Inductance

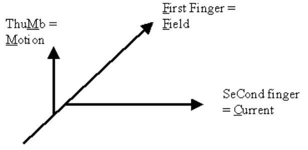
Definitions

Magnetic fields

Magnetic fields can be described in terms of magnetic flux, ∅ (Wb), and magnetic field strength, B (T).

Electromagnetic induction

When 2 of **M**ovement, Magnetic **F**ield and **C**urrent exist at an angle to each other (90° is the optimum angle) the third is induced:



Inductance

Inductance, L, is the ability of an inductor to store energy and it does this in the magnetic field that is created by the flow of electrical current.

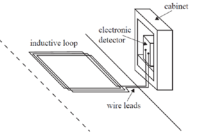
Equations

$\phi = BA$	Magnetic Flux	Φ	Wb
	Magnetic Field Strength	B	T
	Area	A	m^2
$\varepsilon = -L\dfrac{\Delta I}{\Delta t}$	EMF	ε	V
	Inductance	L	H
	Current	I	A
	Time	t	s
$\varepsilon = -\dfrac{\Delta \phi}{\Delta t}$	EMF	ε	V
	Magnetic Flux	Φ	Wb
	Time	t	s

Questions

QUESTION TWO (2019;2)

Inductive loops are also used to sense the presence of cars. Inductive loops are wire coils embedded into the surface of the road and are powered by an AC supply of known voltage and frequency.



One particular inductive loop has 4.00 Ω of resistance and is powered by a 24.0 V_{RMS} AC power supply. The loop is a 1.60 m × 0.600 m rectangular shape, with three coils of wire.

(a) The strength of the magnetic field inside the loop is 0.0413 T. Calculate the maximum magnetic flux in each of the three coils of wire of the inductive loop.

When a car drives over the inductive loop, the steel in the car's body and engine interacts with the magnetic field of the inductive loop. The overall effect of this interaction is to reduce the inductance of the loop.

(b) Explain the effect decreased inductance would have on current in the circuit.

Terms

Magnetic field: Region where ferromagnetic materials (iron, cobalt, nickel) and magnets experience a force.
Magnetic flux: Magnetic field strength multiplied by area.
Magnetic flux density: Amount of flux density in a fixed area

Tips

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Answers

(a) Area = 1.60 m x 0.600 m = 0.960 m^2
Max magnetic flux = *B* x *A* = 0.0413 T x 0.960 m^2 = 0.0396 Wb

(b) Reducing the inductance of the inductive loop would reduce the reactance of the circuit. The resistance remains unchanged, thus the overall impedance would be reduced, and so current would rise.