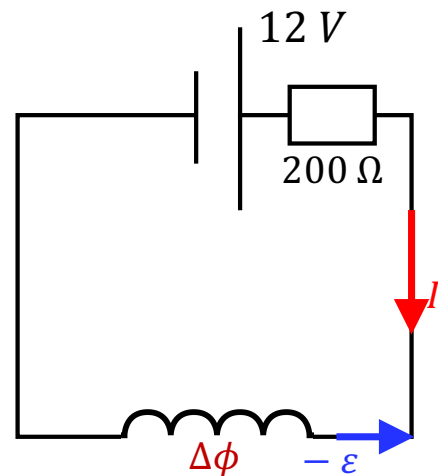
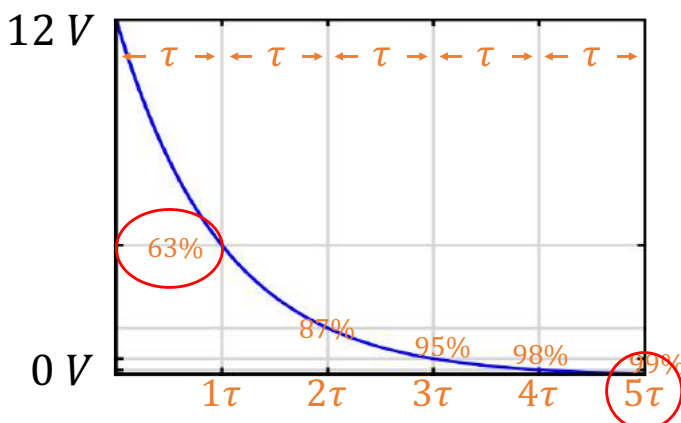
$L$  = Inductance (H)

$\Delta$  current  $\rightarrow$   $\Delta$  magnetic field  $\rightarrow$  opposing voltage  $\rightarrow$  opposing current  $\rightarrow$  opposing magnetic field  $\rightarrow$  ...

## Inductors – Part 2

### What you need to know

$$\tau = \frac{L}{R}$$

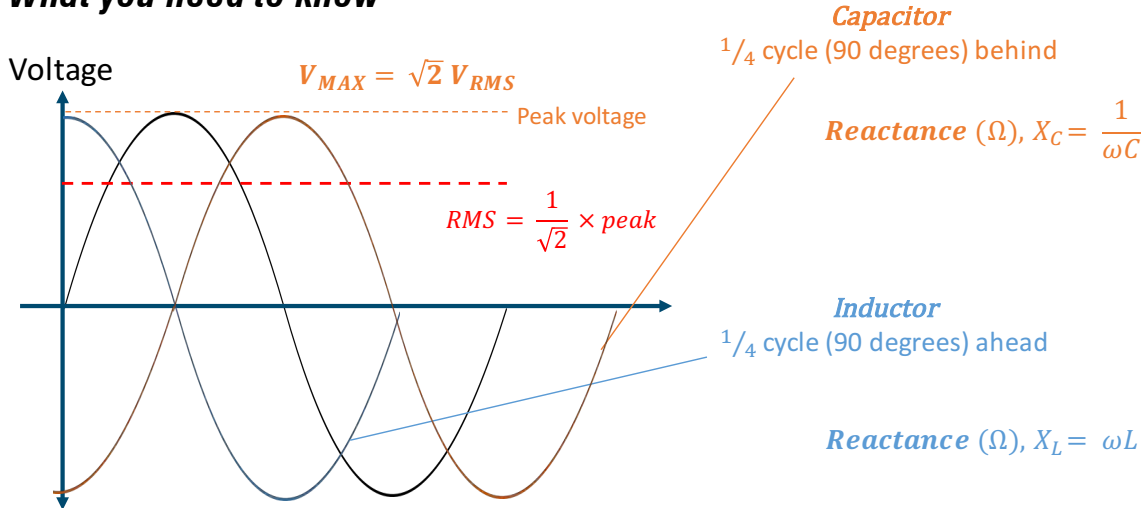


No opposing voltage

# Video Summaries

## AC Circuits – Part 1

### What you need to know

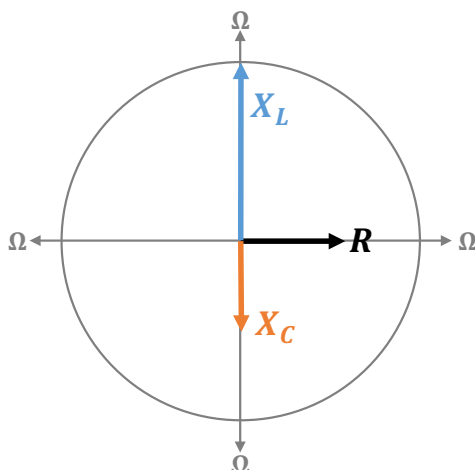


[www.learncoach.co.nz](http://www.learncoach.co.nz)

**learnCOACH**  
study smarter

## AC Circuits – Part 2

### What you need to know



#### Phase

- Inductor and capacitor reactance,  $X$ , (and voltage,  $V$ ) are  $180^\circ$  out of phase (opposite).
- This means they cancel each other out.

#### Impedance

- Impedance is "overall resistance" of the circuit
- Impedance ( $Z$ ) = Resistance ( $R$ ) + Reactance ( $X$ )
- Use SOH CAH TOA and Pythagoras to find

#### Resonance

- When  $X_L$  and  $X_C$  are equal sizes, they cancel each other FULLY. This means NO reactance ( $Z = R$ )
- Minimum impedance ( $Z$ ) means a much higher current ( $V = IZ$ )

[www.learncoach.co.nz](http://www.learncoach.co.nz)

**learnCOACH**  
study smarter