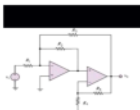
CA2 Practice

Sunday, 3 April 2022 6:07 pm

MA2009-CA2

[redacted]



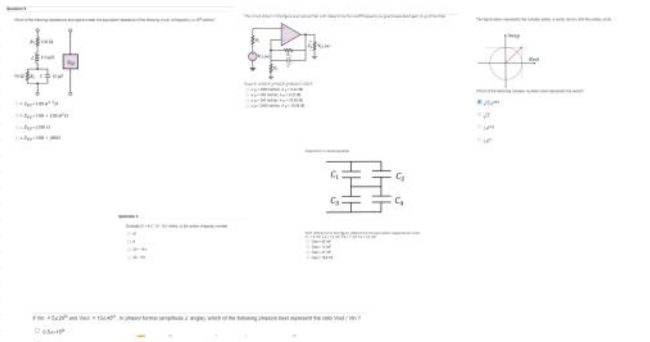
Given R1=10Ω, R2=10 Ω, R3=10 Ω, R4=10 Ω and R5= 30 Ω.

- Av= -2.25(V/V)
- Av= 0.80(V/V)
- Av= -0.80(V/V)
- Av= 2.25(V/V)

[redacted]

Input Values

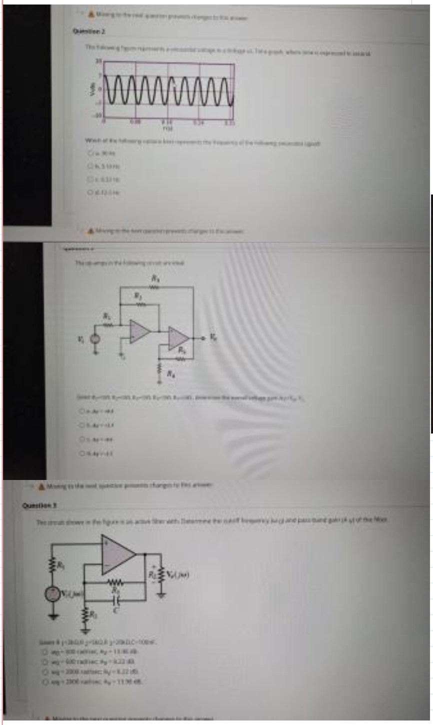
R1	50
R2	10
R3	10
R4	10
R5	10
Vout	-0.2
Vin	1.5
Av	-0.13333

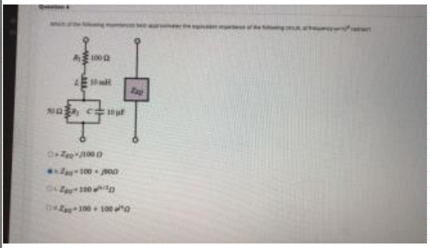


Question 3

Denoting by j the unit imaginary number, which of the following identities is true?

- $|1+j^2| = \sqrt{2}$
- $j^3 = j$
- $j + \pi = 0$
- $1 + e^{j\pi} = 0$





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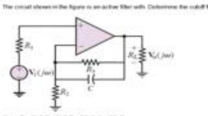
The circuit shown in the figure is an active filter with. Determine the cutoff frequency (ω_0) and pass band gain (A_v) of the filter.



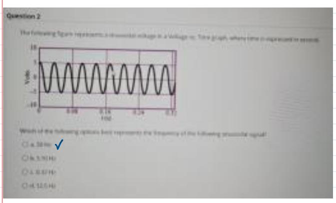
Given R1=2kΩ, R2=5kΩ, R3=50kΩ, C=100nF

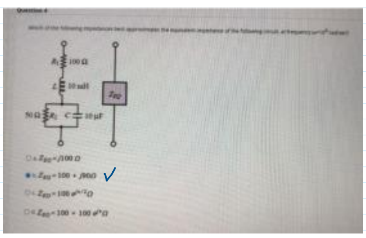
- ω_0 = 2000 rad/sec, A_v = 8.22 dB
- ω_0 = 200 rad/sec, A_v = 20.83 dB
- ω_0 = 2000 rad/sec, A_v = 20.83 dB
- ω_0 = 200 rad/sec, A_v = 8.22 dB

[redacted]

Input

R1	2			
R2	5			
R3	10		SI unit (R), kilo	1.0E+04
C	25.00		SI Unit C, Nano	0.000000015
Wo	4000.00	rad/s		
Vout/Vin	3			
Gain (DB)	9.542425			





Question 3

Evaluate (5 + 4*j*) * (5 - 4*j*) where *j* is the unitary imaginary number.

- 41 ✓
- 9
- 25 + 16*j*
- 25 - 16*j*

Total cycles : 9.5 thru 0.325

$F = \frac{9.5}{0.32}$

$= 29.6875$

≈ 30

$\omega = 2\pi f$

$f = \frac{1}{T}$

$Z_{EQ} = R_1 + j\omega L + R_2 // \frac{1}{j\omega C}$

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

$Z_s = R_1 + j\omega L$

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

$\frac{50}{1+5j} \times \frac{1-5j}{1-5j}$

$(5+4j)(5-4j)$

Total cycles : 9.5 thru 0.325

$F = \frac{9.5}{0.32}$

$= 29.6875$
≈ 30

$w = 2\pi f$

$f = \frac{1}{T}$

$$Z_{EQ} = R_1 + j\omega L + R_2 // \frac{1}{j\omega C}$$

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

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

$$= (100) + j(10^4)(10\times10^{-3}) + \frac{25}{13} - \frac{125}{13} j$$

$$= 101.923 + 90.385 j$$

$Z_s = R_1 + j\omega L$

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

$$= \frac{50}{1 + j(10^4)(50)(10\times10^{-6})} = \frac{50}{1+5j}$$

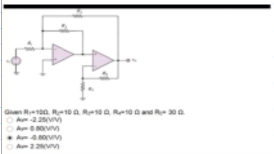
$$\frac{50}{1+5j} \times \frac{1-5j}{1-5j} = \frac{50-250j}{1-25j^2} = \frac{50-250j}{1+25} = \frac{25}{13} - \frac{125}{13} j$$

$$(5+4j)(5-4j)$$

$$= 25 - 20j + 20j - 16j^2$$

$$= 25 + 16$$

$$= 41$$



$-I_1 - I_2 + I_{in} = 0$

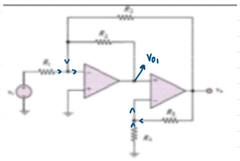
$I_1 + I_2 = I_{in}$

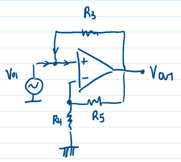
$$\frac{V_S - V^-}{R_1} + \frac{V_{o1} - V^-}{R_2} = \cancel{I_{in}}^{\,0} \qquad V^- = V^+ \qquad V^- = 0$$

$$\frac{V_S}{R_1} + \frac{V_{o1}}{R_2} + \frac{V_{out}}{R_3} = 0$$

$$V_{o1} = -\frac{V_S}{R_1} - \frac{V_{out}}{R_3}$$

$$V_{o1} = \left(-\frac{V_S}{R_1} - \frac{V_{out}}{R_3}\right) R_2$$





$-I_4 - I_5 + I_{in_2} = 0$

$I_4 + I_5 = I_{in_2}$

$$\frac{V_{S_2} - V^-}{R_4} + \frac{V_{out} - V^-}{R_5} = \cancel{I_{in_2}}^{\,0}$$

$V_{S_2} = 0$ (ground)

$V^- = V^+$

$V^+ = V_{o1}$

$$= -V_S \frac{R_2}{R_1} - V_{out} \frac{R_2}{R_3}$$

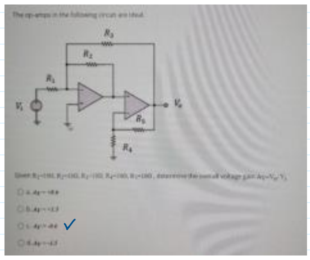
$$\frac{0 - (V^+)}{R_4} + \frac{V_{out} - (V^+)}{R_5} = 0$$

$$V_S \frac{R_2}{R_1 R_4} + V_{out} \frac{R_2}{R_3 R_4} + V_{out}\frac{1}{R_5} + V_S \frac{R_2}{R_1 R_5} + V_{out} \frac{R_2}{R_3 R_5} = 0$$

$$V_{out}\left(\frac{1}{R_5} + \frac{R_2}{R_3 R_4} + \frac{R_2}{R_3 R_5}\right) + V_S\left(\frac{R_2}{R_1 R_4} + \frac{R_2}{R_1 R_5}\right) = 0$$

$$V_{out}\left(\frac{1}{6}\right) + V_S\left(\frac{2}{15}\right) = 0$$

$$\frac{V_{out}}{V_S} = -0.8$$

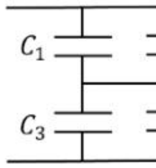


$$V_{out}\left(\frac{1}{R_5} + \frac{R_2}{R_3 R_4} + \frac{R_2}{R_3 R_5}\right) + V_S\left(\frac{R_2}{R_1 R_4} + \frac{R_2}{R_1 R_5}\right)$$

$$V_{out}\left(\frac{1}{4}\right) + V_S\left(\frac{3}{20}\right) = 0$$

$$\frac{V_{out}}{V_S} = -0.6$$

Capacitors in series/parallel.



With reference to the figure, determine the e
C1 = 8 mF, C2 = 12 mF, C3 = 7 mF, C4 = 23 mF

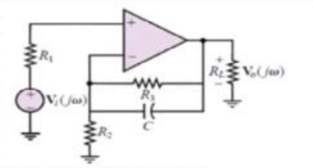
- Ceq = 42 mF
- Ceq = 12 mF ✓
- Ceq = 27 mF
- Ceq = 184 mF

$$C_1 // C_2 + C_3 // C_4$$

$$= \frac{1}{\frac{1}{C_1+C_2} + \frac{1}{C_3+C_4}}$$

$$= \frac{1}{\frac{1}{20} + \frac{1}{30}}$$

$= 12\text{mF}$



Given R1=2kΩ,R2=5kΩ,R3=50kΩ,C=100nF.
- ω_0 = 2000 rad/sec; Av= 8.22 dB
- ω_0 = 200 rad/sec; Av= 20.83 dB
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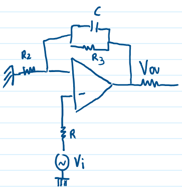
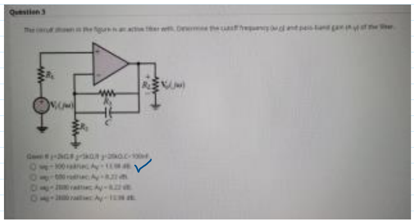
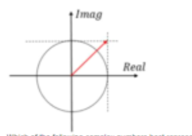
- ω_0 = 200 rad/sec; Av= 8.22 dB





The figure below represents the complex plane, a ve



Which of the following complex numbers best represe

- $\sqrt{2}e^{j\pi/4}$ ✓
- $\sqrt{2}$
- $2e^{j\pi/2}$
- $2e^{j\pi}$

Non - inverting

$$H = 1 + \frac{Z_f}{Z_s}$$

$$Z_s = R_2, \quad Z_f = R_3 // \frac{1}{j\omega C}$$

$$= \frac{R_3 \cdot \frac{1}{j\omega C}}{R_3 + \frac{1}{j\omega C}} = \frac{R_3}{1 + R_3 j\omega C}$$

$$H = 1 + \frac{\frac{R_3}{1 + R_3 j\omega C}}{R_2}$$

$$= 1 + \frac{R_3}{R_2} \cdot \frac{1}{1 + j\omega R_3 C}$$

$\omega \to 0$, $H = 1 + \frac{R_3}{R_2}$

$= 11$

$\omega \to \infty$, $H = 1$

Gain = $20 \log_{10} 11$

$= 20.83$ db

$$\omega_0 = \frac{1}{R_3 C}$$

$= 200$ rad/s

$$H = 1 + \frac{R_3}{R_2} \cdot \frac{1}{1 + j\omega R_3 C}$$

$\omega \to 0$, $H = 1 + \frac{R_3}{R_2}$

$= 5$

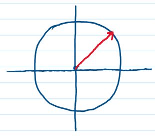
$\omega \to \infty$, $H = 1$

Gain = $20 \log 5$

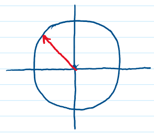
$= 13.98$ db

$$\omega_0 = \frac{1}{R_3 C}$$

$= 500$ rad/s



$e^{j\pi/4}$



$e^{j3\pi/4}$

Question 3

Denoting by j the unit imaginary number, which of the following identities is true?

- $|1+j^2| = \sqrt{2}$ ✗
- $j^3 = j$ ✗
- $j + \pi = 0$
- $1 + e^{j\pi} = 0$ ✓

if Vin = 5∠20° and Vout = 10∠45°, in phasor format (amplitude ∠ angle), which of the following phasors best represent the ratio Vout / Vin ?

- 0.5∠-15°
- 15∠65°
- 2∠15° ✓
- 5∠-15°

$$|1 + (-1)|$$

$= |0|$

$= 0 \neq \sqrt{2}$

$$j^3 = j^2 j$$

$= (-1)j$

$= -j \neq j$

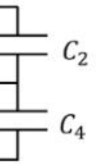
$i + \pi = 0$

$e^{j\pi} = -1$

$$\frac{V_{out}}{V_{in}} = \frac{10\angle 45^\circ}{5\angle 20^\circ}$$

$$= \frac{10}{5} \angle 45 - 20$$

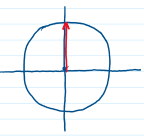
$= 2\angle 15^\circ$



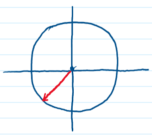
equivalent capacitance when

tor (arrow) and the unitary circle.

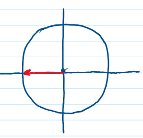
nts the vector?



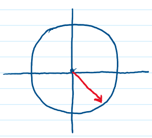
$e^{j\pi/2}$



$e^{j-3\pi/4}$



$e^{j\pi}$



$e^{j-\pi/4}$

$= 0 + \sqrt{2}$

$= -j \neq j$

$= \frac{10}{5} \angle 45 - 20$

$= 2 \angle 15^\circ$

$j + \pi = 0$

HUH?? X

$e^{j\pi} = -1$

$e^{j\pi} = \cos\pi + \sin\pi$

$= -1$ //