BioE 1310 - Review Other 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.

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your signature

1. The decimal number 62 is represented in hexadecimal (base 16) and binary (base 2) respectively as

A. 3E and 111101

B. 3B and 1111110

C. None of the other answers is true.

D. 3E and 111110

E. 3B and 111110

2. The following are true regarding the MOSFET used in our lab, *except*,

A. It controls the flow of electrons between the source and the drain by means of an electrostatic field generated by the voltage at the gate.

B. It is essentially a current amplifying device, as opposed to the bipolar transistor used in the previous labs.

C. It is inherently more sensitive to damage from static charges, such as what might accumulate on a person wearing rubber soled shoes.

D. As opposed to bipolar transistors, for which connecting the base to +5 and the emitter to ground will destroy the device, with a MOSFET connecting the gate to +5V and the source to ground will not by itself cause damage.

E. The gate impedance is so high that currents into or out of the gate can generally be ignored.

3. The following are true regarding properly designed digital circuits, *except*,

A. Digital circuits are often designed to change state on the rising or falling edge of a "clock" signal.

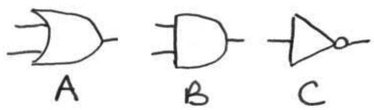
B. Inputs generally contain positive feedback hysteresis, the so-called "Schmidt trigger", to prevent prolonged indeterminate states between '0' and '1'.

C. If they are state machines (i.e., if they have multiple stable conditions) their proper design needs to establish an unambiguous power-one state that they assume when the power is first applied.

D. The acceptable states for certain "tri-state" outputs may include not only '1' and '0' but also "off", so that multiple outputs can be tied together on "busses".

E. A single output of a digital gate can drive virtually unlimited numbers of inputs of other gates.

4. The following statements are true about gates A, B, and C, *except*,



A. Gate C is an "NOT" gate, meaning the output has the opposite state of the input.

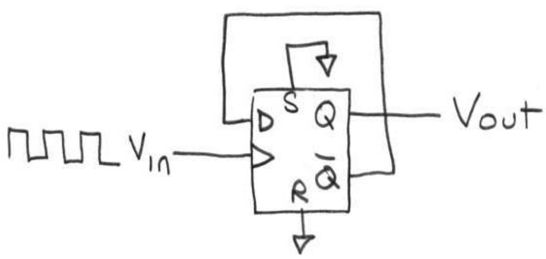
B. Gate A is an "OR" gate, meaning if either of the inputs is '1', the output is a '1'. Otherwise the output is a '0'.

C. Gate C can be constructed from gates A and B.

D. These three gates form the basis of any and all digital circuits.

E. Gate B is an "AND" gate meaning if both inputs are '1', the output is a '1'. Otherwise the output is a '0'.

5. Which of the following is (are) true about the circuit containing a D-flip-flop below.



I - V_{out} will change state with every rising edge of V_{in}.
II - The frequency of V_{out} will be double that of V_{in}.
III - V_{out} will always be the opposite of V_{in}.
IV - Q will always be the opposite of $\overline{Q}$

A. I, II, and IV

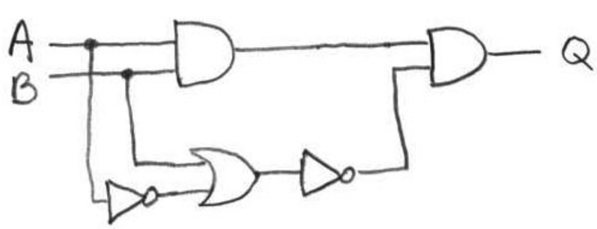
B. I, II and III

C. All of them.

D. I and IV

E. I and III

6. The circuit below is equivalent to the following Boolean equation:



A. $Q = (A + B) + \overline{(\overline{A}B)}$

B. $Q = (AB)(\overline{A} + B)$

C. $Q = (\overline{A} + B)\overline{(A + B)}$

D. $Q = (AB)\overline{(\overline{A} + B)}$

E. $Q = (A + B)\overline{(A + \overline{B})}$

7. The following are true about batteries *except*

A. A practical alternative to batteries is the Super-Capacitor, which simply stores charge without a chemical reaction.

B. Lead-Acid batteries are particularly useful because they can deliver large currents and are rechargeable.

C. Alkaline batteries should not be disposed of in the ordinary garbage because they contain mercury.

D. A fuel cell differs from a battery by using a fuel, such as hydrogen and oxygen, in a continuous manner to produce electricity.

E. Batteries depend on a difference in electron affinity between two different elements.

8. The following are true about the carotid pulse meter that you built in the lab *except*

A. The BLIP is used to measure the number of milliseconds between each carotid pulse cycle.

B. Changes in carotid pressure cause movement in the speaker that creates a current.

C. A D-flip-flop is configured as a "one-shot" to keep the number of positive edges per carotid pulse down to one.

D. The circuit uses an operational amplifier (op amp) configured as a current-to-voltage converter.

E. The proper functioning of the circuit requires a constant carotid pulse frequency.

9. The following are true regarding the BLIP used in our lab *except*, (or all are true).

A. It is powered by the computer into which it is plugged.

B. It delivers characters to the computer as if it were a keyboard, through a USB port.

C. It can be used to power external circuits on a breadboard.

D. Its mode of operation is governed by "jumpers".

E. All are true.

10. Which of the following are representations of the decimal number 23?

I - The binary number 10111.
II - The hexadecimal number 8F.
III - The hexadecimal number 17.
IV - The binary number 1011

A. III and IV

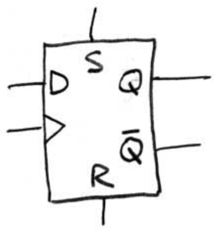
B. None of the other answers is true.

C. I and II

D. I and III

E. II and IV

11. Assuming inputs S (set) and R (reset) are 0, which of the following is (are) true?



I - On the rising edge of the clock input (marked by the triangle) the state of D is transfered to Q.
II - On the falling edge of the clock input, the state of D is transfered to $\overline{Q}$.
III - The circuit, known as a *D flip-flop*, serves as a 1-bit memory with two possible output states.

A. None of the other answers

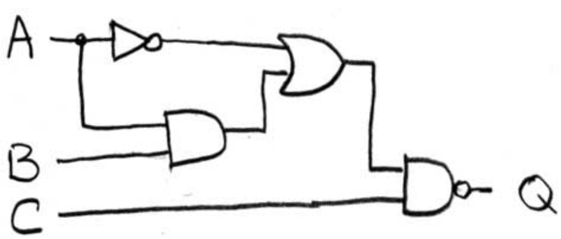
B. I and II

C. I and III

D. II and III

E. I, II, and III

12. Which of the following is a correct Boolean expression for the following digital circuit?



A. $Q = \overline{C(\overline{A} + (AB))}$

B. $Q = \overline{C}(\overline{A}(A + B))$

C. $Q = \overline{C(\overline{A}(A + B))}$

D. None of the expressions are correct.

E. $Q = \overline{C}(\overline{A} + (AB))$

13. A portion of a digital decoder has an output that is true only when a particular number, 5, is present at its input. Representing that input as a 3-bit binary number, ABC, where A is the most significant bit and C is the least significant bit, which of the following Boolean equations is equivalent to that portion of the encoder?

A. $Q = A\overline{B}C$

B. $Q = A + \overline{B} + C$

C. $Q = (A + C)\overline{B}$

D. None of the others is correct.

E. $Q = AC + \overline{B}$

14. The decimal number 163 is represented in hexadecimal (base 16) and binary (base 2) respectively as

A. None of the other answers is true.

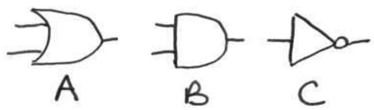
B. 7F and 1111111

C. A3 and 10100011

D. 7F and 10100011

E. A3 and 1111111

15. The following statements are true about gates A, B, and C, *except*, (or all are true)



A. Gate A is an "OR" gate, meaning if either of the inputs is '1', the output is a '1'. Otherwise the output is a '0'.

B. These three gates form the basis of all other digital circuits.

C. Gate C is an "NOT" gate, meaning the output has the opposite state of the input.

D. All are true

E. Gate B is an "AND" gate meaning if both inputs are '1', the output is a '1'. Otherwise the output is a '0'.

16. The following are true about the carotid pulse meter that you built in the lab *except*

A. The BLIP is used to measure the number of milliseconds between each carotid pulse cycle, so that changes in the carotid pulse rate may be seen from one pulse to the next.

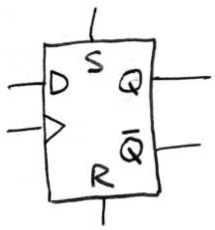
B. The carotid pulses are counted for an entire minute to determine the average rate per minute.

C. A D-flip-flop is configured as a "one-shot" to keep the number of positive edges per carotid pulse down to one.

D. Changes in carotid pressure cause movement in the speaker that creates a current.

E. The circuit uses an operational amplifier (op amp) configured as a current-to-voltage converter to detect the motion of the speaker.

17. Concerning the *D flip-flop* shown below, which of the following is (are) true?



I - Assuming inputs S and R are 0, on the rising edge of the clock input (marked by the triangle) the state of D is transferred to Q.
II - The S and R inputs set and reset the Q output when they are high (respectively) with $\overline{Q}$ assuming the opposite state from Q. (Having both S and R high is not allowed).
III - The circuit can be used to build counters, memories, and shift-registers.

A. II and III

B. I, II, and III

C. III

D. I and II

E. I and III

18. The following are true regarding properly designed digital circuits, *except*, (or all are true)

A. Inputs generally contain positive feedback hysteresis, the so-called "Schmidt trigger", to prevent prolonged indeterminate states between '0' and '1'.

B. The acceptable states for certain "tri-state" outputs may include not only '1' and '0' but also "off", so that multiple outputs can be tied together on "busses".

C. Digital circuits are often designed to change state on the rising edge of a "clock" signal.

D. If they are state machines (i.e., if they have multiple stable conditions) their proper design needs to establish an unambiguous power-one state that they assume when the power is first applied.

E. All are true.

19. The following are true with regard to high frequency signals ($> 10^6$ Hz), *except*,

A. In some antennas, high frequency current can enter or leave through a single wire, in apparent contradiction of Kirchhoff's current law.

B. Spatial considerations become much more important at higher frequencies because voltages and currents are no longer considered to be occurring everywhere simultaneously.

C. Coaxial and paired cables used to transmit over a distance are modeled as an infinite number of inductances along the cable and capacitances between the two conductors in the cable.

D. Coaxial and paired cables used to transmit over a distance exhibit a characteristic impedance, which is real, permitting "termination" with a simple resistor to prevent reflections.

E. Currents tend to concentrate at the center of the wire rather than near the surface.

20. The following are true with regard radio, *except*, (or all are true)

A. Early transmitters (using Morse code) simply created large sparks with a buzzer, which had extremely broad spectra. This was OK because there weren't a lot of them back then.

B. FM radio uses the frequency of the RF signal to carry the audio information, and is commonly demodulated using a phase locked loop.

C. AM radio can be "demodulated" by multiplication with a sinusoid at the radio frequency, which shifts the spectrum down to audio because of the fact that phasors spin each other when multiplied together.

D. All are true.

E. AM radio uses the amplitude of the radio frequency (RF) signal to carry the audio information, and may be demodulated using a simple peak detector.

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

1. The decimal number 62 is represented in hexadecimal (base 16) and binary (base 2) respectively as

A. 3E and 111110

B. 3E and 111101

C. 3B and 111110

D. 3B and 1111110

E. None of the other answers is true.

Explanation: Conversion of decimal to hexadecimal and binary involves finding the coefficient for each "place" (i.e., 1's, 2's, 4's, in binary and 1's, 16's, 256's, in hexadecimal). The letter 'E' represents 14.
[*circuits0043.mcq*]

2. The following are true regarding the MOSFET used in our lab, *except*,

A. It is essentially a current amplifying device, as opposed to the bipolar transistor used in the previous labs.

B. The gate impedance is so high that currents into or out of the gate can generally be ignored.

C. It is inherently more sensitive to damage from static charges, such as what might accumulate on a person wearing rubber soled shoes.

D. It controls the flow of electrons between the source and the drain by means of an electrostatic field generated by the voltage at the gate.

E. As opposed to bipolar transistors, for which connecting the base to +5 and the emitter to ground will destroy the device, with a MOSFET connecting the gate to +5V and the source to ground will not by itself cause damage.

Explanation: The extreme high impedance of the gate is the MOSFET's most useful and unique characteristic. There is no appreciable gate current, so it is not a current amplifying device.
[*circuits0044.mcq*]

3. The following are true regarding properly designed digital circuits, *except*,

A. A single output of a digital gate can drive virtually unlimited numbers of inputs of other gates.

B. Digital circuits are often designed to change state on the rising or falling edge of a "clock" signal.

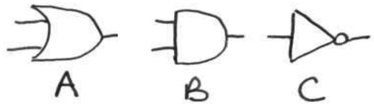
C. If they are state machines (i.e., if they have multiple stable conditions) their proper design needs to establish an unambiguous power-one state that they assume when the power is first applied.

D. The acceptable states for certain "tri-state" outputs may include not only '1' and '0' but also "off", so that multiple outputs can be tied together on "busses".

E. Inputs generally contain positive feedback hysteresis, the so-called "Schmidt trigger", to prevent prolonged indeterminate states between '0' and '1'.

Explanation: The "fan-out" of typical digital circuits is not infinite, and buffers must be used to drive more than that number of inputs.
[*circuits0045.mcq*]

4. The following statements are true about gates A, B, and C, *except*,



A. Gate C can be constructed from gates A and B.

B. These three gates form the basis of any and all digital circuits.

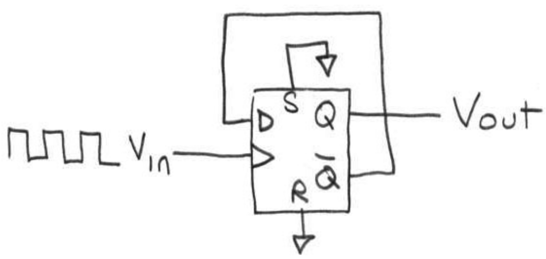
C. Gate A is an "OR" gate, meaning if either of the inputs is '1', the output is a '1'. Otherwise the output is a '0'.

D. Gate C is an "NOT" gate, meaning the output has the opposite state of the input.

E. Gate B is an "AND" gate meaning if both inputs are '1', the output is a '1'. Otherwise the output is a '0'.

Explanation: The "NOT" gate cannot be constructed from "OR" and "AND" gates, try as you might. (Prove me wrong if you can!)
[*circuits0047.mcq*]

5. Which of the following is (are) true about the circuit containing a D-flip-flop below.



I - V_{out} will change state with every rising edge of V_{in}.
II - The frequency of V_{out} will be double that of V_{in}.
III - V_{out} will always be the opposite of V_{in}.
IV - Q will always be the opposite of $\overline{Q}$

A. I and IV

B. I, II and III

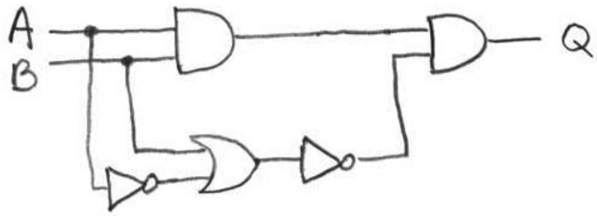
C. I, II, and IV

D. I and III

E. All of them.

Explanation: The frequency of V_{out} will be *half* that of V_{in}, and V_{out} will not always be the opposite of V_{in}, but rather change state on every rising edge of V_{in}.
[*circuits0049.mcq*]

6. The circuit below is equivalent to the following Boolean equation:



A. $Q = (AB)\overline{(\overline{A} + B)}$

B. $Q = (A + B) + \overline{(\overline{A}B)}$

C. $Q = (AB)(\overline{A} + B)$

D. $Q = (A + B)\overline{(A + \overline{B})}$

E. $Q = (\overline{A} + B)\overline{(A + B)}$

Explanation: The Boolean equation in A is one expression of the circuit.
[*circuits0050.mcq*]

7. The following are true about batteries *except*

A. Alkaline batteries should not be disposed of in the ordinary garbage because they contain mercury.

B. Lead-Acid batteries are particularly useful because they can deliver large currents and are rechargeable.

C. Batteries depend on a difference in electron affinity between two different elements.

D. A practical alternative to batteries is the Super-Capacitor, which simply stores charge without a chemical reaction.

E. A fuel cell differs from a battery by using a fuel, such as hydrogen and oxygen, in a continuous manner to produce electricity.

Explanation: Alkaline batteries may now be disposed of in the ordinary garbage without ecological impact because they no longer contain mercury.
[*circuits0052.mcq*]

8. The following are true about the carotid pulse meter that you built in the lab *except*

A. The proper functioning of the circuit requires a constant carotid pulse frequency.

B. Changes in carotid pressure cause movement in the speaker that creates a current.

C. The BLIP is used to measure the number of milliseconds between each carotid pulse cycle.

D. The circuit uses an operational amplifier (op amp) configured as a current-to-voltage converter.

E. A D-flip-flop is configured as a "one-shot" to keep the number of positive edges per carotid pulse down to one.

Explanation: The whole point of the design is to permit the calculation of frequency for each individual carotid pulse, and thus a constant carotid pulse frequency is not required.
[*circuits0055.mcq*]

9. The following are true regarding the BLIP used in our lab *except*, (or all are true).

A. All are true.

B. It is powered by the computer into which it is plugged.

C. Its mode of operation is governed by "jumpers".

D. It delivers characters to the computer as if it were a keyboard, through a USB port.

E. It can be used to power external circuits on a breadboard.

Explanation: See lab.
[*circuits0088.mcq*]

10. Which of the following are representations of the decimal number 23?

I - The binary number 10111.
II - The hexadecimal number 8F.
III - The hexadecimal number 17.
IV - The binary number 1011

A. I and III

B. I and II

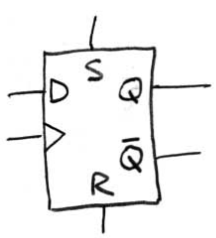
C. II and IV

D. III and IV

E. None of the other answers is true.

Explanation: Conversion of decimal to hexadecimal and binary involves finding the coefficient for each "place" (i.e., 1's, 2's, 4's, in binary and 1's, 16's, 256's, in hexadecimal).
[*circuits0119.mcq*]

11. Assuming inputs S (set) and R (reset) are 0, which of the following is (are) true?



I - On the rising edge of the clock input (marked by the triangle) the state of D is transfered to Q.
II - On the falling edge of the clock input, the state of D is transfered to $\overline{Q}$.
III - The circuit, known as a *D flip-flop*, serves as a 1-bit memory with two possible output states.

A. I and III

B. I and II

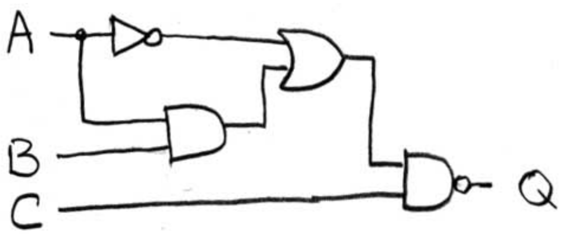
C. II and III

D. None of the other answers

E. I, II, and III

Explanation: II is incorrect. $\overline{Q}$ is the inverse of Q. The flip-flop does not respond to falling edges, only rising edges.
[*circuits0126.mcq*]

12. Which of the following is a correct Boolean expression for the following digital circuit?



A. $Q = \overline{C(\overline{A} + (AB))}$

B. $Q = \overline{C(\overline{A}(A + B))}$

C. $Q = \overline{C}(\overline{A} + (AB))$

D. $Q = \overline{C}(\overline{A}(A + B))$

E. None of the expressions are correct.

Explanation: A is the correct expression.
[*circuits0127.mcq*]

13. A portion of a digital decoder has an output that is true only when a particular number, 5, is present at its input. Representing that input as a 3-bit binary number, ABC, where A is the most significant bit and C is the least significant bit, which of the following Boolean equations is equivalent to that portion of the encoder?

A. $Q = A\overline{B}C$

B. $Q = A + \overline{B} + C$

C. $Q = AC + \overline{B}$

D. $Q = (A + C)\overline{B}$

E. None of the others is correct.

Explanation: The binary equivalent of 5 is 101, so A and C must be true and B must be false.
[*circuits0186.mcq*]

14. The decimal number 163 is represented in hexadecimal (base 16) and binary (base 2) respectively as

A. A3 and 10100011

B. A3 and 1111111

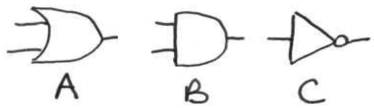
C. 7F and 10100011

D. 7F and 1111111

E. None of the other answers is true.

Explanation: Conversion of decimal to hexadecimal and binary involves finding the coefficient for each “place” (i.e., 1’s, 2’s, 4’s, in binary and 1’s, 16’s, 256’s, in hexadecimal). The letter ‘A’ represents 10.
[*circuits0187.mcq*]

15. The following statements are true about gates A, B, and C, *except*, (or all are true)



A. All are true

B. These three gates form the basis of all other digital circuits.

C. Gate A is an "OR" gate, meaning if either of the inputs is '1', the output is a '1'. Otherwise the output is a '0'.

D. Gate C is an "NOT" gate, meaning the output has the opposite state of the input.

E. Gate B is an "AND" gate meaning if both inputs are '1', the output is a '1'. Otherwise the output is a '0'.

Explanation:
[*circuits0188.mcq*]

16. The following are true about the carotid pulse meter that you built in the lab *except*

A. The carotid pulses are counted for an entire minute to determine the average rate per minute.

B. Changes in carotid pressure cause movement in the speaker that creates a current.

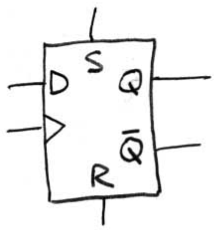
C. The BLIP is used to measure the number of milliseconds between each carotid pulse cycle, so that changes in the carotid pulse rate may be seen from one pulse to the next.

D. The circuit uses an operational amplifier (op amp) configured as a current-to-voltage converter to detect the motion of the speaker.

E. A D-flip-flop is configured as a "one-shot" to keep the number of positive edges per carotid pulse down to one.

Explanation: The whole point of the design is to permit the calculation of frequency for each individual carotid pulse, and thus an average carotid pulse frequency is not reported.
[*circuits0189.mcq*]

17. Concerning the *D flip-flop* shown below, which of the following is (are) true?



I - Assuming inputs S and R are 0, on the rising edge of the clock input (marked by the triangle) the state of D is transferred to Q.
II - The S and R inputs set and reset the Q output when they are high (respectively) with $\overline{Q}$ assuming the opposite state from Q. (Having both S and R high is not allowed).
III - The circuit can be used to build counters, memories, and shift-registers.

A. I, II, and III

B. I and II

C. II and III

D. III

E. I and III

Explanation:
[*circuits0191.mcq*]

18. The following are true regarding properly designed digital circuits, *except*, (or all are true)

A. All are true.

B. Digital circuits are often designed to change state on the rising edge of a "clock" signal.

C. If they are state machines (i.e., if they have multiple stable conditions) their proper design needs to establish an unambiguous power-one state that they assume when the power is first applied.

D. The acceptable states for certain "tri-state" outputs may include not only '1' and '0' but also "off", so that multiple outputs can be tied together on "busses".

E. Inputs generally contain positive feedback hysteresis, the so-called "Schmidt trigger", to prevent prolonged indeterminate states between '0' and '1'.

Explanation:
[*circuits0192.mcq*]

19. The following are true with regard to high frequency signals ($> 10^6$ Hz), *except*,

A. Currents tend to concentrate at the center of the wire rather than near the surface.

B. Coaxial and paired cables used to transmit over a distance exhibit a characteristic impedance, which is real, permitting "termination" with a simple resistor to prevent reflections.

C. Coaxial and paired cables used to transmit over a distance are modeled as an infinite number of inductances along the cable and capacitances between the two conductors in the cable.

D. Spatial considerations become much more important at higher frequencies because voltages and currents are no longer considered to be occurring everywhere simultaneously.

E. In some antennas, high frequency current can enter or leave through a single wire, in apparent contradiction of Kirchhoff's current law.

Explanation: The skin effect has currents concentrating near the surface, rather than at the center, of the wires.
[*circuits0193.mcq*]

20. The following are true with regard radio, *except*, (or all are true)

A. All are true.

B. AM radio uses the amplitude of the radio frequency (RF) signal to carry the audio information, and may be demodulated using a simple peak detector.

C. Early transmitters (using Morse code) simply created large sparks with a buzzer, which had extremely broad spectra. This was OK because there weren't a lot of them back then.

D. AM radio can be "demodulated" by multiplication with a sinusoid at the radio frequency, which shifts the spectrum down to audio because of the fact that phasors spin each other when multiplied together.

E. FM radio uses the frequency of the RF signal to carry the audio information, and is commonly demodulated using a phase locked loop.

Explanation:
[*circuits0194.mcq*]