

Use 0.7 mm mechanical pencil. Keep 0.25 inch from edge of box. Erase mistakes thoroughly.

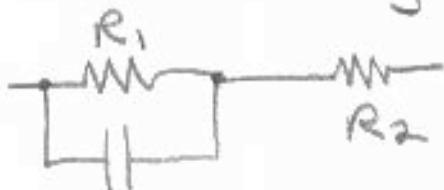
CI 1
Problem Type Acronym

Name _____

ID # _____

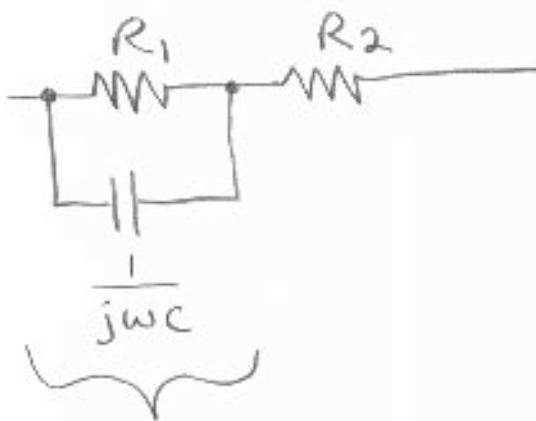
Question

Find the impedance, Z ,
for the following circuit



as $\omega \rightarrow 0$, $Z \rightarrow ?$

Answer



$$\frac{1}{\frac{1}{R_1} + j\omega C} + R_2 = \frac{R_1}{1 + j\omega R_1 C} + R_2$$

as $\omega \rightarrow 0$, $Z \rightarrow R_1 + R_2$

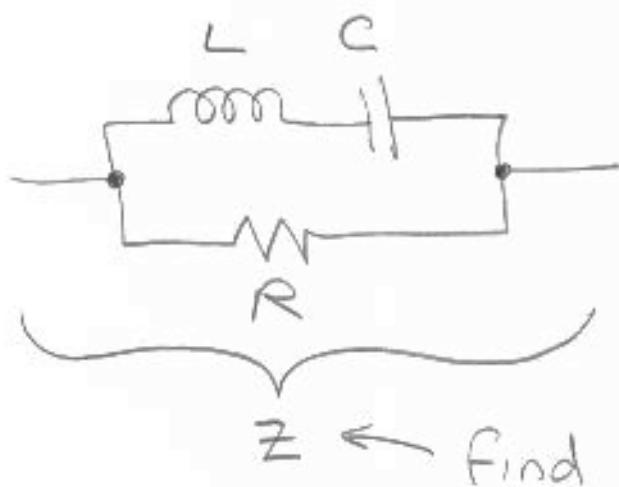
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CI 2

Name _____

四

Question



at what w is $Z = 0$.
 Does that w depend on R ?
 Why or why not?

Answer

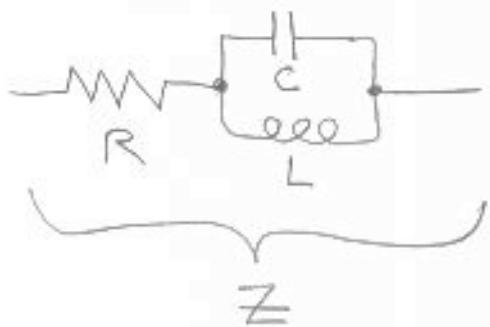
$$N = \frac{1}{R + \frac{1}{j\omega L + \frac{1}{j\omega C}}} = \frac{1}{R + \frac{j\omega C}{1 - \omega^2 LC}}$$

$$Z=0 \text{ when } 1 - \omega^2 LC = 0$$

$$w = \overline{f(c)}$$

Independent of R because the LC branch of the parallel circuit "shorts out" R .

Question



Solve for Z .

for what ω is $|Z|$ minimum

and what is Z at that ω ?

Answer

$$Z = R + \frac{1}{\frac{1}{j\omega L} + j\omega C}$$

$$Z = R + \frac{j\omega L}{1 - \omega^2 LC}$$

$|Z|$ is minimum when
 $\omega = 0$, or $\omega = \infty$
 \uparrow \uparrow
 $Z_L = 0$ $Z_C = 0$

$$Z_{\min} = R$$

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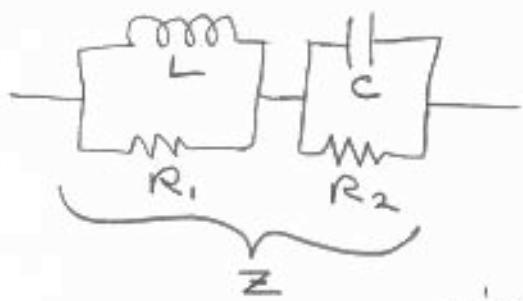
CI4

Problem Type Acronym

Name _____

ID # _____

Question



Solve for $Z(\omega)$ (just write equation)
What is $Z(\omega)$ at $\omega=0$? at $\omega=\infty$?
(answer should be intuitive,
look at the circuit)

Answer

$$Z(\omega) = \frac{1}{\frac{1}{R_1} + \frac{1}{j\omega L}} + \frac{1}{\frac{1}{R_2} + j\omega C}$$

$$Z(0) = R_2$$

$$Z(\infty) = R_1$$

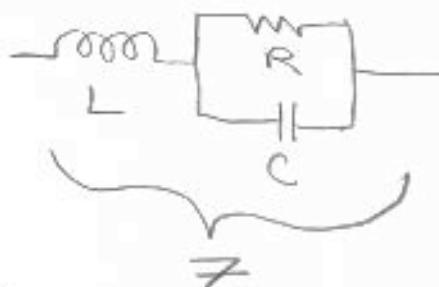
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CI5
Problem Type Acronym

Name _____

ID # _____

Question



Compute the complex impedance Z . Simplify.

what is $|Z|$ when $\omega=0$? when $\omega=\infty$?

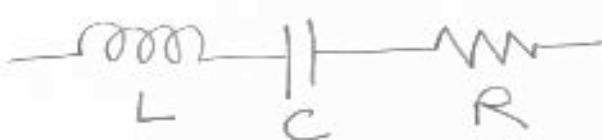
Answer

$$Z = j\omega L + \frac{1}{\frac{1}{R} + j\omega C} = j\omega L + \frac{R}{1 + j\omega RC}$$

at $\omega=0$, $|Z|=R$

at $\omega=\infty$, $|Z|=\infty$

Question



Find the total impedance Z .

what is Z when $\omega = 0$?

what is Z when $\omega = \infty$?

At what value of ω is Z minimum, and what is that minimum value of Z ?

Answer

$$Z = j\omega L + \frac{1}{j\omega C} + R$$
$$= \frac{1 - \omega^2 LC}{j\omega C} + R$$

when $\omega = 0$ $Z = \infty$ (capacitor blocks)

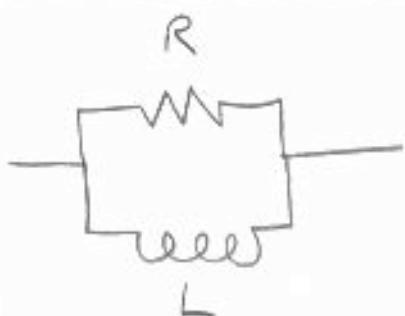
when $\omega = \infty$ $Z = \infty$ (coil blocks)

Z is minimum when

$$1 - \omega^2 LC = 0 \Rightarrow \omega = \sqrt{1/LC}$$

at which point $Z = R$ (resonance)

Question



Compute total impedance Z .

what are Z_{\min} and Z_{\max}
and at what frequencies
do they occur?

Answer

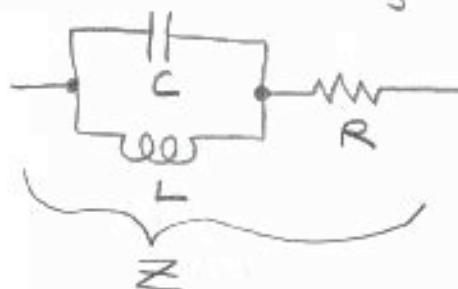
$$Z = \frac{1}{\frac{1}{R} + \frac{1}{j\omega L}} = \frac{j\omega RL}{j\omega L + R}$$

$$Z_{\min} = 0 \text{ at } \omega = 0$$

$$Z_{\max} = R \text{ at } \omega = \infty$$

Question

Given the following circuit



Express the total impedance Z as a function of ω (simplify!)
What is Z at $\omega=0$? at $\omega=\infty$?
At what frequency ω is $|Z|=\infty$?

Answer

$$Z = \frac{1}{\frac{1}{j\omega L} + j\omega C} + R$$

$$Z = \frac{j\omega L}{1 - \omega^2 LC} + R$$

$$Z|_{\omega=0} = R \quad Z|_{\omega=\infty} = R$$

$$Z|_{\omega=\frac{1}{\sqrt{LC}}} = \infty$$

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C19

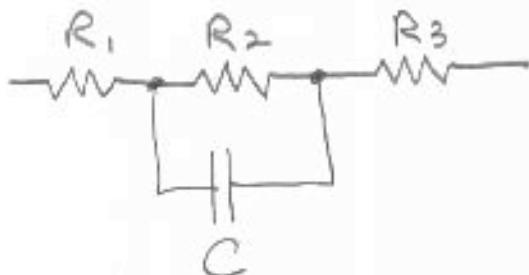
Problem Type Acronym

Name _____

ID # _____

Question

(A) What is the impedance of this circuit?



- (B) what is the impedance when $\omega = 0$?
(C) what is the impedance when $\omega = \infty$?
(D) explain (B) and (C) in English .

Answer

(A) $Z = R_1 + \frac{1}{\frac{1}{R_2} + j\omega C} + R_3 = R_1 + \frac{R_2}{1 + j\omega R_2 C} + R_3$

(B) $Z|_{\omega=0} = R_1 + R_2 + R_3$

(C) $Z|_{\omega=\infty} = R_1 + R_3$

(D) At $\omega=0$, the cap has ∞ impedance and you have 3 resistors in series.
At $\omega=\infty$ the cap shorts out R_2 leaving just R_1 and R_3 in series.