

B - Circuit Lab B SO Practice - Nov 7 Country-wide SO Practice - 11-07-2020

The exam contains three types of questions: multiple choice, fill in the blank, and short answer. For the multiple choice, select only the best answer. For fill in the blank questions, be careful to type the answer properly. For short answer questions, be complete but concise.

There is no hands-on portion for this event.

Multiple choice section. For all questions, select only the best answer.

1. (2.00 pts) The units for electrical charge are named after this scientist.

- A) Ampere
- B) Coulomb
- C) Ohm
- D) Volta

2. (2.00 pts) According to one of Kirchhoff's circuit laws, the sum of this quantity around a closed loop is always zero.

- A) electric charge
- B) electric current
- C) electric potential difference
- D) magnetic flux

3. (2.00 pts) Michael Faraday discovered that an electrical conductor in a changing magnetic field produces an electromotive force. What is the name given to this principle?

- A) capacitance
- B) inductance
- C) magnetic flux
- D) transformation

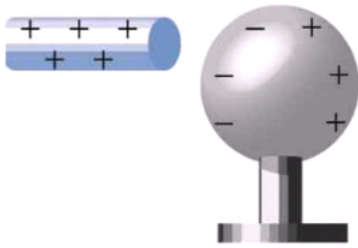
4. (2.00 pts)

After rubbing a rubber balloon on the event proctor's hair, a balloon accumulates a net negative charge. Compared to the total net charge prior to rubbing the balloon, the total net charge of the balloon and the proctor's hair is

- A) greater than before
- B) less than before
- C) the same
- D) needs more information

5. (2.00 pts)

A positively charged rod is brought into contact with a neutral metal sphere. The charges on the metal sphere become separated as shown in the diagram. What is the name of this process?



- A) charging
- B) induction
- C) magnetization
- D) polarization

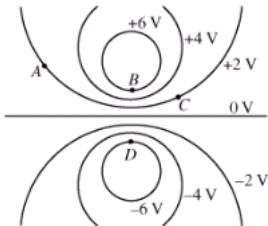
6. (2.00 pts) A negatively charged conductor can attract

- A) A conductor with positive charge
- B) A conductor with zero net charge
- C) A conductor with negative charge
- D) More than one of the above

7. (2.00 pts) Consider a parallel plate capacitor with a voltage applied to its plates. The capacitance of this capacitor can be increased by

- A) Increasing the area of the plates
- B) Increasing the distance between the plates
- C) Increasing the voltage across the plates
- D) None of the above

Answer the following question with the provided image.



8. (2.00 pts) The lines in the diagram above represent electric potential lines. Assuming the top of the page is north, what is the direction of the electric field at point C?

- A) north-west
- B) north-east
- C) south-west
- D) south-east

9. (2.00 pts) Which of the following was the main proprietor of alternating current?

- A) Edison
- B) Faraday
- C) Tesla
- D) Volta

10. (2.00 pts) AC is used over DC in power transmission because

- A) AC signals are easier to step up and down in voltage
- B) AC signals are safer than DC signals
- C) AC signals have less resistance than DC signals
- D) AC signals travel faster than DC signals

11. (2.00 pts) Suppose the current in a circuit is an AC value. What is true about the voltage across any resistor?

- A) The voltage drop is constant over time
- B) The voltage drop increases over time
- C) The voltage drop decreases over time
- D) The voltage drop increases and decreases over time

12. (2.00 pts) Which of the following is a DC power source?

- A) Electrical generator
- B) Solar panels
- C) Transformer
- D) Wall outlet

13. (2.00 pts) Which of the following statements accurately describes the flow of electrons in a circuit? ("near light speed" meaning at least 90% of the speed of light)

- A) Electrons move at near light speed from high potential to low potential
- B) Electrons move at near light speed from low potential to high potential
- C) Electrons move relatively slowly from high potential to low potential
- D) Electrons move relatively slowly from low potential to high potential

14. (2.00 pts) The current through an LED

- A) flows from the anode to the cathode
- B) flows from the cathode to the anode
- C) can flow in either direction
- D) current cannot flow through an LED

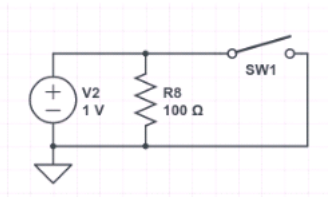
15. (2.00 pts) Which of the following is generally NOT true about LEDs compared to incandescent light sources?

- A) LEDs work better with AC power
- B) LEDs emit less heat
- C) LEDs use less power
- D) LEDs last longer

16. (2.00 pts) Which of the following is NOT a device meant to prevent electrical damage?

- A) circuit breaker
- B) fuse
- C) surge protector
- D) voltage equalizer

17. (2.00 pts) The voltage across the open switch in the diagram below is



- A) 0 (zero)
- B) 1 V
- C) infinite
- D) none of the above

18. (2.00 pts) Magnetic field lines represent what about the magnetic field?

- A) magnitude and direction
- B) only magnitude
- C) only direction
- D) polarity

19. (2.00 pts) A positively charged particle moving parallel to a magnetic field will experience

- A) a force in the direction of its motion
- B) a force opposite of its motion
- C) a centripetal (circular) force
- D) no force

20. (2.00 pts) An electromagnet can be constructed with a coil of wire wrapped around an iron core. The strength of this electromagnet can decrease by

- A) Increasing the current of its coils
- B) Increasing the amount of its coils
- C) Lengthening the iron core
- D) Passing the electromagnet through a magnetic field

21. (2.00 pts) These windings in an electric motor carry the load current that produces a magnetic field.

- A) armature
- B) brush
- C) rotor
- D) slip ring

22. (2.00 pts) Which of these is NOT a property of magnetic field lines?

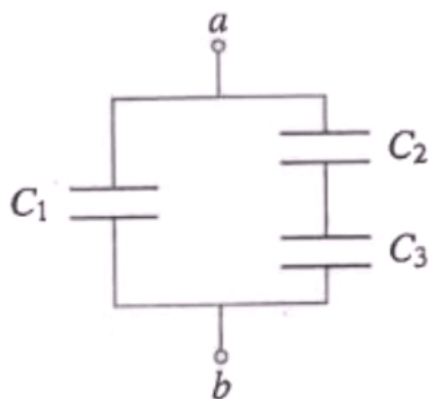
- A) lines show direction of the magnetic field
- B) lines cross at equal magnitude
- C) lines form continuous loops
- D) lines match compass directions

Fill in the blank questions. Make sure to be exact with your answers.

23. (3.00 pts)

In this diagram, $C_1 = 5 \text{ F}$, $C_2 = 3 \text{ F}$, $C_3 = 6 \text{ F}$ What is the equivalent capacitance in farads between a and b?

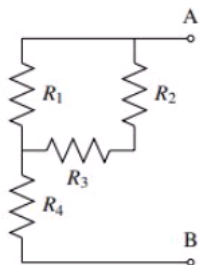
Only give the number in your answer, do not include the units. For example, if the answer is 100 F, your answer should be "100". (Only put the number inside the "quotation marks".)



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24. (3.00 pts) $R_1 = 5$ ohms, $R_2 = 5$ ohms, $R_3 = 15$ ohms, $R_4 = 10$ ohms. Give the equivalent resistance in ohms between nodes A and B.

Only give the number in your answer, do not include the units. For example, if the answer is 21 ohms, your answer should be "21".



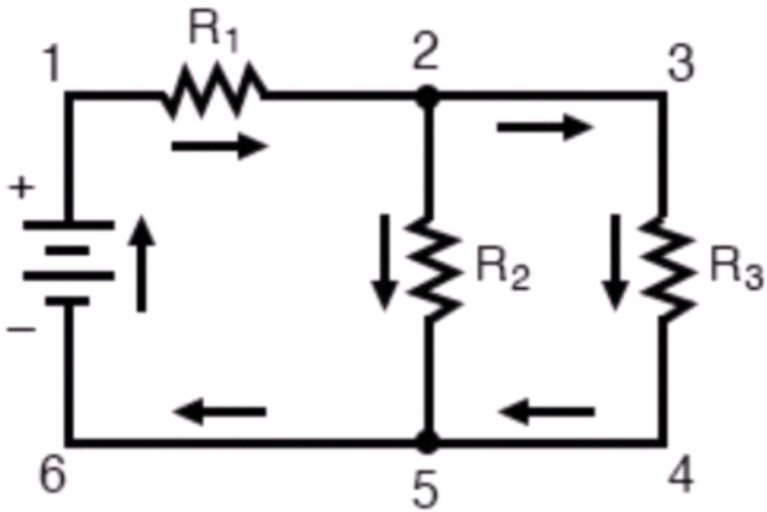
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Answer the following questions with the following figure. Assume $R_1 = 1$ Ohm, $R_2 = 4$ Ohms, and $R_3 = 4$ Ohms. The voltage source has a voltage of 6 Volts.

All answers can be expressed as a positive integer (1, 2, 3, 4, 5, etc.). Especially pay attention to parts 1 and 2, since these affect the other answers.

Only give the number in your answer, do not include the units. Provide your answers assuming the units are ohms for resistance, amperes for current, volts for voltage, and watt for power.

For example, if the answer is 52 A, your answer should just be "52".



25. (1.00 pts) 1) What is the equivalent resistance of R_2 and R_3 together in parallel?

26. (1.00 pts) 2) What is the equivalent resistance of the circuit?

27. (2.00 pts) 3) What is the current that leaves the battery?

28. (2.00 pts) 4) What is the voltage across R_1 ?

29. (2.00 pts) 5) What is the voltage across R_2 ?

30. (1.00 pts) 6) What is the current through R_1 ?

31. (1.00 pts) 7) What is the current through R_3 ?

32. (2.00 pts) 8) How much power do the resistors R2 and R3 dissipate combined?

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33. (2.00 pts) 9) How much power does the battery supply?

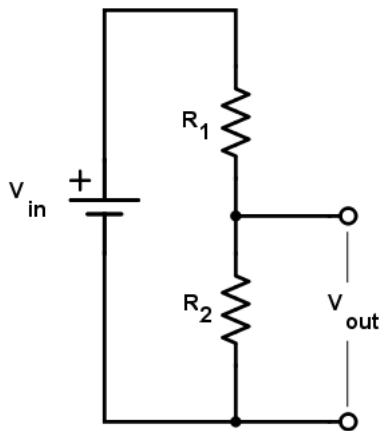
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Short answer questions. Be complete but concise with your answers.

34. (3.00 pts)

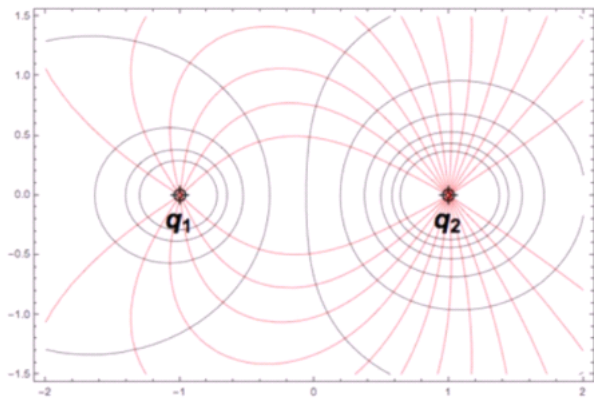
You want to design a voltage divider circuit. You currently have a 100 Ohm resistor. What value resistor do you need to create a voltage divider circuit such that your circuit divides the value of the output voltage to be 3/4 of the input voltage value? For example, if the input voltage is 4 V, the output voltage should be 3 V.

Hint: there are 2 correct answers, but you only need to provide 1.



Expected Answer: 300 or 33.333 (100/3) ohms

Use this diagram for the following two questions.



35. (2.00 pts) What do the lines that encircle the charges represent?

Expected Answer: Answers are likely: electrical potential, equipotential lines, voltage. Do NOT accept "electrical potential energy".

36. (2.00 pts) What do the lines that directly connect the two charges represent?

Expected Answer: Answer should be similar to: electric field, electrical field, electric field lines

Use this diagram for the next two questions. The vertical line below is a wire where the current points toward the top of the page.



37. (2.00 pts) Describe what the shape of the magnetic field lines around the wire looks like.

Expected Answer: Something like circle or circular around the wire, use best judgment

38. (2.00 pts)

In which direction is the magnetic field line to the left and right of the wire? Specify your answer relative to the page. If they are different, make sure to specify which is left and which is right.

Expected Answer: Left is out of the page, right is into the page

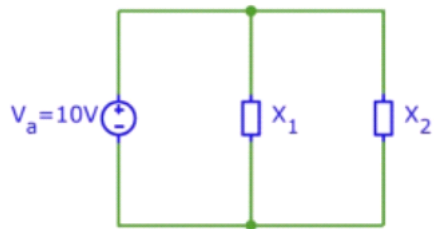
39. (3.00 pts) From one end to another, a resistor has colors brown, black, red, gold. What is the value and tolerance of this resistor? **Make sure to include the proper units.**

Expected Answer: 1000 ohms (or 1 kilo-ohm or equivalent) with plus/minus 5% tolerance

40. (3.00 pts) Why are metals good conductors of electricity? Hint: related to electrons.

Expected Answer: Electrons have a large amount of freedom to move around in metals, electron sea, delocalized electrons, mobile electrons, similar answers

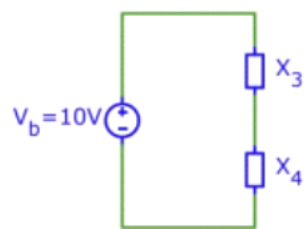
41. (3.00 pts) Assume the resistors are all 1 ohm. Calculate the total power dissipated in the circuit. **Make sure to include the proper units.**



Circuit (a)

Expected Answer: 200 W or 200 watts

42. (3.00 pts) Assume the resistors are all 1 ohm. Calculate the total power dissipated in the circuit. **Make sure to include the proper units.**



Circuit (b)

Expected Answer: 50 W or 50 watts

End of Exam