BioE 1310 - Review AC Concepts 3/20/2010

Instructions: On the Answer Sheet, enter your 2-digit ID number (with a leading 0 if needed) in the boxes of the ID section. *Fill in the corresponding numbered circles.* Answer each of the numbered questions by filling in the corresponding circles in the numbered question section. Print your name in the space at the bottom of the answer sheet. Sign here stating that you have neither given nor received help.

_____

your signature

1. A condenser microphone is reported to have a signal-to-noise ratio of 60dB. This means that the ratio of the largest amplitude the microphone is capable of handling to the amplitude of background noise seen on the microphone's output is

A. 60,000

B. 1,000,000

C. 30

D. 1,000

E. 60

2. Evaluate the complex number expressed in polar notation by $\frac{6\angle 90^\circ}{3\angle 45^\circ}$

A. $2\angle 235^\circ$

B. $\sqrt{2}(1+i)$

C. $3\angle 2^\circ$

D. none of the other answers

E. $\frac{\sqrt{2}}{2}(1+i)$

3. The following are true regarding square and triangle waves *except*, (or all are true).

A. Square waves result from differentiating triangle waves, which boosts their higher harmonics.

B. Neither wave can be actually created because infinitely high harmonics would be required.

C. Each wave can be mathematically represented by a Fourier series of harmonics.

D. All are true.

E. Square waves sound "harsher" than triangle waves because higher harmonics have greater amplitudes in the square wave as compared to the triangle wave.

4. If $L = 250$mH, $C = 300\mu$F, the circuit below has zero impedance at what frequency (in Hz)?

A. 18.4 Hz

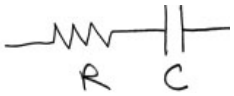
B. 83.8 KHz

C. 13.3 KHz

D. 115 Hz

E. 75 KHz

5. What is the total complex impedance (in ohms) of this branch if $C = 0.1\mu$F, $R = 10$KΩ, f = 1000Hz?



A. $10^4 - 1.59 \times 10^3 j$

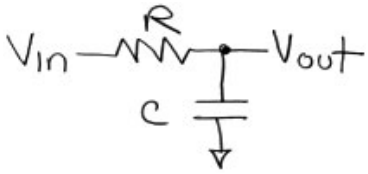
B. $10^4 + 10^4 j$

C. $10^4 + 1.59 \times 10^3 j$

D. $10^4 - 10^7 j$

E. $10^4 - 10^4 j$

6. Which of the following is (are) true about the circuit below, given that $R = 1$MΩ and $C = .01\mu$F.



I - The circuit is a high pass filter.
II - $|V_{out}| = \frac{1}{2}|V_{in}|$ at frequency f = 15.9 Hz.
III - Since it is constructed from linear components, the circuit represents a linear system.

A. II and III

B. I and III

C. I, and II

D. I, II and III

E. III

7. Euler's Identity $e^{j\theta} = \cos\theta + i\sin\theta$, can be rewritten as $\cos\theta = \frac{e^{j\theta}+e^{-j\theta}}{2}$ and $\sin\theta = \frac{e^{j\theta}-e^{-j\theta}}{2j}$.
Using these, which of the following is an equivalent expression for $\cos^2\theta$?

A. $\frac{1-\cos 2\theta}{2}$

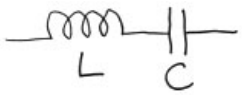
B. $\frac{1-\cos 2\theta}{2}$

C. $\frac{1+\cos 2\theta}{2}$

D. $\frac{1+\sin 2\theta}{2}$

E. $\sin^2\theta$

8. If $L = 125\text{mH}$, $C = 150\mu\text{F}$, the circuit below has zero impedance at what frequency (in Hz)?
(Recall that $Z_L = j\omega L$ and $Z_C = \frac{1}{j\omega C}$, where frequency in Hz $f = \omega/2\pi$).



A. 167.6 KHz

B. 26.6 KHz

C. 150 KHz

D. 230 Hz

E. 36.8 Hz

9. The following are true regarding a circuit containing a resistor and a capacitor with the following relationship between input and output voltages

$\frac{V_{out}}{V_{in}} = \frac{1}{1+j\omega RC}$

at frequency ω, *except*,

A. At $\omega = \frac{1}{RC}$ it exhibits a phase shift.

B. It lets all frequencies through equally.

C. It acts as a low pass filter.

D. At $\omega = 0$ it acts like a piece of wire.

E. At $\omega = \infty$ it lets nothing through.

10. Two acoustic signals A and B are present in a system. The powers of the signals are
A = 10 mW and B = 10 μW.
The ratio of the two powers A/B expressed in dB is

A. 60 dB

B. 30 dB

C. 0 dB

D. -30 dB

E. -60 dB

11. Evaluate the complex number expressed in polar notation by $\frac{3\angle 120^\circ}{9\angle 150^\circ}$

A. $\frac{1}{3}\angle 30^\circ$

B. $6\angle -30^\circ$

C. $\frac{\sqrt{2}}{2}(1+i)$

D. none of the other answers

E. $\frac{1}{2\sqrt{3}} - \frac{1}{6}i$

12. Euler's Identity $e^{j\theta} = \cos\theta + i\sin\theta$, can be rewritten as $\cos\theta = \frac{e^{j\theta}+e^{-j\theta}}{2}$ and $\sin\theta = \frac{e^{j\theta}-e^{-j\theta}}{2j}$. Using these, which of the following is an equivalent expression for $\cos^2\theta$?

A. $\frac{1-\sin 2\theta}{2}$

B. $\frac{1+\cos 2\theta}{2}$

C. $1 + \sin^2\theta$

D. $\frac{1+\sin 2\theta}{2}$

E. $\frac{1-\cos 2\theta}{2}$

13. The following is *false* regarding square and triangle waves.

A. Square waves sound "harsher" than triangle waves because higher harmonics have greater relative amplitudes in the square wave as compared to the triangle wave.

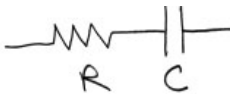
B. Triangle waves result from integrating square waves, which boosts their lower harmonics.

C. Square waves result from differentiating triangle waves, which boosts their higher harmonics.

D. Triangle waves at 400 Hz into a speaker are audible, whereas square waves at 400 Hz are not.

E. Neither wave can be actually created because infinitely high harmonics would be required.

14. The total complex impedance of this branch is



A. $1 + j\omega RC$

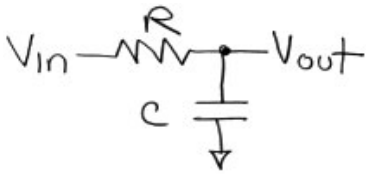
B. $\frac{1+RC}{j\omega C}$

C. $\frac{1+j\omega RC}{j\omega C}$

D. $\frac{1}{R} + \frac{1}{j\omega C}$

E. $R + j\omega C$

15. Which of the following is (are) true about the circuit below, given that $R = 1\text{M}\Omega$ and $C = .001\mu\text{F}$ and that V_{in} is sinusoidal at a particular frequency.



I - The circuit is a low pass filter.
II - $|V_{out}| = \frac{1}{2}|V_{in}|$ at frequency f = 159.1 Hz.
III - The impedance of the capacitor increases as frequency increases.
IV - V_{out} is also sinusoidal at the same frequency as V_{in}

A. I, II and IV

B. All are true.

C. I, III, and IV

D. II, III, and IV

E. I, II and III

16. Evaluate the complex number expressed as a complex exponential as $-2e^{-j\frac{\pi}{4}}$

A. $\sqrt{2}(1-j)$

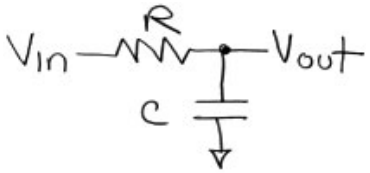
B. none of the other answers

C. $\sqrt{2}(j-1)$

D. -2

E. $2j$

17. Which of the following is (are) true about the circuit below, given that R = 10 KΩ and C = 1 μF.



I - The circuit is a low pass filter.
II - At frequency $\omega = 100$ radians per second, the impedances of the capacitor and the resistor are equal in magnitude.
III - At very low frequencies the capacitor approaches an open circuit (infinite impedance).

A. I, and II

B. I and III

C. None of the other answers is correct

D. II and III

E. I, II and III

18. The following are true about safety and electricity, *except*

A. Electricity usually kills by effecting the heart, so electricians are taught to use one hand near a high voltage.

B. Skin resistivity is lowered by water, especially salt water.

C. Alternating current (AC) is inherently safer than direct current (DC), which is why we use it to transmit power.

D. High voltage can cause muscle contraction preventing the victim from releasing the wire.

E. Hospital equipment often prevents direction connection between the patient-contacting equipment and 110 V by use of optical isolators and transformers.

19. The inductance of a coil produces a relationship between current and voltage described by $V = L\frac{dI}{dt}$. All of the following are true *except*

A. The same relationship can also be written $I = \frac{1}{L}\int V dt$

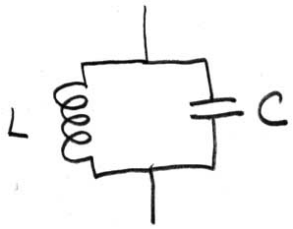
B. To intentionally produce a spark, as in a spark-plug in your car, one uses a coil with a large inductance L and interrupts a large current by opening a switch.

C. The equivalent equation for capacitance is $I = C\frac{dV}{dt}$, and energy in the capacitor is stored in the charge.

D. Being basically a piece of wire, the impedance of an inductor is extremely low for high frequencies.

E. Energy is stored in the magnetic field produced by the current, resulting in a tendency for the current to continue flowing unless opposed by a voltage.

20. Given that L = 10 μH and C = 100 pF, which of the following is (are) true about the following branch?



I - The impedance at both 0 Hz and ∞ Hz is 0.
II - The impedance at resonance is infinite.
III - Resonance happens at $\omega = \frac{1}{\sqrt{LC}}$.

A. II and III

B. I and III

C. None of the other answers is correct.

D. I and II

E. I, II, and III

21. Evaluate the complex number expressed in polar notation by $\frac{8\angle 0^\circ}{\sqrt{8}\angle 45^\circ}$

A. $(8 - \sqrt{8})\angle 0^\circ$

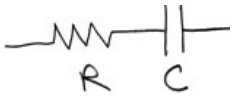
B. none of the other answers

C. $\sqrt{8}\angle 45^\circ$

D. $\frac{\sqrt{2}}{2}(1 + i)$

E. $(2 - 2i)$

22. At what frequency (expressed in radians per second) will the capacitor in this branch have the same magnitude of impedance as the resistor, if $C = 1\mu$F, $R = 1$KΩ?



A. none of the other answers is correct

B. 10^{12}

C. 10^{9}

D. 10^{3}

E. 10^{6}

23. Two sinusoidal signals A and B are present in a system. The powers of the signals are A = 0.1W and B = 100W. The ratio of the two powers A/B expressed in dB is

A. -30 dB

B. 0 dB

C. 30 dB

D. -60 dB

E. 60 dB

24. Which of the following is (are) true about the circuit below,

I - The circuit is a low pass filter.
II - At frequency $\omega = \frac{1}{\sqrt{LC}}$ the impedance is 0.
III - At very low or very high frequencies the impedance approaches infinite impedance.

A. II and III

B. I and II

C. I, II, and III

D. None of the others is correct.

E. I and III

25. A system is said to have a gain of 60dB. What is the ratio of the *output power* to the *input power* of the system.

A. 10^{-6}

B. None of the other answers is correct.

C. 1,000,000

D. 1,000

E. 0.001

26. Which of these statements is false about the following branch? (or all are true)

A. At the resonant frequency, the branch alternately stores energy as an electric and a magnetic field.

B. The impedance is infinite and imaginary at frequency $\omega = \infty$.

C. The impedance is zero at $\omega = \frac{1}{\sqrt{LC}}$.

D. The impedance is infinite and negative imaginary at frequency $\omega = 0$.

E. All are true.

27. Evaluate the complex exponential $\sqrt{2}e^{-j\frac{\pi}{4}}$

A. $-\sqrt{2}(j)$

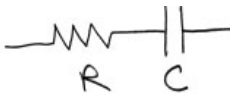
B. $(1-j)$

C. $\sqrt{2}(j-1)$

D. none of the other answers is correct.

E. $(j-1)$

28. The total complex impedance of this branch is



A. None of the other answers are correct.

B. $R + j\omega C$

C. $1 + j\omega RC$

D. $\frac{1+j\omega RC}{j\omega C}$

E. $\frac{1+RC}{j\omega C}$

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BioE 1310 - Review AC Concepts 3/20/2010
Answer Sheet - Correct answer is A for all questions

1. A condenser microphone is reported to have a signal-to-noise ratio of 60dB. This means that the ratio of the largest amplitude the microphone is capable of handling to the amplitude of background noise seen on the microphone's output is

A. 1,000

B. 1,000,000

C. 60

D. 60,000

E. 30

Explanation: $60 = 20log_{10}(1000)$.
[*circuits0021.mcq*]

2. Evaluate the complex number expressed in polar notation by $\frac{6\angle 90^\circ}{3\angle 45^\circ}$

A. $\sqrt{2}(1+i)$

B. $\frac{\sqrt{2}}{2}(1+i)$

C. $3\angle 2^\circ$

D. $2\angle 235^\circ$

E. none of the other answers

Explanation: $\frac{6\angle 90^\circ}{3\angle 45^\circ} = 2\angle 45^\circ$
[*circuits0022.mcq*]

3. The following are true regarding square and triangle waves *except*, (or all are true).

A. All are true.

B. Square waves sound "harsher" than triangle waves because higher harmonics have greater amplitudes in the square wave as compared to the triangle wave.

C. Square waves result from differentiating triangle waves, which boosts their higher harmonics.

D. Each wave can be mathematically represented by a Fourier series of harmonics.

E. Neither wave can be actually created because infinitely high harmonics would be required.

Explanation: The Fourier series is infinite, with the higher harmonics especially prominent in the square wave, giving it its harsh, buzzer-like quality.
[*circuits0024.mcq*]

4. If $L = 250$mH, $C = 300\mu$F, the circuit below has zero impedance at what frequency (in Hz)?

A. 18.4 Hz

B. 115 Hz

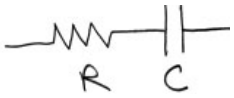
C. 13.3 KHz

D. 83.8 KHz

E. 75 KHz

Explanation: $\omega = \frac{1}{\sqrt{LC}}$; $f = \omega/2\pi$.
[*circuits0037.mcq*]

5. What is the total complex impedance (in ohms) of this branch if $C = 0.1\mu$F, $R = 10$KΩ, f = 1000Hz?



A. $10^4 - 1.59 \times 10^3 j$

B. $10^4 + 1.59 \times 10^3 j$

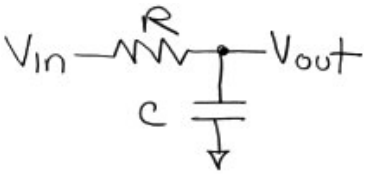
C. $10^4 - 10^4 j$

D. $10^4 + 10^4 j$

E. $10^4 - 10^7 j$

Explanation: The impedance of a capacitor is $1/j\omega C$, $\omega = 2\pi f$. The unit of complex impedance is still ohms.
[*circuits0039.mcq*]

6. Which of the following is (are) true about the circuit below, given that $R = 1$MΩ and $C = .01\mu$F.



I - The circuit is a high pass filter.
II - $|V_{out}| = \frac{1}{2}|V_{in}|$ at frequency f = 15.9 Hz.
III - Since it is constructed from linear components, the circuit represents a linear system.

A. II and III

B. I, II and III

C. I, and II

D. I and III

E. III

Explanation: $|R| = |\frac{1}{j\omega C}|$; $\omega = \frac{1}{RC}$; $f = \frac{\omega}{2\pi}$
[*circuits0040.mcq*]

7. Euler's Identity $e^{j\theta} = \cos\theta + i\sin\theta$, can be rewritten as $\cos\theta = \frac{e^{j\theta}+e^{-j\theta}}{2}$ and $\sin\theta = \frac{e^{j\theta}-e^{-j\theta}}{2j}$.
Using these, which of the following is an equivalent expression for $\cos^2\theta$?

A. $\frac{1+\cos 2\theta}{2}$

B. $\frac{1+\sin 2\theta}{2}$

C. $\frac{1-\cos 2\theta}{2}$

D. $\frac{1-\cos 2\theta}{2}$

E. $\sin^2\theta$

Explanation: Simply square $\cos\theta = \frac{e^{j\theta}+e^{-j\theta}}{2}$ and regroup terms.
[*circuits0041.mcq*]

8. If $L = 125$mH, $C = 150\mu$F, the circuit below has zero impedance at what frequency (in Hz)?
(Recall that $Z_L = j\omega L$ and $Z_C = \frac{1}{j\omega C}$, where frequency in Hz $f = \omega/2\pi$).

A. 36.8 Hz

B. 230 Hz

C. 26.6 KHz

D. 167.6 KHz

E. 150 KHz

Explanation: $\omega = \frac{1}{\sqrt{LC}}$; $f = \omega/2\pi$.
[*circuits0054.mcq*]

9. The following are true regarding a circuit containing a resistor and a capacitor with the following relationship between input and output voltages

$\frac{V_{out}}{V_{in}} = \frac{1}{1+j\omega RC}$

at frequency ω, *except*,

A. It lets all frequencies through equally.

B. It acts as a low pass filter.

C. At $\omega = 0$ it acts like a piece of wire.

D. At $\omega = \infty$ it lets nothing through.

E. At $\omega = \frac{1}{RC}$ it exhibits a phase shift.

Explanation: The circuit acts as a low pass filter, letting DC through completely, not letting infinitely high frequencies through at all, and shifting the phase of frequencies in between, such as $\omega = \frac{1}{RC}$, where it shifts by 45°.
[*circuits0093.mcq*]

10. Two acoustic signals A and B are present in a system. The powers of the signals are A = 10 mW and B = 10 μW.
The ratio of the two powers A/B expressed in dB is

A. 30 dB

B. -30 dB

C. 60 dB

D. -60 dB

E. 0 dB

Explanation: Since we are talking power, not amplitude, $10log_{10}(\frac{10^{-2}}{10^{-5}}) = 30$.
[*circuits0095.mcq*]

11. Evaluate the complex number expressed in polar notation by $\frac{3\angle 120^\circ}{9\angle 150^\circ}$

A. $\frac{1}{2\sqrt{3}} - \frac{1}{6}i$

B. $\frac{\sqrt{2}}{2}(1+i)$

C. $\frac{1}{3}\angle 30^\circ$

D. $6\angle -30^\circ$

E. none of the other answers

Explanation: $\frac{3\angle 120^\circ}{9\angle 150^\circ} = \frac{1}{3}\angle -30^\circ$
[*circuits0096.mcq*]

12. Euler's Identity $e^{j\theta} = \cos\theta + i\sin\theta$, can be rewritten as $\cos\theta = \frac{e^{j\theta}+e^{-j\theta}}{2}$ and $\sin\theta = \frac{e^{j\theta}-e^{-j\theta}}{2j}$.
Using these, which of the following is an equivalent expression for $\cos^2\theta$?

A. $\frac{1+\cos 2\theta}{2}$

B. $\frac{1+\sin 2\theta}{2}$

C. $\frac{1-\cos 2\theta}{2}$

D. $\frac{1-\sin 2\theta}{2}$

E. $1+\sin^2\theta$

Explanation: Simply square $\cos\theta = \frac{e^{j\theta}+e^{-j\theta}}{2}$ and regroup terms.
[*circuits0097.mcq*]

13. The following is *false* regarding square and triangle waves.

A. Triangle waves at 400 Hz into a speaker are audible, whereas square waves at 400 Hz are not.

B. Square waves sound "harsher" than triangle waves because higher harmonics have greater relative amplitudes in the square wave as compared to the triangle wave.

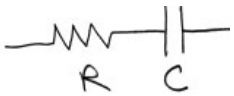
C. Square waves result from differentiating triangle waves, which boosts their higher harmonics.

D. Triangle waves result from integrating square waves, which boosts their lower harmonics.

E. Neither wave can be actually created because infinitely high harmonics would be required.

Explanation: The higher harmonics especially prominent in the square wave, giving it its harsh, buzzer-like quality. The actual Fourier transform for either is infinite and thus neither can actually be created in the physical world.
[*circuits0098.mcq*]

14. The total complex impedance of this branch is



A. $\frac{1+j\omega RC}{j\omega C}$

B. $\frac{1+RC}{j\omega C}$

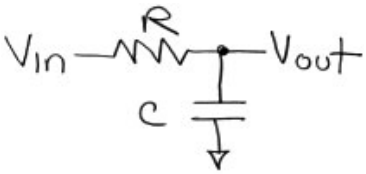
C. $1 + j\omega RC$

D. $R + j\omega C$

E. $\frac{1}{R} + \frac{1}{j\omega C}$

Explanation: The total impedance is that of the capacitor, $\frac{1}{j\omega C}$, plus that of the resistor, R. Combining terms yields a reassuring RC term in the numerator.
[*circuits0103.mcq*]

15. Which of the following is (are) true about the circuit below, given that $R = 1\text{M}\Omega$ and $C = .001\mu\text{F}$ and that V_{in} is sinusoidal at a particular frequency.



I - The circuit is a low pass filter.
II - $|V_{out}| = \frac{1}{2}|V_{in}|$ at frequency f = 159.1 Hz.
III - The impedance of the capacitor increases as frequency increases.
IV - V_{out} is also sinusoidal at the same frequency as V_{in}

A. I, II and IV

B. I, II and III

C. I, III, and IV

D. II, III, and IV

E. All are true.

Explanation: $|R| = |\frac{1}{j\omega C}|$; $\omega = \frac{1}{RC}$; $f = \frac{\omega}{2\pi}$. The circuit is a low pass filter and a linear system, so a sinusoid only changes phase and amplitude, not frequency. The impedance of a capacitor, $\frac{1}{j\omega C}$, *decreases* with frequency.
[*circuits0105.mcq*]

16. Evaluate the complex number expressed as a complex exponential as $-2e^{-j\frac{\pi}{4}}$

A. $\sqrt{2}(j-1)$

B. $\sqrt{2}(1-j)$

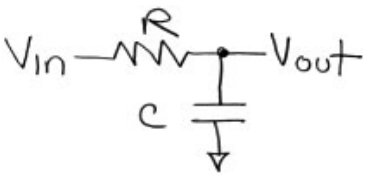
C. -2

D. $2j$

E. none of the other answers

Explanation: $-2e^{-j\frac{\pi}{4}} = -2(\frac{1}{\sqrt{2}} + \frac{-j}{\sqrt{2}}) = \sqrt{2}(j-1)$.
[*circuits0115.mcq*]

17. Which of the following is (are) true about the circuit below, given that R = 10 KΩ and C = 1 μF.



I - The circuit is a low pass filter.
II - At frequency $\omega = 100$ radians per second, the impedances of the capacitor and the resistor are equal in magnitude.
III - At very low frequencies the capacitor approaches an open circuit (infinite impedance).

A. I, II and III

B. II and III

C. I, and II

D. I and III

E. None of the other answers is correct

Explanation: Impedance for capacitor is $Z = \frac{1}{j\omega C}$. $|R| = |\frac{1}{j\omega C}|$ when $\omega = \frac{1}{RC}$;
[*circuits0122.mcq*]

18. The following are true about safety and electricity, *except*

A. Alternating current (AC) is inherently safer than direct current (DC), which is why we use it to transmit power.

B. Electricity usually kills by effecting the heart, so electricians are taught to use one hand near a high voltage.

C. Hospital equipment often prevents direction connection between the patient-contacting equipment and 110 V by use of optical isolators and transformers.

D. Skin resistivity is lowered by water, especially salt water.

E. High voltage can cause muscle contraction preventing the victim from releasing the wire.

Explanation: AC is actually more dangerous than DC, because the skin impedance is lower at 60 Hz than at 0 Hz. We use AC because it permits the use of transformers to step-up and step-down the voltage for long range transmission.
[*circuits0123.mcq*]

19. The inductance of a coil produces a relationship between current and voltage described by $V = L\frac{dI}{dt}$. All of the following are true *except*

A. Being basically a piece of wire, the impedance of an inductor is extremely low for high frequencies.

B. Energy is stored in the magnetic field produced by the current, resulting in a tendency for the current to continue flowing unless opposed by a voltage.

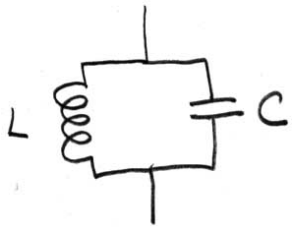
C. The same relationship can also be written $I = \frac{1}{L}\int V dt$

D. To intentionally produce a spark, as in a spark-plug in your car, one uses a coil with a large inductance L and interrupts a large current by opening a switch.

E. The equivalent equation for capacitance is $I = C\frac{dV}{dt}$, and energy in the capacitor is stored in the charge.

Explanation: The impedance of an inductor is $Z = j\omega L$, and thus increases with frequency.
[*circuits0125.mcq*]

20. Given that L = 10 μH and C = 100 pF, which of the following is (are) true about the following branch?



I - The impedance at both 0 Hz and ∞ Hz is 0.
II - The impedance at resonance is infinite.
III - Resonance happens at $\omega = \frac{1}{\sqrt{LC}}$.

A. I, II, and III

B. None of the other answers is correct.

C. I and II

D. II and III

E. I and III

Explanation: The impedance of the branch is $\omega = \frac{1}{j\omega C + \frac{1}{j\omega L}} = \frac{j\omega L}{1-\omega^2 LC}$.
[*circuits0129.mcq*]

21. Evaluate the complex number expressed in polar notation by $\frac{8\angle 0^\circ}{\sqrt{8}\angle 45^\circ}$

A. $(2 - 2i)$

B. $\frac{\sqrt{2}}{2}(1 + i)$

C. $(8 - \sqrt{8})\angle 0^\circ$

D. $\sqrt{8}\angle 45^\circ$

E. none of the other answers

Explanation: $\frac{8\angle 0^\circ}{\sqrt{8}\angle 45^\circ} = \sqrt{8}\angle -45^\circ$
[*circuits0157.mcq*]

22. At what frequency (expressed in radians per second) will the capacitor in this branch have the same magnitude of impedance as the resistor, if $C = 1\mu$F, $R = 1$KΩ?

A. 10^3

B. 10^{12}

C. 10^9

D. 10^6

E. none of the other answers is correct

Explanation: The impedance of a capacitor is $1/j\omega C$ and the magnitude of that impedance is $1/\omega C$. Set this equal to R and solve for ω.
[*circuits0158.mcq*]

23. Two sinusoidal signals A and B are present in a system. The powers of the signals are A = 0.1W and B = 100W. The ratio of the two powers A/B expressed in dB is

A. -30 dB

B. 30 dB

C. 60 dB

D. -60 dB

E. 0 dB

Explanation: Since we are talking power, not amplitude, $10log_{10}(\frac{A}{B})$.
[*circuits0159.mcq*]

24. Which of the following is (are) true about the circuit below,

I - The circuit is a low pass filter.
II - At frequency $\omega = \frac{1}{\sqrt{LC}}$ the impedance is 0.
III - At very low or very high frequencies the impedance approaches infinite impedance.

A. II and III

B. I and II

C. I and III

D. I, II, and III

E. None of the others is correct.

Explanation: At very high frequencies the coil approaches infinite impedance and at very low frequencies the capacitor does likewise. This is a bandpass filter (letting a certain frequency through at $\omega = \frac{1}{\sqrt{LC}}$, not a low-pass filter.
[*circuits0160.mcq*]

25. A system is said to have a gain of 60dB. What is the ratio of the *output power* to the *input power* of the system.

A. 1,000,000

B. 10^{-6}

C. 1,000

D. 0.001

E. None of the other answers is correct.

Explanation: For power, $60 = 10log_{10}(1,000,000)$.
[*circuits0179.mcq*]

26. Which of these statements is false about the following branch? (or all are true)

A. All are true.

B. The impedance is infinite and imaginary at frequency $\omega = \infty$.

C. The impedance is infinite and negative imaginary at frequency $\omega = 0$.

D. At the resonant frequency, the branch alternately stores energy as an electric and a magnetic field.

E. The impedance is zero at $\omega = \frac{1}{\sqrt{LC}}$.

Explanation: This is the classic resonant system, whose impedance is $\frac{1}{j\omega C} + j\omega L = \frac{1-\omega^2 LC}{j\omega C}$. It acts something like a pendulum, with the energy being handed back and forth between the capacitor and the coil.
[*circuits0180.mcq*]

27. Evaluate the complex exponential $\sqrt{2}e^{-j\frac{\pi}{4}}$

A. $(1 - j)$

B. $\sqrt{2}(j - 1)$

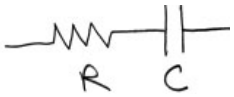
C. $(j - 1)$

D. $-\sqrt{2}(j)$

E. none of the other answers is correct.

Explanation: $\sqrt{2}e^{-j\frac{\pi}{4}} = \sqrt{2}(\frac{1}{\sqrt{2}} + \frac{-j}{\sqrt{2}}) = (1 - j)$.
[*circuits0182.mcq*]

28. The total complex impedance of this branch is



A. $\frac{1+j\omega RC}{j\omega C}$

B. $\frac{1+RC}{j\omega C}$

C. $1 + j\omega RC$

D. $R + j\omega C$

E. None of the other answers are correct.

Explanation: The total impedance is that of the capacitor, $\frac{1}{j\omega C}$, plus that of the resistor, R. Combining terms yields a reassuring RC term in the numerator.
[*circuits0183.mcq*]