

Circuit Lab

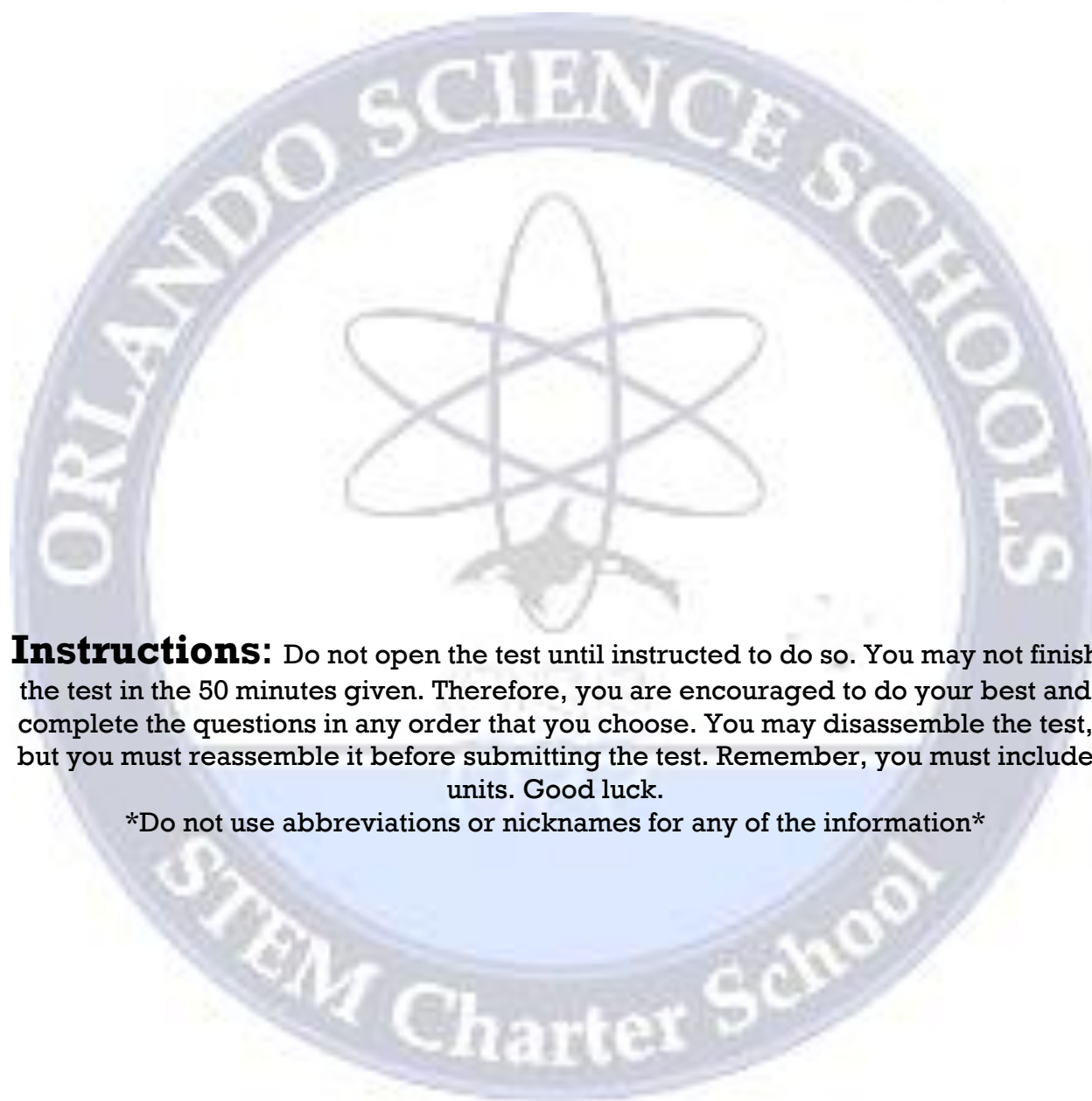
Division C Test

/208

School: _____

Team Number: _____

Team Members: _____



Instructions: Do not open the test until instructed to do so. You may not finish the test in the 50 minutes given. Therefore, you are encouraged to do your best and complete the questions in any order that you choose. You may disassemble the test, but you must reassemble it before submitting the test. Remember, you must include units. Good luck.

Do not use abbreviations or nicknames for any of the information

Part I: History

1. In what year was the voltaic pile created in?
 - A. 1762
 - B. 1785
 - C. 1799
 - D. 1816
2. What are the two electrodes used in the first electrochemical cell created by Alessandro Volta?
 - A. Rhodium and Gold
 - B. Zinc and Platinum
 - C. Zinc and Copper
 - D. Graphite and Lead
3. In what year did Ohm's Law appear in *Die galvanische Kette*?
 - A. 1827
 - B. 1829
 - C. 1836
 - D. 1838
4. Voltage is also known as EMF. What does EMF stand for?
 - A. Electromagnetic Field
 - B. Electromotive Force
 - C. Electric and Magnetic Fields
 - D. Eclipse Modeling Framework
5. Who licensed the AC patents of Nikola Tesla in 1888?
 - A. California Electric Company
 - B. Grand Rapids Electric Light & Power Company
 - C. Brush Electric Company
 - D. Westinghouse Electric
6. In which project did Nikola Tesla attempt to create an intercontinental wireless communication and power transmitter?
 - A. Wardencllyffe
 - B. Edison
 - C. Columbian Exposition
 - D. Niagara
7. Who theorized the existence of electromagnetic waves with his electromagnetic theory of light?
 - A. Heinrich Hertz
 - B. James Clerk Maxwell
 - C. Michael Faraday
 - D. Nikola Tesla
8. Who created an apparatus to measure the velocity of electromagnetic waves?
 - A. Michael Faraday
 - B. Alessandro Volta
 - C. Nikola Tesla
 - D. Heinrich Hertz

9. Who discovered the theory of electrolysis?
A. Nikola Tesla
B. Michael Faraday
C. Heinrich Hertz
D. James Clerk Maxwell
10. Which famous scientist kept a picture of Michael Faraday on his study wall?
A. Albert Einstein
B. Charles Darwin
C. Thomas Edison
D. Niels Bohr
11. Who created the breadboard?

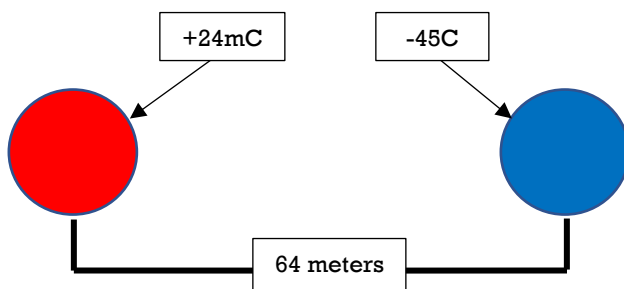
12. Who created the voltmeter?

13. Who created the multimeter?

14. Who created the ammeter?

15. Who created an electric utility basing its infrastructure on DC power?

Part II: Charges and Capacitance



1. What is the force between these two point-charges?

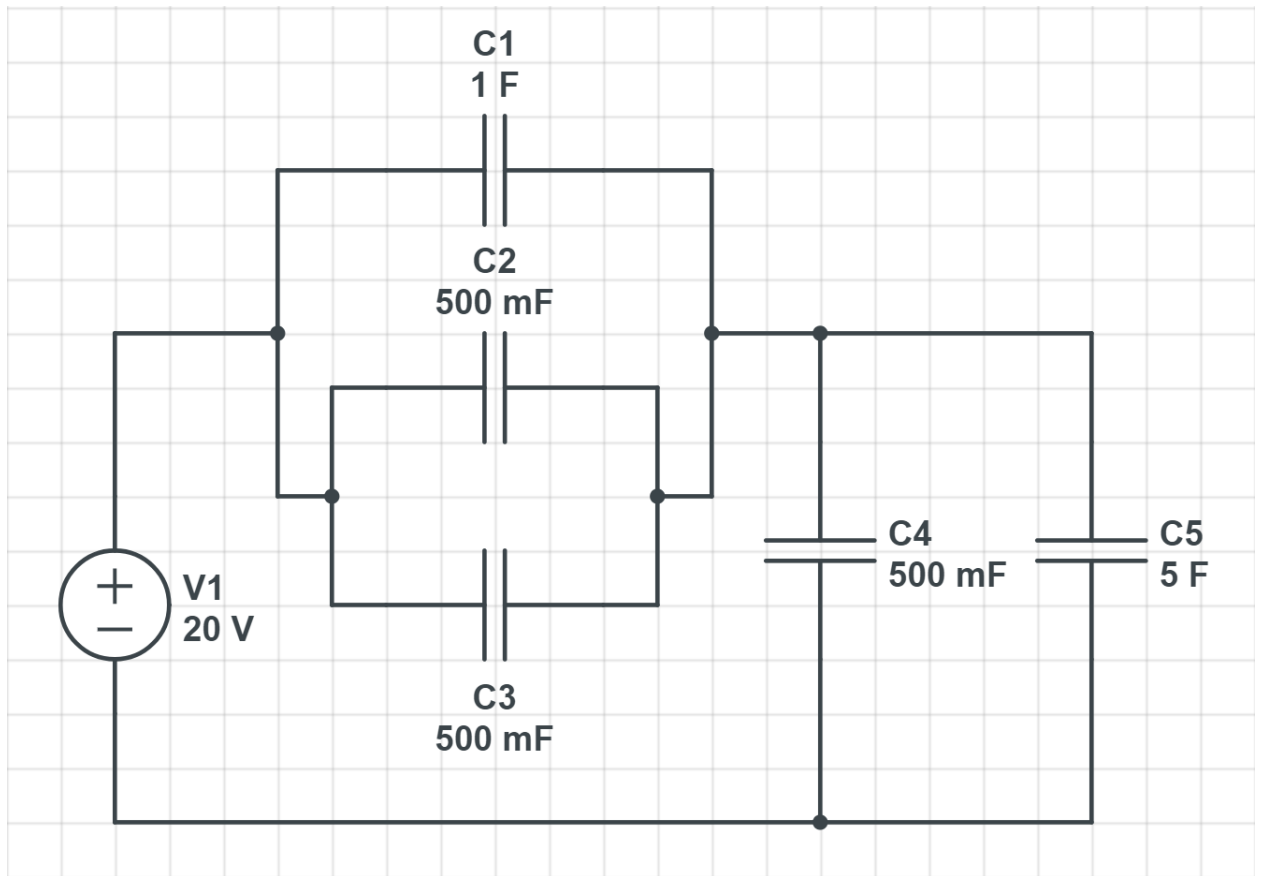
2. What is the formula used to quantify the amount of force with which stationary electrically charged particles repel or attract each other?

The next two questions relate to the answer given in Question 2 of Part II

3. What is the electrostatic constant? (Hint: The answer should be answered in $\frac{N \cdot m^2}{C^2}$)

4. When was this law first published and by who?

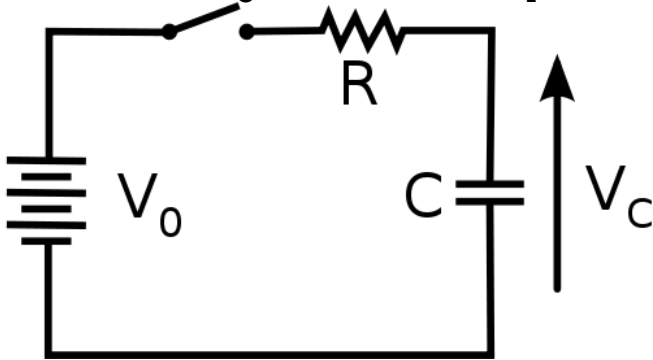
Use the following circuit to answer questions 5 and 6



5. What is the overall capacitance of the above circuit?

6. What is the overall charge of the circuit?

Use the following circuit to answer questions 7 and 8



7. If the capacitor in the above circuit is charging, with $V_0 = 10V$, $R = 50\Omega$, $C = 5F$. What is the voltage through the capacitor, V_C , after 23 seconds?

8. What is the overall charge of the circuit?

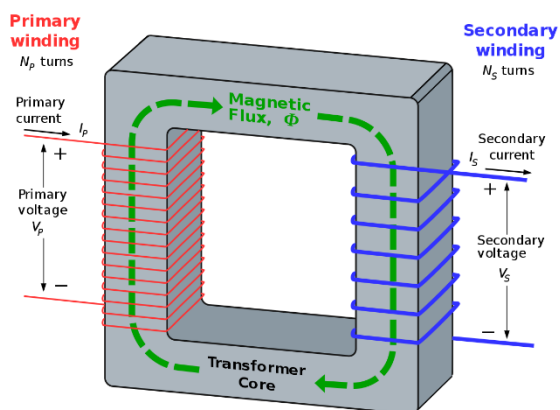
Part III: Current

1. What is the most common type of DC Source?
 - A. Phones
 - B. Batteries
 - C. Cars
 - D. Computers
2. How many parts are there to a battery?
 - A. 1
 - B. 2
 - C. 3
 - D. 4
3. Fill In The Blank: DC Current can cause fibrillation of the heart. This typically takes place at ___ mA of DC Current.
 - A. 30-50
 - B. 120-140
 - C. 300-500
 - D. 1200-1500

4. True or False: When you recharge a battery, you change the direction of the flow of electrons using another power source.
5. Which type of voltage can be converted from high voltages easily using transformers?
 - A. AC
 - B. DC
 - C. Both
 - D. Neither
6. Draw a graph depicting the 2 types of currents (Properly label each line)

7. Fill In The Blank: Generators convert ___ energy to ___ energy.
 - A. Mechanical; Electrical
 - B. Chemical; Mechanical
 - C. Electrical; Chemical
 - D. Chemical; Electrical

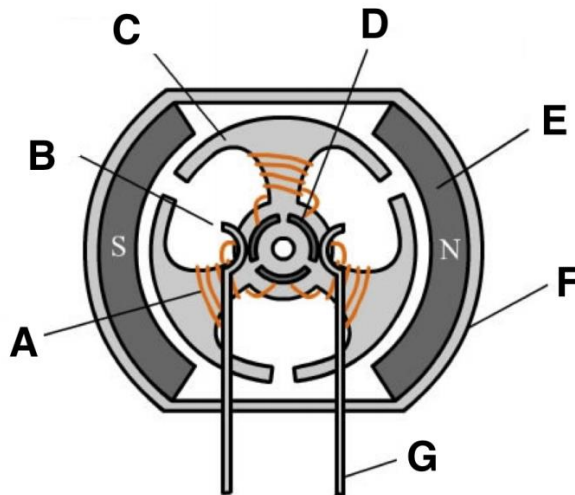
Part IV: Transformers, Motors, and Generators



1. In this transformer, suppose that $I_p = 10A$, $N_p = 5$, $N_s = 20$. What is the secondary (output) current?

2. In this transformer, suppose that $V_p = 20V$, $N_p = 5$, $V_s = 400V$. What is the secondary (output) winding?

3. Label each part of this on the answer sheet.



4. What are the 4 types of DC Motors?

5. What are the 2 types of AC Motors?

6. Fill In The Blank: The moving part of a motor is called ___.

7. Fill In The Blank: The stationary part of a motor is called ___.

Part V: Circuits

1. What is the component with the following symbol?



2. What is the component with the following symbol?



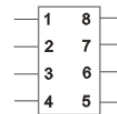
3. What is the component with the following symbol?



4. What is the component with the following symbol?



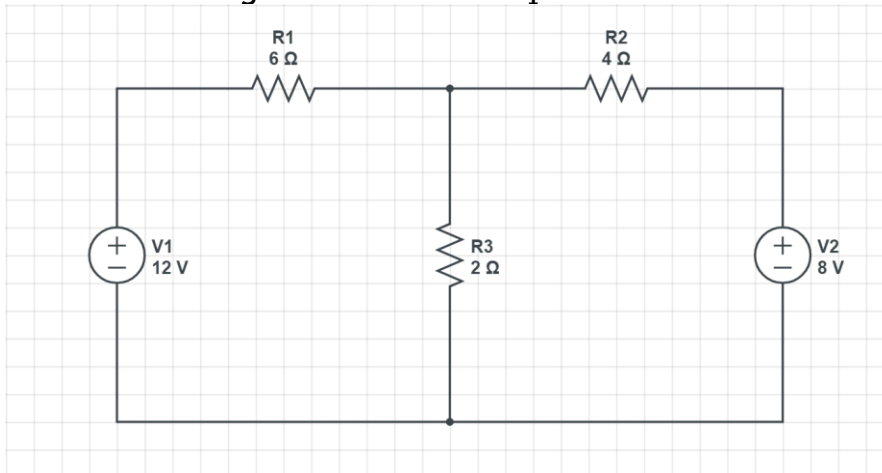
5. What is the component with the following symbol?



6. What is the component with the following symbol?



Use the following circuit to answer questions 7-12



7. What is the current through R1?

8. What is the current through R2?

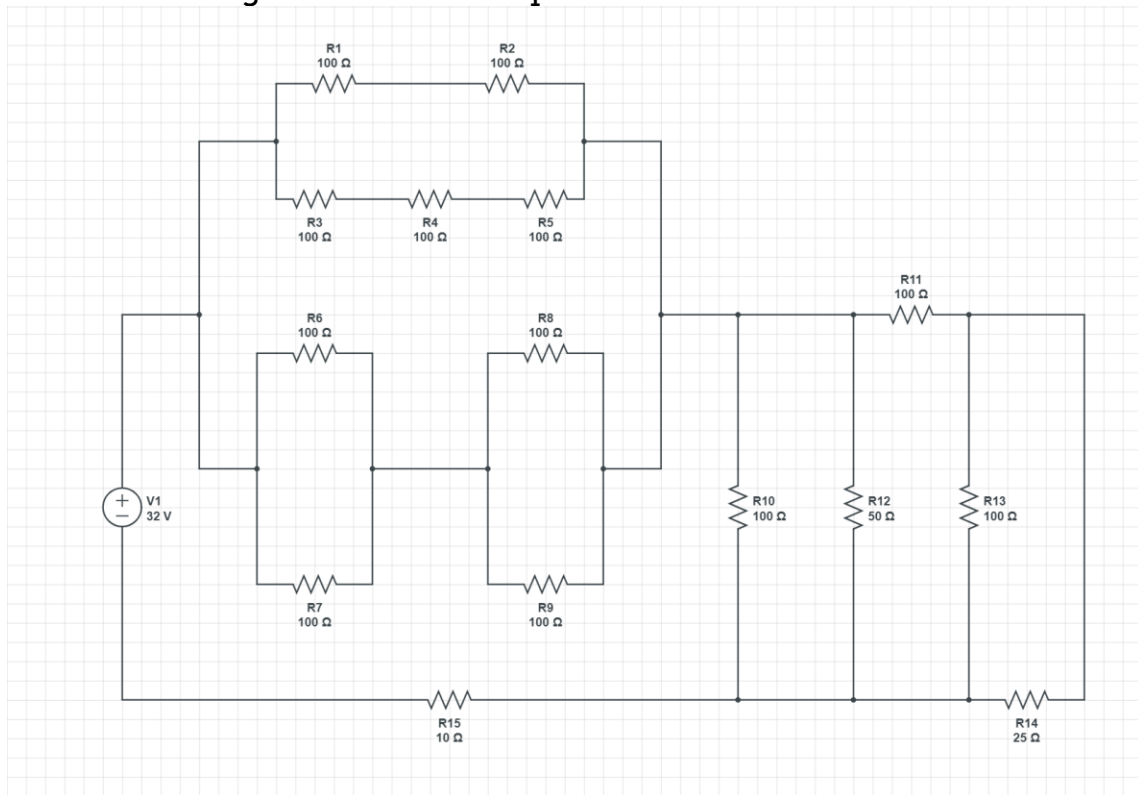
9. What is the current through R3?

10. What is the voltage through R1?

11. What is the voltage through R2?

12. What is the voltage through R3?

Use the following circuit to answer question 13

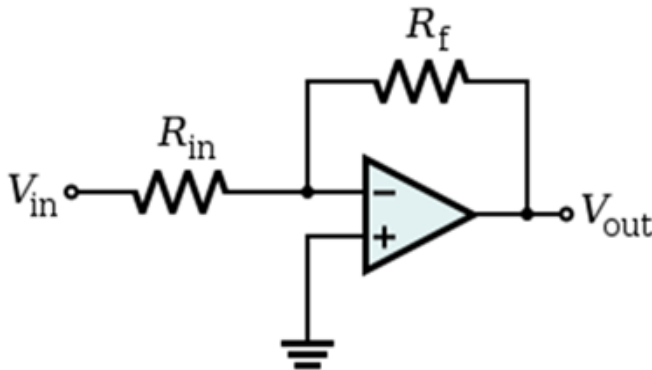


13. What is the total resistance in this circuit?

Part VI: PN Junctions and Op-Amps

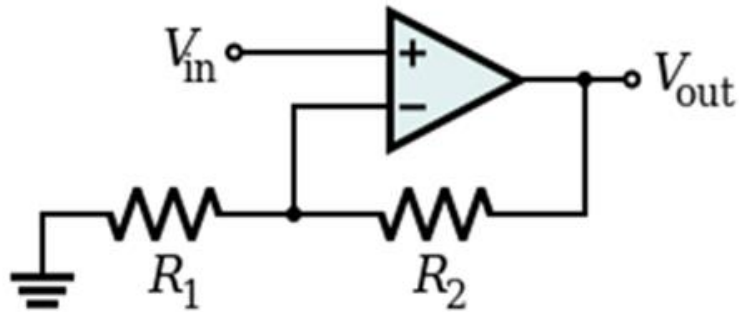
1. What type of charge do “holes” have in PN Junctions?
2. True or False: During forward bias, the holes in the p-type region and the electrons in the n-type region are pushed away from the junction and increase the depletion area.
3. What is the most common type of PN Junction? (Hint: Which element?)

Use the following to answer questions 4 and 5



4. If $V_{in} = 20V$, $R_{in} = 40\Omega$, $R_f = 30\Omega$, then what is V_{out} ?
5. What would be the gain if $R_{in} = 40\Omega$, $R_f = 30\Omega$?

Use the following to answer questions 4 and 5



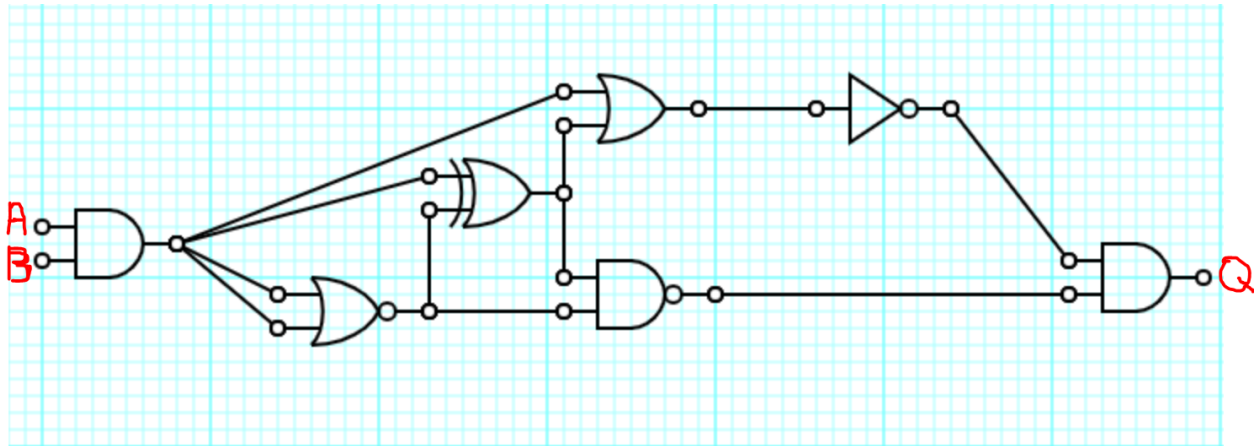
6. If $V_{in} = 20V$, $R_1 = 40\Omega$, $R_2 = 30\Omega$, then what is V_{out} ?

7. What would be the gain if $R_{in} = 40\Omega$, $R_f = 30\Omega$?

Part VII: Logic Gates

	Gate	A	B	Q
1	NAND	0	0	
2	AND	1	1	
3	XNOR	0	1	
4	OR	1	0	
5	AND	1	0	
6	XOR	0	1	
7	NAND	0	1	
8	XNOR	1	1	
9	OR	0	0	
10	OR	1	1	

Use the following to solve question 11



11. If A is 1 and B is 0, what will be the value of Q?