QUIZ – ANSWER KEY

QUIZ NO: 92

TOPIC: ELECTRICAL ENGINEERING

DATE: 23/07/2022

1. What will be the equivalent capacitance (in mF) of three capacitors connected in a series having the capacitance of 0.04 mF, 0.08 mF, and 0.02 mF respectively?

   [A] 0.026

   [B] 0.032

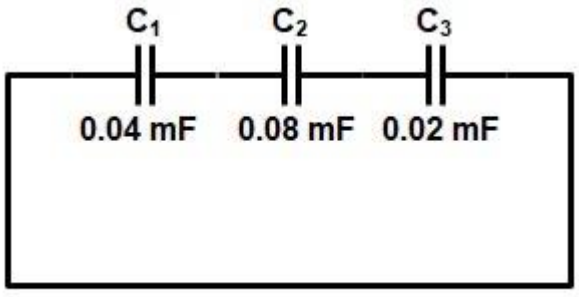
   [C] 0.065

   [D] 0.011

   Answer: D

   Explanation:-

   The three capacitor **C_1, C_2, C_3** is connected in a series as shown in the figure;



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Now the Equivalent capacitance connected in the series will be;

$1/C_{eq} = 1/C_1 + 1/C_2 + 1/C_3$

$1/C_{eq} = 1/0.04 + 1/0.08 + 1/0.02$

$1/C_{eq} = 25 + 12.5 + 50$

$1/C_{eq} = 87.5$

$C_{eq} = 1/87.5$

$C_{eq} = 0.011$

2. Determine the voltage (in V) of a battery connected to a parallel plate capacitor (filled with air) when the area of the plate is 10 square centimeters, the separation between the plate is 5 mm and the charged stored on the plate is 20 pC ?

[A] 12.3

[B] 10.3

[C] 11.3

[D] 14.3

Answer: C

Explanation:-

Consider the parallel plate capacitor connected to the battery as shown in the figure;

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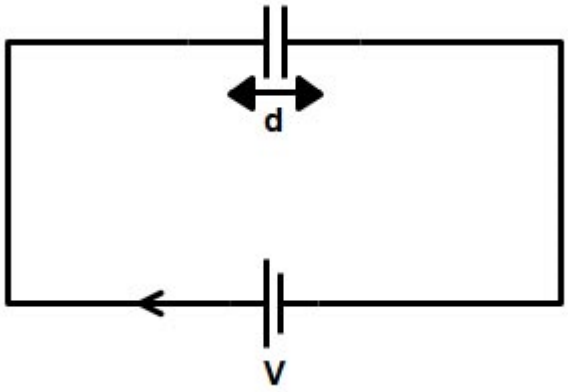

The capacitance **"C"** of the parallel plate capacitor is given as;

$C = \varepsilon_o A/d$

Where;
A = Area = 10 square centimeter = $\mathbf{10 \times 10^{-4}}$ **meter**
$\boldsymbol{\varepsilon_o}$ **=** Permittivity of free space = $\mathbf{8.85 \times 10^{-12}}$
d = distance between the parallel plate capacitor = 5mm = $\mathbf{5 \times 10^{-3}}$ **meter**
q = Charge stored in the capacitor = 20 pC = $\mathbf{20 \times 10^{-12}}$

$C = (8.85 \times 10^{-12} \times 10 \times 10^{-4}) / 5 \times 10^{-3}$

$C = 1.77 \times 10^{-12}$ F

The *self-capacitance* of a conductor is defined by;

$C = q / V$

Hence the voltage across the capacitor;

$V = q / V = (20 \times 10^{-12}) / (1.77 \times 10^{-12})$

V = 11. 3 Volts

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3. Which one of the following statements is **TRUE?**

[A] Kirchhoff's Law is not applicable to the circuit with the passive elements

[B] Kirchhoff's Law is not applicable to the circuit with the non-Linear resistance

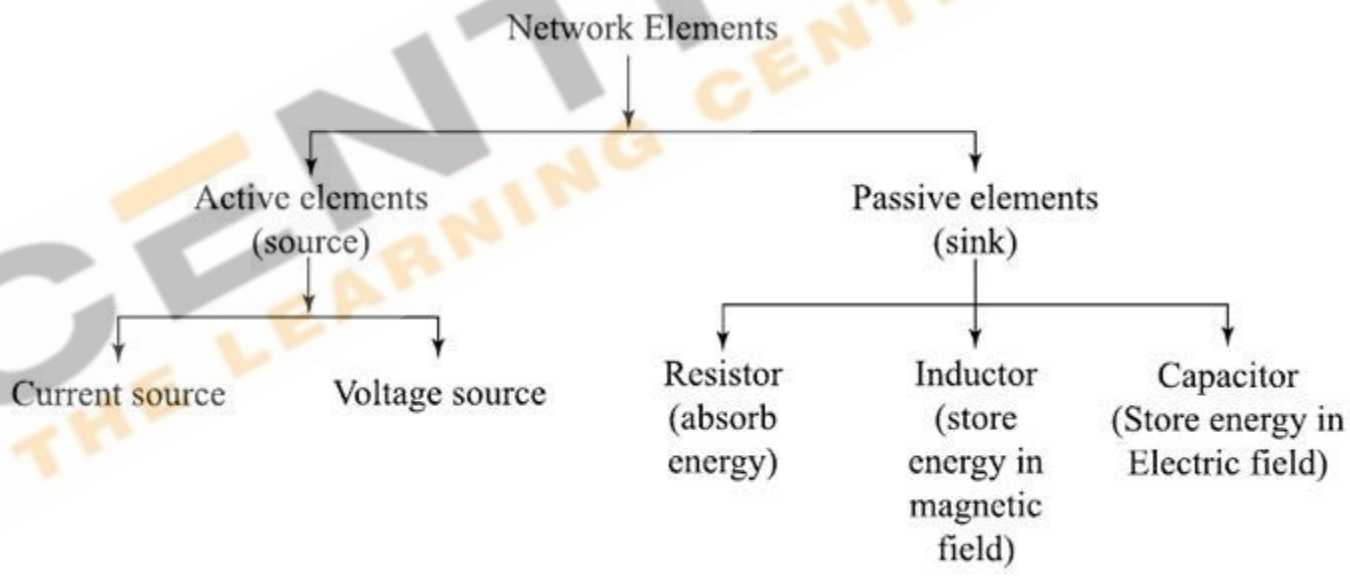
[C] Kirchhoff's Law is not applicable to the circuit with the non-Linear resistance

[D] Kirchhoff's Law is not applicable to circuits with the distributed elements

Answer: D

Explanation:-

Types of Elements in a Network Circuit



Passive Network/Element:- Passive network is one, which contains no source of emf in it i.e., **R, L, C.**

An element that is capable of receiving power is called passive element Ex: Resistor, Inductor, Capacitor.

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Active Network/Element:- Active network is one that contains one or more than one source of emf, then the network is called an active network.

An element that is capable of supplying power is called an **active element**.

The network element can further be classified into more different groups

- Linear or Non-Linear
- Unilateral or Bilateral
- Time-variant or Time invariant
- Lumped or distributed Network

Lumped Elements:- When it is possible to separate the elements of a network physically like resistors, inductors, capacitors, etc. the elements are called as lumped elements. **Kirchhoff's law is only applicable to the circuit with lumped elements.**

Distributed Elements:- When it is not possible to separate the elements of a network physically the elements are known as distributed elements. The best example of such a network is a transmission line where resistance, inductance, and capacitance of a transmission line are distributed all along its length and cannot be shown as a separate element, anywhere in the circuit.

4. Which of the following represent the relation between the peak value and the RMS value of voltage for a sine wave?

   [A] Vrms = 1.414Vpeak

   [B] Vrms = 0.637Vpeak

   [C] Vrms = 0.424Vpeak

   [D] Vrms = 0.707Vpeak

   Answer: D

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5. Determine the total impedance (in ohms) of a series RLC circuit having a resistance of 10 Ohms, capacitive reactance of 2 ohms and the inductive reactance of 6 ohms, connected in a series across a 200 V, 50 Hz supply.

   [A] 8.64

   [B] 10.77

   [C] 12.21

   [D] 14.65

   Answer: B

   Explanation:-

   In RLC series circuit the total impedance of the series LCR circuit is given as;

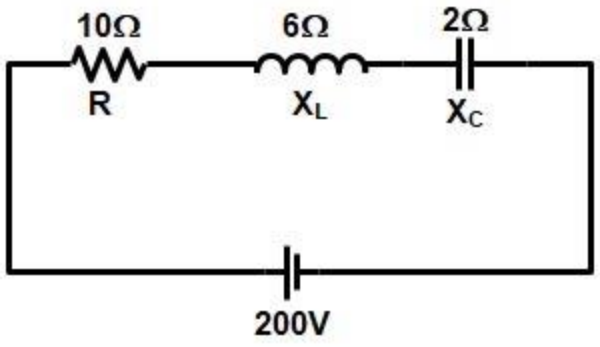
   $$\mathbf{Z^2 = R^2 + (X_L - X_C)^2}$$

   Where;

   R = Resistance = 10Ω

   X_L is inductive reactance = 6Ω

   and X_C is capacitive reactance = 2Ω



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$Z^2 = 10^2 + (6 - 2)^2$

$Z^2 = 116$

Z = 10.77Ω

6. Determine the value of the phase current (in A) for a balanced delta connected system, when the value of the line current is 8.7 A ?

[A] 8

[B] 6

[C] 7

[D] 5

Answer: D

Explanation:-

In a delta connected system, the phase current is 1/√3 times the line current and the phase voltage is equal to the line voltage of the system.

I_{PH} = Line/√3

I_{PH} = 8.7/√3 = 5.02 A

I_{PH} = 5.02 A

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7. What will be the value of inductance (in mH) connected in parallel with a capacitance of 4F in a series RLC circuit having the quality factor of 2, when the resonant frequency is 6 rad/sec?

[A] 2

[B] 3

[C] 5

[D] 7

Answer: D

Explanation:-

As explained in question no 32 the quality of the RLC circuit is given as;

$$Q = \omega_o L / R \text{ ———— (1)}$$

or

$$Q = 1 / \omega_o C.R \text{ ————(2)}$$

Now the given quantities are;

Quality factor Q = 2

Resonance Frequency = ω_o = 6 rad/Sec

Capacitance C = 4 F

Resistance R =?

Inductance L = ?

Now from **equation Number 2**, we can find the value of resistance;

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$Q = 1 / \omega_o C.R$

$2 = 1 / 6 \times 4 \times R$

$R = 1 / 48\ \Omega$

Now again To find the value of an inductance we will use equation number 2;

$Q = \omega_o L / R$

$2 = 6 \times L / 1 / 48$

$L = 0.0069 \cong 0.007$

L = 7mH

8. Determine the total power (in kW) consumed in the 3-Phase delta connected system supplied by line voltage of 230 V, if the value of the phase current is 30 A and the current lags the voltage by 30 degrees ?

[A] 14.6
[B] 15.26
[C] 16.62
[D] 17.93

Answer: D

Explanation:-

The power consumed by the three-phase circuit is

$P = 3\ V_{ph}\ I_{ph} \cos\phi_{ph}$

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In delta connected system

Line voltage is equal to the phase voltage i.e

$V_L = V_{PH} = 230$ V

Phase current **$I_{PH} = 30$ A**

phase angle $\phi = 30°$

$\therefore P = 3 \times 230 \times 30 \times \cos 30°$

P = 17926.2 watts or 17.93 kW

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9. Determine the power (in W) of a lamp of 220 V, when the resistance of the lamp is 100 Ohms.

[A] 448
[B] 446
[C] 484
[D] 488

Answer: C

Explanation:-

Given;

Voltage V = 220 V

Resistance R = 100 ohms

Power consumed by the lamp;

$P = V^2/R = 220^2/100$

P = 484 Watt

10. What will be the voltage (in V) of a battery connected to a parallel plate capacitor with air as the dielectric, having a plate area of 6 sq cm and separation between the plates are 2 mm, which stores a charge of 8.0 pC on the plates?

[A] 3
[B] 9
[C] 6

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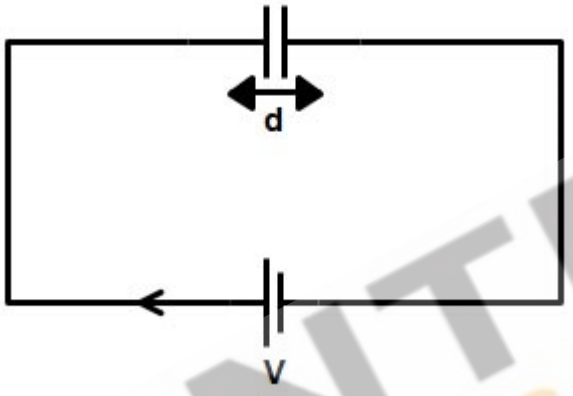
[D] 5

Answer: A

Explanation:-

Consider the parallel plate capacitor connected to the battery as shown in the figure;



The capacitance **"C"** of the parallel plate capacitor is given as;

$C = \varepsilon_o A/d$

Where;
A = Area = 10 square centimeter = **6×10^{-4} meter**
ε_o = Permittivity of free space = **8.85×10^{-12}**
d = distance between the parallel plate capacitor = 2mm = **2×10^{-3} meter**
q = Charge stored in the capacitor = 8 pC = **8×10^{-12}**

$C = (8.85 \times 10^{-12} \times 6 \times 10^{-4}) / 2 \times 10^{-3}$

$C = 26.55 \times 10^{-13}$ F

The *self-capacitance* of a conductor is defined by;

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$C = q / V$

Hence the voltage across the capacitor;

$V = q / C = (8 \times 10^{-12}) / (26.55 \times 10^{-13})$

V = 3.013 Volts