BioE 1310 - Review Coils and Capacitors (also included in Review AC Concepts) 1/30/2010

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. A 1 F capacitor begins with no charge on it. A current of 3 A is then flows one way through the capacitor for 4 seconds. A current of 2 A then flows the other way through the same capacitor for 2 seconds. The voltage on the capacitor immediately after that is

A. 5 V

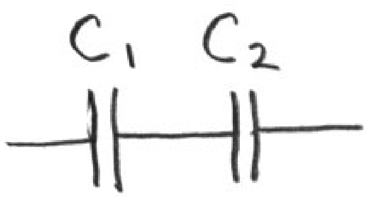
B. 0 V

C. 16 V

D. 8 V

E. not determinable from the data given.

2. What is the total capacitance of this branch if $C_1 = 100\ \mu$F, $C_2 = 40\ \mu$F?



A. 7.14 mF

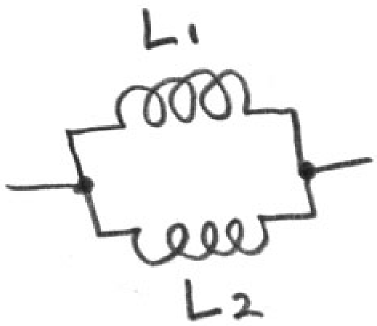
B. 28.6 μF

C. 60 μF

D. 0 Ω

E. 140 μF

3. What is the total inductance of this branch if $L_1 = 5\ \mu$H, $L_2 = 10$ H?



A. 3.3 μF

B. 2000 μH

C. 10 H

D. 5 μH

E. 15 μH

4. The property of inductance may best be described as

A. the magnetic field surrounding a current providing something roughly akin to 'inertia' to that current.

B. electrons becoming concentrated on one plate causing electrons to leave the other plate.

C. electrons becoming concentrated in a piece of wire due to the surrounding magnetic field.

D. the mass of the electrons making them want to keep going in a straight line.

E. the magnetic field around a piece of wire interacting with the magnetic field of the earth.

5. A current is increased linearly from 1 A to 6 A over 10 seconds in a 100 mH inductor. During that time, what voltage would be measured across the inductor?

A. 50 mV

B. 0 V

C. 5 V

D. cannot be determined without knowing the other components in the circuit

E. 50 V

6. A current of 10 A is flowing in a 10 H inductor. What voltage would theoretically develop across the inductor if the current were stopped instantly?

A. ∞ V

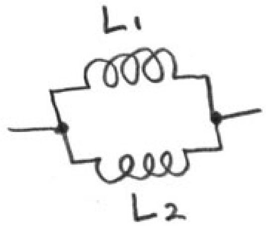
B. 0 V

C. 100 V

D. 50 V

E. 1 V

7. If $L_1 = 150\text{mH}$, $L_2 = 300\text{mH}$, the circuit below is equivalent to



A. an RC filter

B. a single 450mH inductor.

C. a single 100mH inductor.

D. a single 100mF capacitor.

E. none of the other answers.

8. 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. 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.

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

C. The equivalent equation for capacitance is $I = C\frac{dV}{dt}$, which basically says that to build up a charge on the capacitor over time takes a current.

D. Energy is stored in the magnetic field of the coil, making it take a voltage to change the current over time.

E. The larger the inductance L, the more rapid the change in current for a given voltage.

9. The current entering one wire into a perfect capacitor

A. cannot actually enter the capacitor at all, because no charge can accumulate on either of the individual plates inside the capacitor.

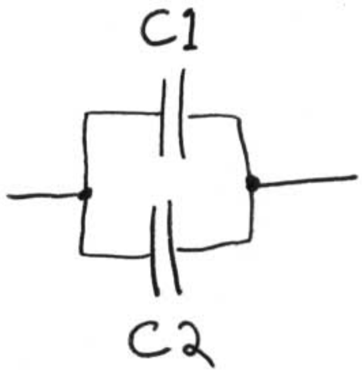
B. results in charge building up on one plate of the capacitor, which pushes charge off of the other plate out the other wire.

C. is of much larger magnitude than the current leaving via the other wire, resulting in the buildup of voltage across the capacitor.

D. can continue forever without experiencing the buildup of a voltage.

E. experiences the buildup over time of a voltage pushing back against it proportional to the capacitance.

10. What is the total capacitance of this branch if $C_1 = 20\ \mu$F, $C_2 = 20\ \mu$F?



A. 10 μF

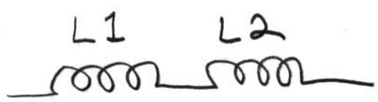
B. 40 μF

C. Cannot be determined without knowing the frequency.

D. 20 μF

E. 5 μF

11. What is the total inductance of this branch if $L_1 = 5\ \mu$H, $L_2 = 10\ \mu$H?



A. 3.3 μF

B. 10 H

C. 5 μH

D. 2000 μH

E. 15 μH

12. A current is decreased linearly from 10 A to 0 A over 0.01 seconds in a 5 H inductor. During that time, what voltage would be measured across the inductor?

A. -20 mV

B. -5000 V

C. cannot be determined without knowing the other components in the circuit

D. -0.5 V

E. -200 V

13. The following are true about the discharge of a capacitor with capacitance C through a resistor with resistance R, *except*

A. The time required to discharge to a certain percentage of the initial charge is proportional to RC.

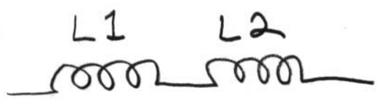
B. Current will gradually decrease as the capacitor discharges.

C. The discharge is governed by a first order differential equation similar to that governing radioactive decay of a certain initial amount of Carbon-14.

D. Electrons leaving the positively charged plate of the capacitor are replaced by electrons entering the negatively charged plate.

E. The energy initially stored in the capacitor is released as heat by the resistor.

14. What is the total inductance of this branch if $L_1 = 5$ H, $L_2 = 10$ H?



A. 3.3 μF

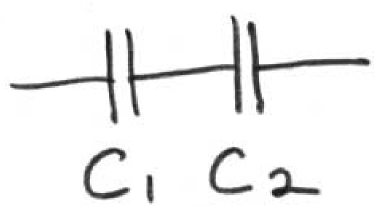
B. 5 μH

C. 15 μH

D. 2000 μH

E. 10 H

15. What is the total capacitance of this branch if $C_1 = C_2 = 10\mu$F?



A. 5 μF

B. 10 μF

C. ∞ μF

D. 0 μF

E. 20 μF

16. The farad is a unit of

A. voltage

B. charge

C. capacitance

D. current

E. energy

17. The energy stored in an inductor (coil) with 5 A through it

A. is linearly proportional to the current for a given inductance.

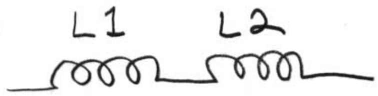
B. equals 25 J.

C. depends on how long it took to achieve the current.

D. is due to the charge built up within the coil.

E. cannot be determined without more information.

18. What is the total inductance of this branch if $L_1 = 10\ \mu\text{H}$, $L_2 = 10\ \mu\text{H}$?



A. 5 μH

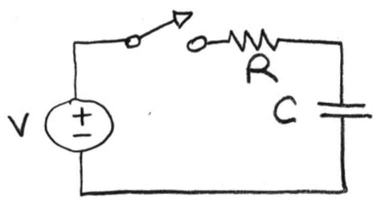
B. 10 μH

C. 20 μH

D. 1 μH

E. 100 μH

19. What equation describes the voltage on the capacitor $V_C(t)$ after the switch is closed at $t = 0$, given the capacitor is completely discharged beforehand, i.e., $V_c(0) = 0$? (Ignore the equation's behavior for $t < 0$).



A. $V_C(t) = V\left(e^{-\frac{t}{RC}}\right)$

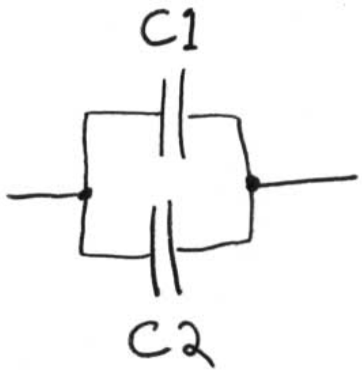
B. $V_C(t) = V \times \frac{C}{R+C}$

C. Cannot be determined with the information given.

D. $V_C(t) = V\left(1 - e^{-\frac{t}{RC}}\right)$

E. $V_C(t) = \left(1 - e^{-\frac{t}{RC}}\right)$

20. What is the total capacitance of this branch if $C_1 = 80\ \mu$F, $C_2 = 80\ \mu$F?



A. 80 μF

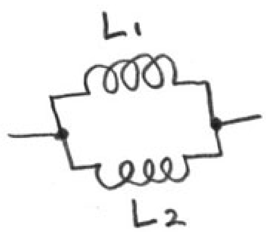
B. Cannot be determined without knowing the frequency.

C. 20 μF

D. 40 μF

E. 160 μF

21. If $L_1 = 300$ mH, $L_2 = 600$ mH , the circuit below is equivalent to



A. a single 900 mH inductor.

B. none of the other answers.

C. a single 300 mH inductor.

D. a 900 mA current source.

E. a single 200 mH inductor.

22. A current is increased linearly from 0 A to 20 A over 0.2 seconds in a 100 H inductor. During that time, what voltage would be measured across the inductor?

A. cannot be determined without knowing the other components in the circuit

B. 400 V

C. 1 V

D. 10,000 V

E. 40 mV

23. The millihenry is

A. a certain amount of inductance, which results in 1 volt when changing the current at a rate of 1 ampere/millisecond.

B. a certain amount of inductance, which results in 1 volt after charging a capacitor for 1 second at 1 mA..

C. a certain amount of inductance, which results in 1 kilovolt when changing the current at a rate of 1 ampere/second.

D. a certain strength of magnetic field.

E. a certain amount of inductance, equivalent to 1000 henries.

24. The following are true about the discharge of a capacitor with capacitance C through a resistor with resistance R, *except*

A. The total charge in the capacitor (the sum on both plates) gradually decreases to zero.

B. The time required to discharge to a certain percentage of the initial charge is proportional to RC.

C. Current will gradually decrease as the capacitor discharges.

D. The energy initially stored in the capacitor is released as heat by the resistor.

E. The discharge is governed by a first order differential equation similar to that governing radioactive decay of a certain initial amount of Carbon-14.

25. The cause of magnetism may best be described as

A. the curvature of coils of wires creating a centrifugal force on the moving charges.

B. the interaction between moving charges and the nuclei of neighboring iron atoms.

C. the Lorenz contraction of moving charges making them appear to other moving charges to be more densely packed than neighboring stationary charges.

D. an independent fundamental force unrelated to the electrostatic force.

E. a quantum effect on moving charges due to the effect of gravity.

26. The capacitance of a capacitor produces a relationship between current and voltage described by $I = C\frac{dV}{dt}$. All of the following are true *except*

A. Special capacitors with very large capacitance may store appreciable energy comparable to a battery.

B. Energy is stored in the charge difference between the plates, making it take a current to change the voltage over time.

C. The equivalent equation for inductance is $V = L\frac{dI}{dt}$.

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

E. The larger the capacitance C, the more rapid the change in voltage for a given current.

27. Which of the following is *false* about permittivity (or all are true)?

A. All are true.

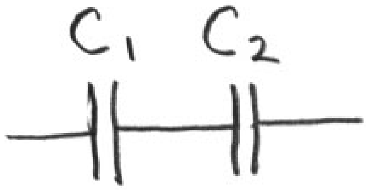
B. It permits a constant current to leak between the plates of the capacitor.

C. Even free space has a non-zero permittivity.

D. In a given capacitor, it determines the capacitance for a given area of plates and distance between them.

E. It can be increased by the alignment of charges in the material between the plates of a capacitor.

28. What is the total capacitance of this branch if $C_1 = 0.1$ μF, $C_2 = 0.1$ μF?



A. None of the other answers is correct.

B. 0.5 μF

C. 0.1 μF

D. 0.05 μF

E. 0.2 μF

29. The property of *inductance* in a coil may best be described as follows:

A. The mass of the electrons provides inertia, which makes them want to keep moving in a given direction.

B. The magnetic field within the coil is non-linear with respect to the magnetic field of the earth.

C. The current in a coil is proportional to the voltage across the coil over the resistance of the coil.

D. The buildup of charge on one section of the coil is offset by the depletion of charge on a neighboring section of the coil.

E. The magnetic field surrounding a current contains energy, and it requires a voltage applied over time to change that energy.

30. The following are true about the discharge of a capacitor with capacitance C through a resistor with resistance R, *except*, (or all are true)

A. Electrons leaving the negatively charged plate of the capacitor are replaced by electrons entering the postively charged plate.

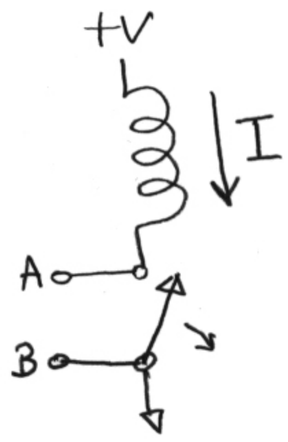
B. All are true.

C. The energy initially stored in the capacitor ($\frac{1}{2}CV^2$, where V is the initial voltage on the capacitor) is released primarily as heat by the resistor.

D. The discharge is governed by a first order differential equation, with current gradually decreasing as the capacitor discharges.

E. The time required for the capacitor to discharge to exactly 50% of the initial voltage is RC.

31. Given a current I through this inductor with the switch closed, what voltage would theoretically be generated between A and B if the switch were opened instantly (in zero time)?



A. $+V$

B. None of the other answers is correct.

C. 0

D. ∞

E. I

32. The following is *not* true about current:

A. When measured across a resistor, the voltage is linearly related to the current through that resistor.

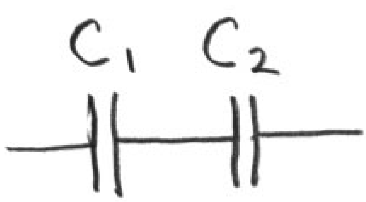
B. The sum of the currents around any loop must equal zero.

C. The unit of current is the Ampere, which equals 6.241×10^{18} electrons per second.

D. Its relationship to voltage across either a capacitor or inductor (coil) takes the form of a first order differential equation with respect to time.

E. In general, it can be said to obey Kirchhoff's Current Law, which states that no charge accumulates at any given node in a circuit.

33. What is the total capacitance of this branch if $C_1 = 2\ \mu$F, $C_2 = 2\ \mu$F?



A. 2 μF

B. 1 μF

C. 0.5 μF

D. None of the other answers is correct.

E. 4 μF

34. The energy stored in a 3 Henry inductor (coil) with 4 A through it

A. cannot be determined without more information.

B. is 12 J.

C. is 24 J.

D. equals the heat dissipated by the coil.

E. depends on how long it took to achieve the current.

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BioE 1310 - Review Coils and Capacitors (also included in Review AC Concepts) 1/30/2010
Answer Sheet - Correct answer is A for all questions

1. A 1 F capacitor begins with no charge on it. A current of 3 A is then flows one way through the capacitor for 4 seconds. A current of 2 A then flows the other way through the same capacitor for 2 seconds. The voltage on the capacitor immediately after that is

A. 8 V

B. 0 V

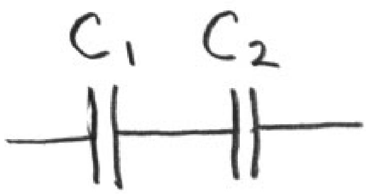
C. not determinable from the data given.

D. 5 V

E. 16 V

Explanation:
[*circuits0006.mcq*]

2. What is the total capacitance of this branch if $C_1 = 100\ \mu\text{F}$, $C_2 = 40\ \mu\text{F}$?



A. 28.6 μF

B. 140 μF

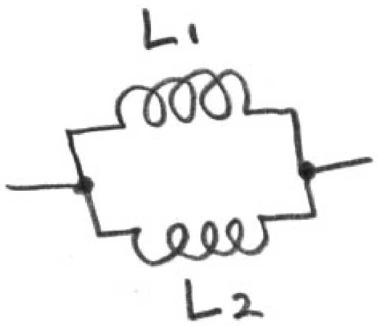
C. 60 μF

D. 7.14 mF

E. 0 Ω

Explanation: Capacitances in series add like resistors in parallel. In other words, $C_S = \frac{C_1 \times C_2}{C_1 + C_2}$.
[*circuits0010.mcq*]

3. What is the total inductance of this branch if $L_1 = 5\ \mu$H, $L_2 = 10$ H?



A. 5 μH

B. 15 μH

C. 3.3 μF

D. 10 H

E. 2000 μH

Explanation:
[*circuits0011.mcq*]

4. The property of inductance may best be described as

A. the magnetic field surrounding a current providing something roughly akin to 'inertia' to that current.

B. the mass of the electrons making them want to keep going in a straight line.

C. electrons becoming concentrated in a piece of wire due to the surrounding magnetic field.

D. electrons becoming concentrated on one plate causing electrons to leave the other plate.

E. the magnetic field around a piece of wire interacting with the magnetic field of the earth.

Explanation:
[*circuits0014.mcq*]

5. A current is increased linearly from 1 A to 6 A over 10 seconds in a 100 mH inductor. During that time, what voltage would be measured across the inductor?

A. 50 mV

B. 5 V

C. 50 V

D. 0 V

E. cannot be determined without knowing the other components in the circuit

Explanation: $V = L\frac{dI}{dt}$
[*circuits0016.mcq*]

6. A current of 10 A is flowing in a 10 H inductor. What voltage would theoretically develop across the inductor if the current were stopped instantly?

A. ∞ V

B. 50 V

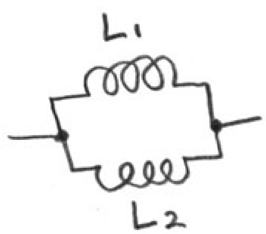
C. 100 V

D. 0 V

E. 1 V

Explanation: $V = L\frac{dI}{dt}$ so if $dt = 0$ the voltage would theoretically be infinite. This is how large voltages are created in a car for the spark plugs.
[*circuits0023.mcq*]

7. If $L_1 = 150$mH, $L_2 = 300$mH, the circuit below is equivalent to



A. a single 100mH inductor.

B. a single 100mF capacitor.

C. a single 450mH inductor.

D. an RC filter

E. none of the other answers.

Explanation: Inductors add in parallel as resistors do: $L_{parallel} = \frac{1}{\frac{1}{L_1}+\frac{1}{L_2}}$.
[*circuits0036.mcq*]

8. 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 larger the inductance L, the more rapid the change in current for a given voltage.

B. Energy is stored in the magnetic field of the coil, making it take a voltage to change the current over time.

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 $I = C\frac{dV}{dt}$, which basically says that to build up a charge on the capacitor over time takes a current.

Explanation: A larger inductance yields a *less* rapid change in current for a given voltage. The current demonstrates greater "inertia". It takes more voltage to change it.
[*circuits0071.mcq*]

9. The current entering one wire into a perfect capacitor

A. results in charge building up on one plate of the capacitor, which pushes charge off of the other plate out the other wire.

B. is of much larger magnitude than the current leaving via the other wire, resulting in the buildup of voltage across the capacitor.

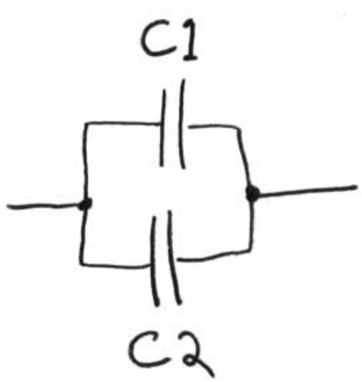
C. can continue forever without experiencing the buildup of a voltage.

D. experiences the buildup over time of a voltage pushing back against it proportional to the capacitance.

E. cannot actually enter the capacitor at all, because no charge can accumulate on either of the individual plates inside the capacitor.

Explanation: The current entering one of the wires causes a charge to accumulate on one of the plates, pushing an equal charge off the other plate and out the other wire. A voltage will accumulate over time pushing back against the current, *inversely* proportional to the capacitance. A bigger capacitor can handle more current to produce the same voltage.
[*circuits0072.mcq*]

10. What is the total capacitance of this branch if $C_1 = 20\ \mu$F, $C_2 = 20\ \mu$F?



A. 40 μF

B. 20 μF

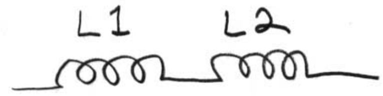
C. 10 μF

D. 5 μF

E. Cannot be determined without knowing the frequency.

Explanation: Capacitance adds when in parallel, and is (ideally) independent of frequency.
[*circuits0074.mcq*]

11. What is the total inductance of this branch if $L_1 = 5\ \mu$H, $L_2 = 10\ \mu$H?



A. 15 μH

B. 5 μH

C. 3.3 μF

D. 10 H

E. 2000 μH

Explanation: Total inductance in series is $L_1 + L_2$
[*circuits0075.mcq*]

12. A current is decreased linearly from 10 A to 0 A over 0.01 seconds in a 5 H inductor. During that time, what voltage would be measured across the inductor?

A. -5000 V

B. -0.5 V

C. -200 V

D. -20 mV

E. cannot be determined without knowing the other components in the circuit

Explanation: $V = L\frac{dI}{dt}$
[*circuits0084.mcq*]

13. The following are true about the discharge of a capacitor with capacitance C through a resistor with resistance R, *except*

A. Electrons leaving the positively charged plate of the capacitor are replaced by electrons entering the negatively charged plate.

B. The time required to discharge to a certain percentage of the initial charge is proportional to RC.

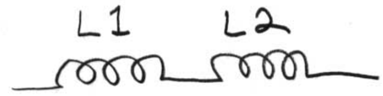
C. The discharge is governed by a first order differential equation similar to that governing radioactive decay of a certain initial amount of Carbon-14.

D. Current will gradually decrease as the capacitor discharges.

E. The energy initially stored in the capacitor is released as heat by the resistor.

Explanation: Electrons leaving the *negatively* charged plate of the capacitor are replaced (and only within the capacitor as a whole, not within a particular plate) by electrons entering the *positively* charged plate.
[*circuits0086.mcq*]

14. What is the total inductance of this branch if $L_1 = 5$ H, $L_2 = 10$ H?



A. 15 μH

B. 5 μH

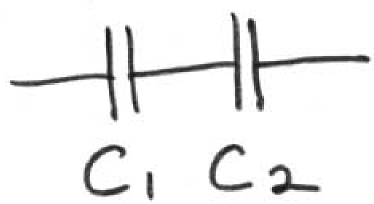
C. 3.3 μF

D. 10 H

E. 2000 μH

Explanation: Total inductance in series is $L_1 + L_2$
[*circuits0091.mcq*]

15. What is the total capacitance of this branch if $C_1 = C_2 = 10\mu$F?



A. 5 μF

B. 20 μF

C. ∞ μF

D. 0 μF

E. 10 μF

Explanation: Total capacitance in series is $\frac{1}{\frac{1}{C_1}+\frac{1}{C_2}}$
[*circuits0100.mcq*]

16. The farad is a unit of

A. capacitance

B. voltage

C. current

D. energy

E. charge

Explanation: A farad is a certain amount of capacitance, the amount that results in the accumulation of 1 volt when charging at 1 ampere for 1 second.
[*circuits0111.mcq*]

17. The energy stored in an inductor (coil) with 5 A through it

A. cannot be determined without more information.

B. is due to the charge built up within the coil.

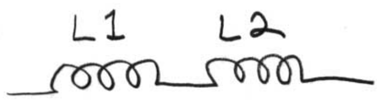
C. is linearly proportional to the current for a given inductance.

D. equals 25 J.

E. depends on how long it took to achieve the current.

Explanation: Answer A is correct, since one needs to know the inductance to determine energy. The energy is due to the current, not charge, and is independent of how long it took to achieve the current. The energy is proportional to the square of the current for a given inductance, $E = \frac{1}{2}LI^2$.
[*circuits0114.mcq*]

18. What is the total inductance of this branch if $L_1 = 10\ \mu$H, $L_2 = 10\ \mu$H?



A. 20 μH

B. 5 μH

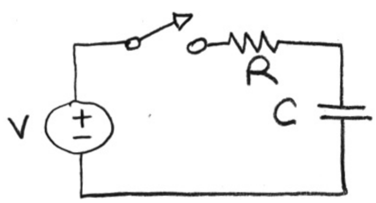
C. 100 μH

D. 10 μH

E. 1 μH

Explanation: Total inductance in series is $L_1 + L_2$
[*circuits0120.mcq*]

19. What equation describes the voltage on the capacitor $V_C(t)$ after the switch is closed at $t = 0$, given the capacitor is completely discharged beforehand, i.e., $V_c(0) = 0$? (Ignore the equation's behavior for $t < 0$).



A. $V_C(t) = V\left(1 - e^{-\frac{t}{RC}}\right)$

B. $V_C(t) = \left(1 - e^{-\frac{t}{RC}}\right)$

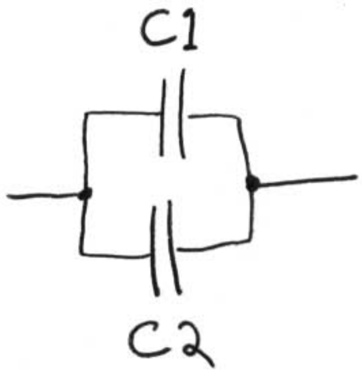
C. $V_C(t) = V\left(e^{-\frac{t}{RC}}\right)$

D. $V_C(t) = V \times \frac{C}{R+C}$

E. Cannot be determined with the information given.

Explanation: This is the solution to the differential equation given by $I(t) = \frac{V - V_C(t)}{R}$ and $I(t) = C\frac{dV_C(t)}{dt}$. It is also the only choice that behaves appropriately; it starts at 0V and approaches the voltage V.
[*circuits0138.mcq*]

20. What is the total capacitance of this branch if $C_1 = 80\ \mu\text{F}$, $C_2 = 80\ \mu\text{F}$?



A. 160 μF

B. 20 μF

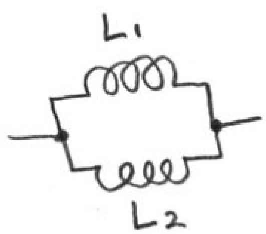
C. 40 μF

D. 80 μF

E. Cannot be determined without knowing the frequency.

Explanation: Capacitance adds when in parallel, and is (ideally) independent of frequency.
[*circuits0143.mcq*]

21. If $L_1 = 300$ mH, $L_2 = 600$ mH , the circuit below is equivalent to



A. a single 200 mH inductor.

B. a 900 mA current source.

C. a single 900 mH inductor.

D. a single 300 mH inductor.

E. none of the other answers.

Explanation: Inductors add in parallel as resistors do: $L_{parallel} = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2}}$.
[*circuits0144.mcq*]

22. A current is increased linearly from 0 A to 20 A over 0.2 seconds in a 100 H inductor. During that time, what voltage would be measured across the inductor?

A. 10,000 V

B. 400 V

C. 1 V

D. 40 mV

E. cannot be determined without knowing the other components in the circuit

Explanation: $V = L\frac{dI}{dt}$
[*circuits0145.mcq*]

23. The millihenry is

A. a certain amount of inductance, which results in 1 volt when changing the current at a rate of 1 ampere/millisecond.

B. a certain amount of inductance, which results in 1 kilovolt when changing the current at a rate of 1 ampere/second.

C. a certain amount of inductance, equivalent to 1000 henries.

D. a certain strength of magnetic field.

E. a certain amount of inductance, which results in 1 volt after charging a capacitor for 1 second at 1 mA..

Explanation: A millihenry is 1/1000 of a henry, the unit of inductance, relating voltage to the rate of change of current in an inductor, $V = L\frac{dI}{dt}$.
[*circuits0146.mcq*]

24. The following are true about the discharge of a capacitor with capacitance C through a resistor with resistance R, *except*

A. The total charge in the capacitor (the sum on both plates) gradually decreases to zero.

B. The time required to discharge to a certain percentage of the initial charge is proportional to RC.

C. The discharge is governed by a first order differential equation similar to that governing radioactive decay of a certain initial amount of Carbon-14.

D. Current will gradually decrease as the capacitor discharges.

E. The energy initially stored in the capacitor is released as heat by the resistor.

Explanation: The total charge on both plates stays constant, increasing on one plate as it decreases on the other.
[*circuits0147.mcq*]

25. The cause of magnetism may best be described as

A. the Lorenz contraction of moving charges making them appear to other moving charges to be more densely packed than neighboring stationary charges.

B. the curvature of coils of wires creating a centrifugal force on the moving charges.

C. an independent fundamental force unrelated to the electrostatic force.

D. a quantum effect on moving charges due to the effect of gravity.

E. the interaction between moving charges and the nuclei of neighboring iron atoms.

Explanation: the Lorenz contraction was, in fact, deduced as the only reasonable explanation for magnetism.
[*circuits0148.mcq*]

26. The capacitance of a capacitor produces a relationship between current and voltage described by $I = C\frac{dV}{dt}$. All of the following are true *except*

A. The larger the capacitance C, the more rapid the change in voltage for a given current.

B. Energy is stored in the charge difference between the plates, making it take a current to change the voltage over time.

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

D. Special capacitors with very large capacitance may store appreciable energy comparable to a battery.

E. The equivalent equation for inductance is $V = L\frac{dI}{dt}$.

Explanation: A larger capacitance yields a *less* rapid change in voltage for a given current.
[*circuits0149.mcq*]

27. Which of the following is *false* about permittivity (or all are true)?

A. It permits a constant current to leak between the plates of the capacitor.

B. Even free space has a non-zero permittivity.

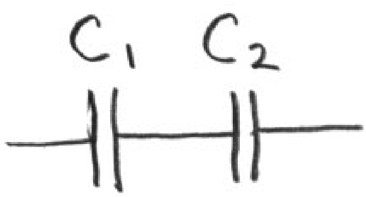
C. It can be increased by the alignment of charges in the material between the plates of a capacitor.

D. All are true.

E. In a given capacitor, it determines the capacitance for a given area of plates and distance between them.

Explanation: A capacitor may leak, but not because of permittivity. Permittivity relates to the storage capacity for charge between the plates due to the material between them.
[*circuits0152.mcq*]

28. What is the total capacitance of this branch if $C_1 = 0.1$ μF, $C_2 = 0.1$ μF?



A. 0.05 μF

B. 0.2 μF

C. 0.1 μF

D. 0.5 μF

E. None of the other answers is correct.

Explanation: Capacitances in series add like resistors in parallel. In other words, $C_S = \frac{C_1 \times C_2}{C_1 + C_2}$.
[*circuits0177.mcq*]

29. The property of *inductance* in a coil may best be described as follows:

A. The magnetic field surrounding a current contains energy, and it requires a voltage applied over time to change that energy.

B. The mass of the electrons provides inertia, which makes them want to keep moving in a given direction.

C. The current in a coil is proportional to the voltage across the coil over the resistance of the coil.

D. The buildup of charge on one section of the coil is offset by the depletion of charge on a neighboring section of the coil.

E. The magnetic field within the coil is non-linear with respect to the magnetic field of the earth.

Explanation: Answer B is the actual inertia of the electrons, an insignificant factor. Answer C is simply Ohm's law, accounting for the coil's *resistance*, not its inductance. Answers D describes capacitance. Answer E is not related to inductance.
[*circuits0178.mcq*]

30. The following are true about the discharge of a capacitor with capacitance C through a resistor with resistance R, *except*, (or all are true)

A. The time required for the capacitor to discharge to exactly 50% of the initial voltage is RC.

B. Electrons leaving the negatively charged plate of the capacitor are replaced by electrons entering the postively charged plate.

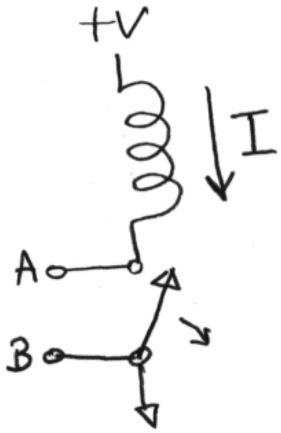
C. The discharge is governed by a first order differential equation, with current gradually decreasing as the capacitor discharges.

D. All are true.

E. The energy initially stored in the capacitor ($\frac{1}{2}CV^2$, where V is the initial voltage on the capacitor) is released primarily as heat by the resistor.

Explanation: RC is the time to reach $1/e$ (about 37%) times the initial voltage on the capacitor, not 50%.
[*circuits0181.mcq*]

31. Given a current I through this inductor with the switch closed, what voltage would theoretically be generated between A and B if the switch were opened instantly (in zero time)?



A. ∞

B. 0

C. I

D. $+V$

E. None of the other answers is correct.

Explanation: ∞ because the voltage across the coil is $L\frac{dI}{dt}$. The current goes from I to 0 instantly, so point A goes to infinity above +V, and therefore point A is also infinity above ground (point B).
[*circuits0201.mcq*]

32. The following is *not* true about current:

A. The sum of the currents around any loop must equal zero.

B. When measured across a resistor, the voltage is linearly related to the current through that resistor.

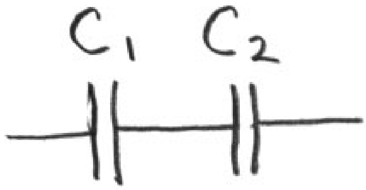
C. The unit of current is the Ampere, which equals 6.241×10^{18} electrons per second.

D. In general, it can be said to obey Kirchhoff's Current Law, which states that no charge accumulates at any given node in a circuit.

E. Its relationship to voltage across either a capacitor or inductor (coil) takes the form of a first order differential equation with respect to time.

Explanation: The sum a the *voltages* (not the currents) around any loop must equal zero. This is Kirchhoff's voltage law.
[*circuits0203.mcq*]

33. What is the total capacitance of this branch if $C_1 = 2\ \mu$F, $C_2 = 2\ \mu$F?



A. 1 μF

B. 2 μF

C. 4 μF

D. 0.5 μF

E. None of the other answers is correct.

Explanation: Capacitances in series add like resistors in parallel. In other words, $C_S = \frac{C_1 \times C_2}{C_1 + C_2}$.
[*circuits0208.mcq*]

34. The energy stored in a 3 Henry inductor (coil) with 4 A through it

A. is 24 J.

B. equals the heat dissipated by the coil.

C. is 12 J.

D. cannot be determined without more information.

E. depends on how long it took to achieve the current.

Explanation: The energy is due to the magnetic field and is independent of how long it took to achieve the current. The energy is proportional to the square of the current for a given inductance, $E = \frac{1}{2}LI^2$. The heat given off is due to the resistance of the coil, not the inductance.
[*circuits0209.mcq*]