

PRAIRIE VIEW A&M UNIVERSITY

ROY G. PERRY COLLEGE OF ENGINEERING

DEPARTMENT OF

ELECTRICAL & COMPUTER ENGINEERING

COURSE BINDER

ELEG 2315 – INTRODUCTION TO ELECTRICAL ENGINEERING – SPRING 2022

NAME OF INSTRUCTOR: A. ANIL KUMAR

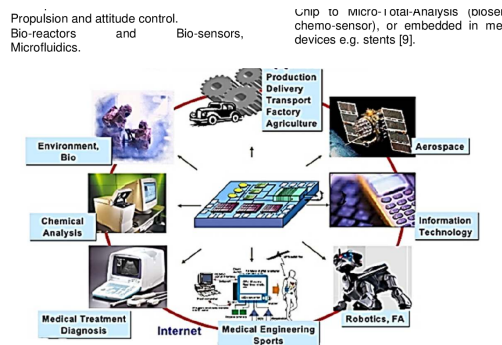


Fig. 1 (a). Applications of MEMS Devices/Systems [10]

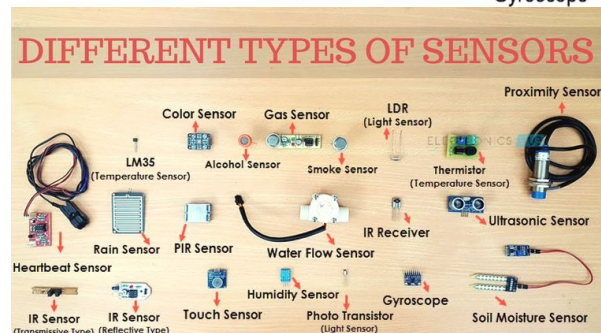
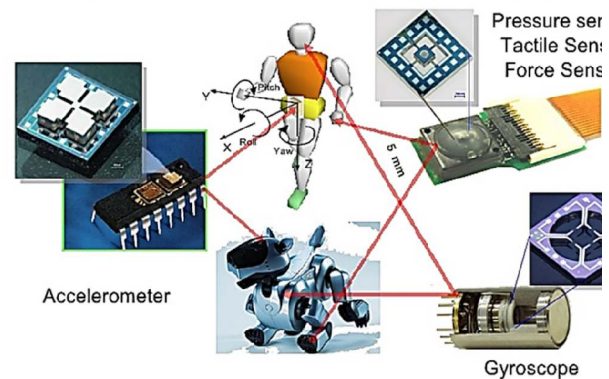
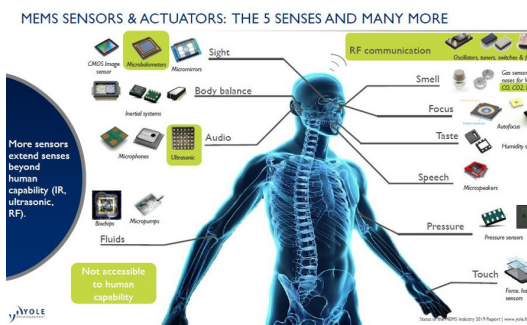


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I. COURSE SYLLABUS



PRAIRIE VIEW
A&M UNIVERSITY

SYLLABUS

1. **Course number and name:** ELEG 2315. Introduction to Electrical Engineering
2. **Credits and contact hours:** Credit 3 semester hours. Contact hours 3.
3. **Instructor's name:** A. Anil Kumar, Ph.D., Professor

4. **Text book, title, author, and year**

Fundamentals of Electrical Engineering, by Giorgio Rizzoni, McGraw-Hill (2009)
ISBN 978-0-07-338037-7.

a. **other supplemental materials**

Course Specific:

1. Class Notes and Handouts
2. University of Utah <http://www.ece.utah.edu/~ece2210/> This website has a lot of excellent material.
3. Schaum's Outline of Basic Circuit Analysis, Author: John O'Malley, 2nd Edition, ISBN 13: 9780070478244
4. [https://my.ece.utah.edu/~ece2210/ECE2210lect S20.htm](https://my.ece.utah.edu/~ece2210/ECE2210lect%20.htm)

5. **Specific course information**

brief description of the content of the course (catalog description): Introductory course for non-majors. Basic circuit theory, analysis of DC circuits; transient analysis of RLC circuits; steady state analysis; transformers; dc machines and induction motors; diode circuits; operational amplifiers; numbering systems, logic gates and combinational circuits.

- a. **prerequisites or co-requisites:** Undergraduate level [MATH 2320](#) Minimum Grade of C and Undergraduate level [PHYS 2326](#) Minimum Grade of C
- b. **indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program:** Required

6. **Specific goals for the course**

- a. **specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)**

1. Be able to apply circuit analysis techniques to resistive, capacitive and inductive networks.
 2. Be able to characterize the behavior of resistors, capacitors, and inductors.
 3. Be able to identify relevant electrical and electronic components in a physical structure, such as a sensor, accelerometer, robot, a bridge, a chemical monitoring system.
 4. Demonstrate a knowledge of modern developments in your own major and how this course might help you advance your knowledge.
- a. **explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.** Not applicable.

7. Brief list of topics to be covered

1. Introduction to Electrical Engineering
2. Fundamentals of Electrical Circuits
3. Resistive Network Analysis
4. Transient – Capacitive and Inductive – Network Analysis
5. A.C. Frequency Response
6. Logic Circuits
7. Communications – Signal processing, Coding
8. Applications – Sensors, Actuators, Robotics

II. Assessment of the Course in Spring 2022

Over the previous semesters, my observation was that the students – majors in Chemical, Civil and Mechanical Engineering – were less than enthused with the subject material. For the most part, their reactions were along the lines of, “Where am I going to use this?” Their reaction to logic circuit design, Boolean Algebra implementations, and decimal to binary conversions, has been a lot more positive. Their reactions are partially justified since the textbook, and many other such textbooks, tend to be written by electrical engineering faculty for electrical engineering students. The adaptation of such a text to a non-EE environment is tenuous at best.

My explanation to the students for the importance of the subject material included the following:

1. An engineer, whatever their chosen area of specialization, has to have some working knowledge of electrical engineering, since almost every device or appliance used in daily life is electric or electronic.
2. Real world career environment is no longer subject matter specific. One needs to be able to converse with another from a different subject expertise. I gave examples such as needing a comprehension of sensors for traffic or bridge design, vision and motor control systems for a robot, safety system design for a chemical plant, among others.
3. The course also addresses mathematical preparation such as matrix analysis and solutions of systems of equations. An ability to demonstrate “transference of skills” is of paramount importance in the real world.

Having said that, detailed discussions of nodal and loop analysis, network equivalent theorems and Bode Plots, for instance, are largely irrelevant to non-EE majors. The exposure to electromagnetic aspects, digital logic circuits and alternate number representations, especially binary formats, on the other hand, is extremely important.

In view of this, a few changes in instruction will be made during the Fall 2022 semester.

III. Recommendations for Fall 202

In view of my assessment of the course, I propose to change the format of the course as follows.

Traditional List of Topics	Proposed List of Topics
1. Introduction to Electrical Engineering 2. Fundamentals of Electrical Circuits 3. Resistive Network Analysis 4. Transient – Capacitive and Inductive – Network Analysis 5. A.C. Frequency Response 6. Logic Circuits 7. Communications – Signal processing, Coding 8. Applications – Sensors, Actuators, Robotics	1. Introduction to Electrical Engineering 2. Fundamentals of Everyday Electrical Systems – sensors, actuators, microelectron-mechanical systems (MEMS), communication devices 3. Decimal and Binary Formats 4. Logic Gates and Circuits 5. Boolean Algebra Implementation 6. Transient – Capacitive and Inductive – Network Analysis 7. Communications – Signal processing, Coding

Additionally, at least three “laboratory” sessions will be conducted that will cover:

1. Basic electrical measurements – current, voltage, resistance.
2. Simple assembly of circuits.
3. Capacitive and Inductive transient measurements.

IV. SAMPLES OF STUDENT WORK

Tyler Mannings

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

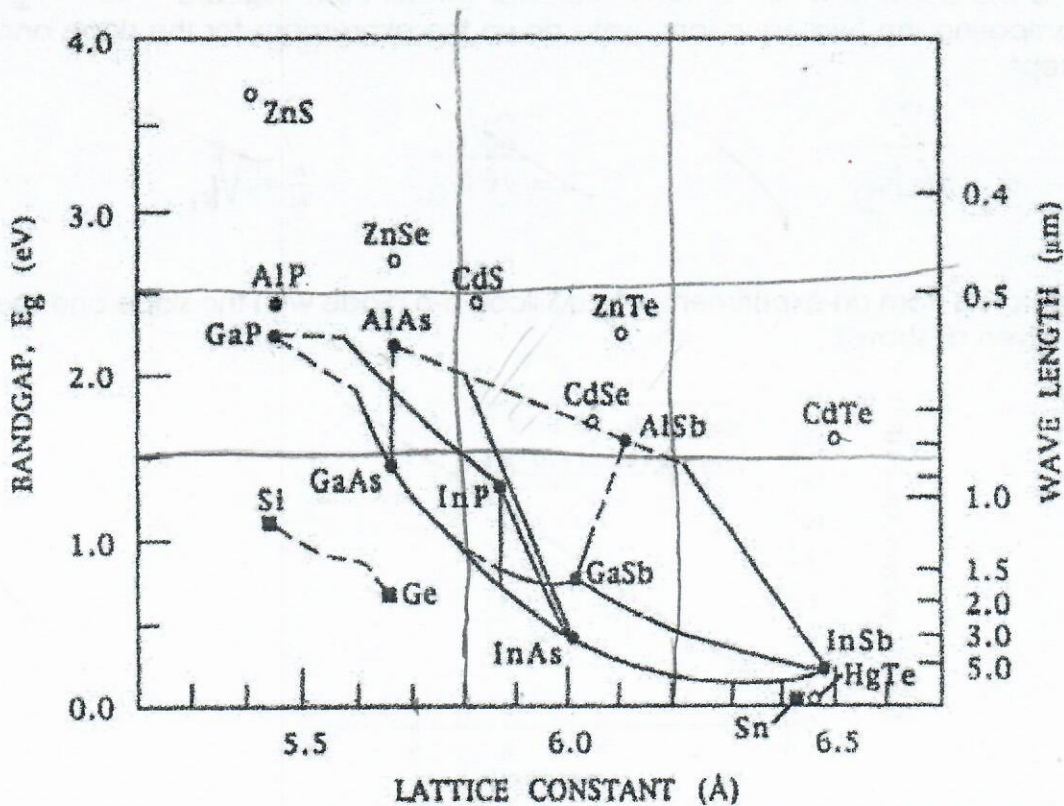
ELEG 3033 - SPRING 2022

QUIZ I

30

PROBLEM 1 (10 POINTS)

Examine the band gap vs. lattice constant diagram below. Suppose you want to choose all the semiconductors with the band gaps between 1.5 eV and 2.5 eV, and the lattice constants between 5.8 Å and 6.2 Å. List your choices in the table below in order of decreasing band gap.



	Choice 1	Choice 2	Choice 3	Choice 4	Choice 5	Choice 6
Band Gap	CdS	ZnTe	CdSe	AlSb		
Lattice Constant	5.82	6.1	6.03	6.1		

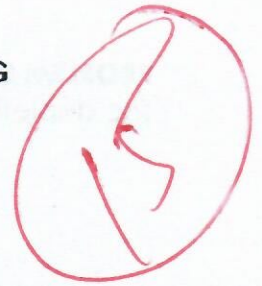
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DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

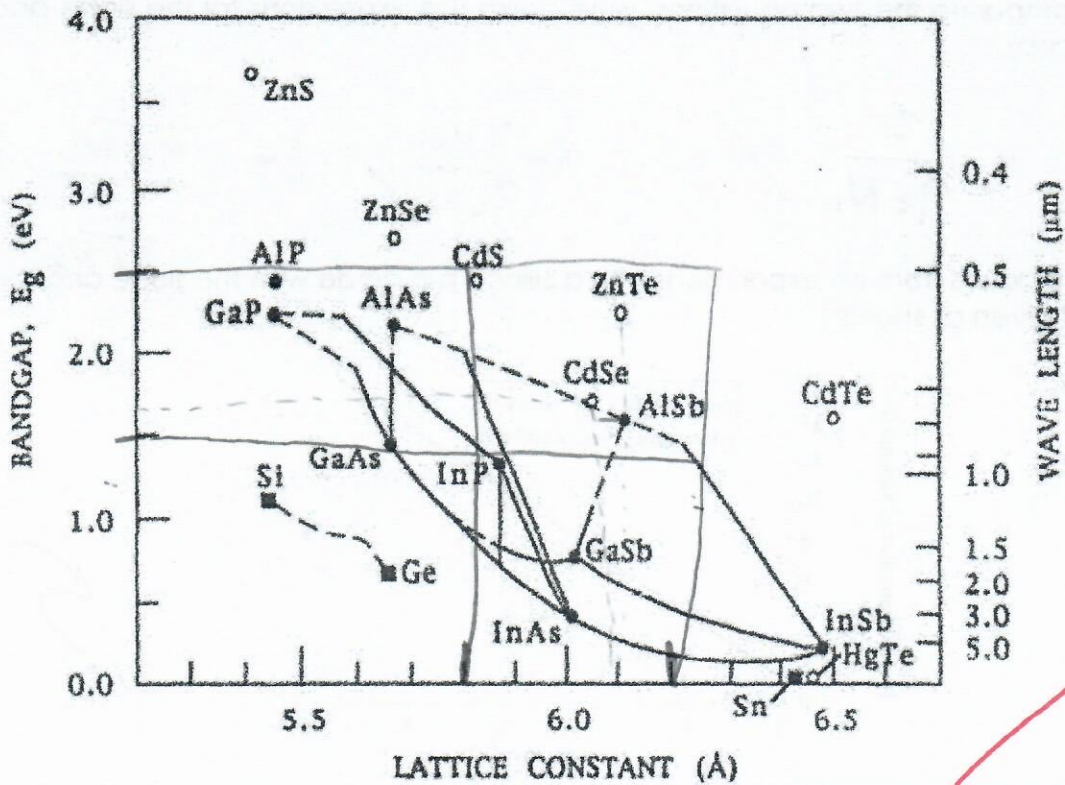
ELEG 3033 - SPRING 2022

QUIZ I



PROBLEM 1 (10 POINTS)

Examine the band gap vs. lattice constant diagram below. Suppose you want to choose all the semiconductors with the band gaps between 1.5 eV and 2.5 eV, and the lattice constants between 5.8 Å and 6.2 Å. List your choices in the table below in order of decreasing band gap.



10

	Choice 1	Choice 2	Choice 3	Choice 4	Choice 5	Choice 6
Band Gap	CdS	ZnTe	CdSe	AlSb		
Lattice Constant	5.8	6.1	6.08	6.1		

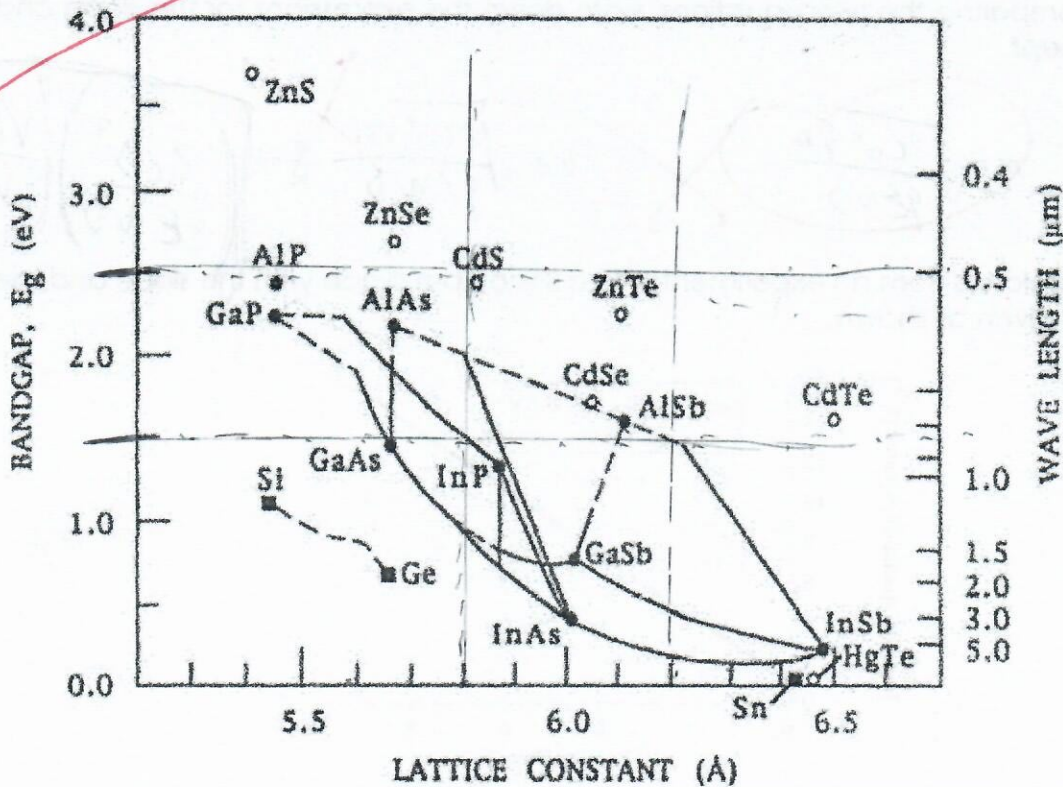
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ELEG 3033 - SPRING 2022

QUIZ I

PROBLEM 1 (10 POINTS)

Examine the band gap vs. lattice constant diagram below. Suppose you want to choose all the semiconductors with the band gaps between 1.5 eV and 2.5 eV, and the lattice constants between 5.8 Å and 6.2 Å. List your choices in the table below in order of decreasing band gap.



	Choice 1	Choice 2	Choice 3	Choice 4	Choice 5	Choice 6
Band Gap	AlP	CdS	ZnTe	GaP	AlAs	CdSe
Lattice Constant	CdS	ZnTe	CdSe	AlSb	InP	GaSb

PROBLEM 2 (20 POINTS)

The depletion capacitance C_D of a p-n diode is given by

$$\frac{1}{C_D^2} = \frac{2}{q\epsilon N_D} V_R + \frac{2V_{bi}}{q\epsilon N_D}$$

You should be familiar with all the notations. This looks like the equation of a straight line:

$$y = mx + b$$

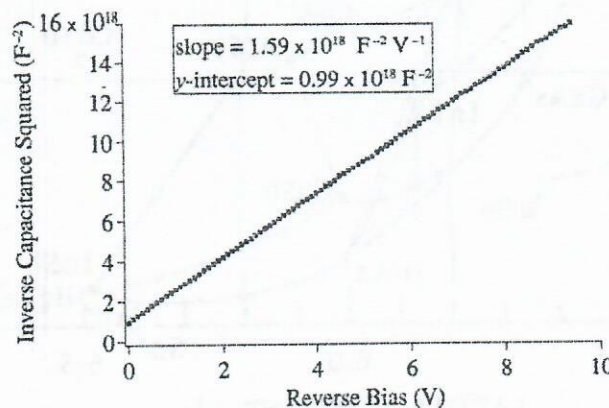
where "m" is the slope and "b" is the y-intercept (recall from Algebra 1 from high school). Comparing the two equations, write down the expressions for the slope and the y-intercept.

$$m = \frac{2}{q\epsilon N_D}$$

$$b = \frac{2V_{bi}}{q\epsilon N_D}$$

$$\frac{b}{m} = V_{bi}$$

The graph below is from an experiment with a Silicon p-n diode with the slope and the y-intercept given as shown.



Equating the slope and the intercept from your equation to the information shown on the graph, compute the value of V_{bi} and N_D .

($q = 1.6 \times 10^{-19} C$, $\epsilon = 11.7 \times 8.85 \times 10^{-14} cm^2 V^{-1} s^{-1}$)

$$m = 1.59 \times 10^{18} F^{-2} V^{-1} = \frac{2}{q\epsilon N_D}$$

$$1.59 \times 10^{18} = \frac{2}{(1.6 \times 10^{-19})(11.7 \times 8.85 \times 10^{-14})(N_D)}$$

$$N_D = 7.59 \times 10^{12} cm^{-3}$$

$$V_{bi} = \frac{b}{m} = \frac{0.99 \times 10^{18}}{1.59 \times 10^{18}} = 0.623 V$$

PROBLEM 2 (20 POINTS)

The depletion capacitance C_D of a p-n diode is given by

$$\frac{1}{C_D^2} = \frac{2}{q\epsilon N_D} V_R + \frac{2V_{bi}}{q\epsilon N_D}.$$

You should be familiar with all the notations. This looks like the equation of a straight line:

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where "m" is the slope and "b" is the y-intercept (recall from Algebra 1 from high school). Comparing the two equations, write down the expressions for the slope and the y-intercept.

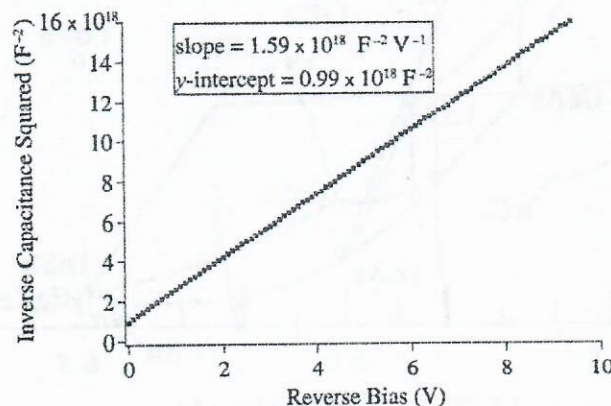
$$m = \frac{2}{q\epsilon N_D}$$

$$b = \frac{2V_{bi}}{q\epsilon N_D}$$

$$\frac{b}{m} =$$

$$\frac{\frac{2V_{bi}}{q\epsilon N_D}}{\frac{2}{q\epsilon N_D}} = \frac{2V_{bi} \cdot q\epsilon N_D}{2 \cdot q\epsilon N_D} = V_{bi}$$

The graph below is from an experiment with a Silicon p-n diode with the slope and the y-intercept given as shown.



Equating the slope and the intercept from your equation to the information shown on the graph, compute the value of V_{bi} and N_D .

($q = 1.6 \times 10^{-19} C$, $\epsilon = 11.7 \times 8.85 \times 10^{-14} cm^2 V^{-1} s^{-1}$.)

$$Slope = \frac{2}{1.6 \times 10^{-19} \cdot 11.7 \times 8.85 \times 10^{-14} N_D}$$

$$= \frac{2}{1.66 \times 10^{-31} N_D}$$

$$= 1.207^3 N_D$$

$$\frac{2V_{bi}}{1.207^3} = 1.657 V_{bi}$$

?

PROBLEM 2 (20 POINTS)

The depletion capacitance C_D of a p-n diode is given by

$$\frac{1}{C_D^2} = \frac{2}{q\epsilon N_D} V_R + \frac{2V_{bi}}{q\epsilon N_D}$$

$$\sqrt{\frac{C_D^2}{1}} = \sqrt{\frac{2C_D^2 V_R}{q\epsilon N_D}} + \sqrt{\frac{2C_D^2 V_{bi}}{q\epsilon N_D}}$$

$$C_D = \sqrt{\frac{2C_D^2 V_R}{q\epsilon N_D}} + \sqrt{\frac{2C_D^2 V_{bi}}{q\epsilon N_D}}$$

You should be familiar with all the notations. This looks like the equation of a straight line:

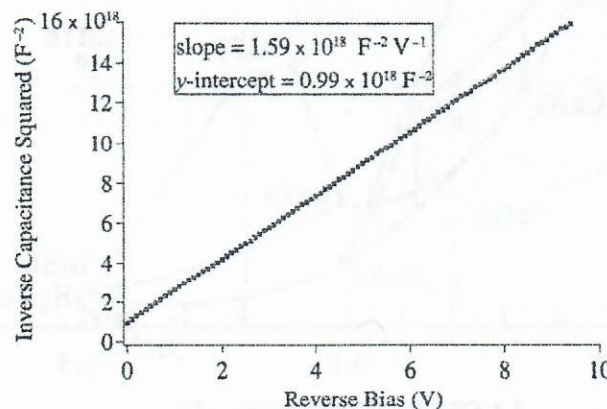
$$y = mx + b$$

where "m" is the slope and "b" is the y-intercept (recall from Algebra 1 from high school). Comparing the two equations, write down the expressions for the slope and the y-intercept.

$$m = \sqrt{\frac{2C_D^2 V_R}{q\epsilon N_D}}$$

$$b = \sqrt{\frac{2C_D^2 V_{bi}}{q\epsilon N_D}} \quad \frac{b}{m} = \sqrt{\frac{2C_D^2}{q\epsilon N_D}} \left(\frac{V_{bi}}{V_R} \right)$$

The graph below is from an experiment with a Silicon p-n diode with the slope and the y-intercept given as shown.



Equating the slope and the intercept from your equation to the information shown on the graph, compute the value of V_{bi} and N_D . ($q = 1.6 \times 10^{-19} C$, $\epsilon = 11.7 \times 8.85 \times 10^{-14} cm^2 V^{-1} s^{-1}$.)

$$0.99 \times 10^{18} = \sqrt{2}$$

$$1.59 \times 10^{18} = \frac{2}{(1.6 \times 10^{-19})(11.7 \times 8.85 \times 10^{-14})} N_D$$

$$1.59 \times 10^{18} = 1.207 \times 10^{31} \left(\frac{2}{N_D} \right)$$

$$1 - \frac{1}{N_D} = \frac{3.18 \times 10^6}{N_D} = \frac{1.207 \times 10^{31}}{N_D}$$

$$N_D = 2.63 \times 10^{11}$$

$$0.99 \times 10^{18} = \frac{2 V_{bi}}{1.6 \times 10^{-19} (\epsilon) N_D}$$

$$0.99 \times 10^{18} = \frac{2}{4.36 \times 10^{-20}} + \frac{V_{bi}}{4.36 \times 10^{-20}}$$

$$= 4.59 \times 10^{19} + \frac{V_{bi}}{4.36 \times 10^{-20}}$$

$$-4.49 \times 10^{19} = \frac{V_{bi}}{4.36 \times 10^{-20}}$$

$$-1.93 = V_{bi}$$

Name: Aliah Hamilton

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
ROY G. PERRY COLLEGE OF ENGINEERING
PRAIRIE VIEW A&M UNIVERSITY
ELEG 2053 – SPRING 2022
EXAMINATION III
THURSDAY, APRIL 7, 2022
Total: 100 Points

83

PROBLEM 1 (20 Points)

Perform the following decimal to binary and binary to decimal conversions. Show your work.

Decimal	Binary
79	1001111 ✓
95	1011111 ✓
137	10001001 ✓
194	11000010 ✓
248	11111000 ✓
114	✓ 1110010 ✓
272	✓ 100010000
462	✓ 111001110
337	✓ 101010001
385	✓ 110000001

20

Note: Did on
Scratch
Paper

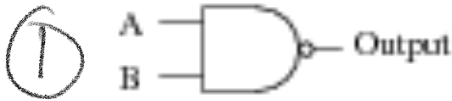
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SCRATCH SHEET FOR PROBLEM 1

Name: Phah Hamilton

PROBLEM 2 (18 Points)

Identify each of these logic gates by name, and complete their respective truth tables



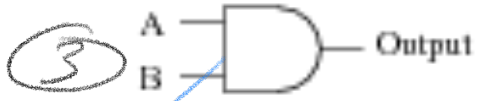
A	B	Output
0	0	1
0	1	1
1	0	1
1	1	0

NAND Gate



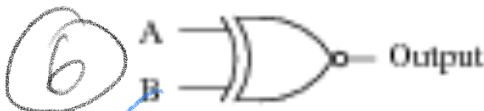
A	B	Output
0	0	1
0	1	0
1	0	0
1	1	0

NOR Gate



A	B	Output
0	0	0
0	1	0
1	0	0
1	1	1

AND Gate



A	B	Output
0	0	1
0	1	0
1	0	0
1	1	1

XNOR



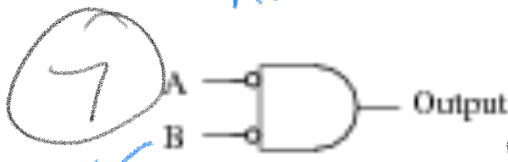
A	B	Output
0	0	0
0	1	1
1	0	1
1	1	1

OR Gate



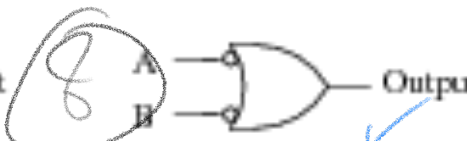
A	Output
0	1
1	0

NOT Gate



A	B	Output
0	0	1
0	1	0
1	0	0
1	1	0

Neg And



A	B	Output
0	0	1
0	1	1
1	0	1
1	1	0

NEG-OR



A	B	Output
0	0	0
0	1	1
1	0	1
1	1	0

XOR Gate

18

Name: Niah H.

PROBLEM 3 (10 Points)

Show that the following expression is verified by constructing the truth tables.

$$A + A'B = A + B.$$

Input			Output
A	A'	B	$A + A'B$
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1

Input		Output
A	B	$A + B$
0	0	0
0	1	1
1	0	1
1	1	1

18

PROBLEM 4 (8 Points)

Simplify the Boolean expression $(A+B+C)(D+E)' + (A+B+C)(D+E)$ and choose the best answer. Show your work.

- (a) $A+B+C$ (b) $D+E$ (c) $A'B'C'$ (d) $D'E'$ (e) None of these

original

$$(A+B+C)(D+E)' + (A+B+C)(D+E)$$

$$(A+B+C)[(D+E)' + (D+E)]$$

$= \boxed{A+B+C}$ $= 1$

8

Name: _____

PROBLEM 5 (8 Points)

Simplification of the Boolean expression $(A + B)'(C + D + E)' + (A + B)'$ yields which of the following results? Use the Boolean Algebra Rules. Show your work.

- (a) $A+B$ (b) $A'B'$ (c) $C+D+E$ (d) $C'D'E'$ (e) $A'B'C'D'E'$

$$(A+B)'[(C+D+E)'+1] = (A+B)'$$

$$= \boxed{A' \cdot B'}$$

PROBLEM 6 (8 Points)

Given that $F = A'B' + C' + D' + E'$, which of the following represent the only correct expression for F' ? Use the Boolean Algebra Rules. Show your work.

- (a) $A+B+C+D+E$ (b) $ABCDE$ (c) $AB(C+D+E)$ (d) $AB+C'+D'+E'$ (e) $(A+B)CDE$

$$F = \overline{A} \overline{B} + \overline{C} + \overline{D} + \overline{E}$$

$$F' = \overline{\overline{A} \overline{B} + \overline{C} + \overline{D} + \overline{E}}$$

$$= (\overline{\overline{A} \overline{B}}) \cdot \overline{\overline{C}} \cdot \overline{\overline{D}} \cdot \overline{\overline{E}}$$

$$= (\overline{\overline{A}} + \overline{\overline{B}}) \cdot C \cdot D \cdot E$$

$$= (A+B)CDE$$

PROBLEM 7 (8 Points)

Simplification of the Boolean expression $AB + ABC + ABCD + ABCDE + ABCDEF$ yields which of the following results? Use the Boolean Algebra Rules. Show your work.

- (a) $ABCDEF$ (b) AB (c) $AB+CD+EF$ (d) $A+B+C+D+E+F$ (e) $A'B'C'D'E'$

$$AB + ABC + ABCD + ABCDE + ABCDEF$$

$$= AB + ABC[1+D] + AB[CD+DE+EF]$$

$$= AB + ABC + ABCDE = AB + ABC[1+DE]$$

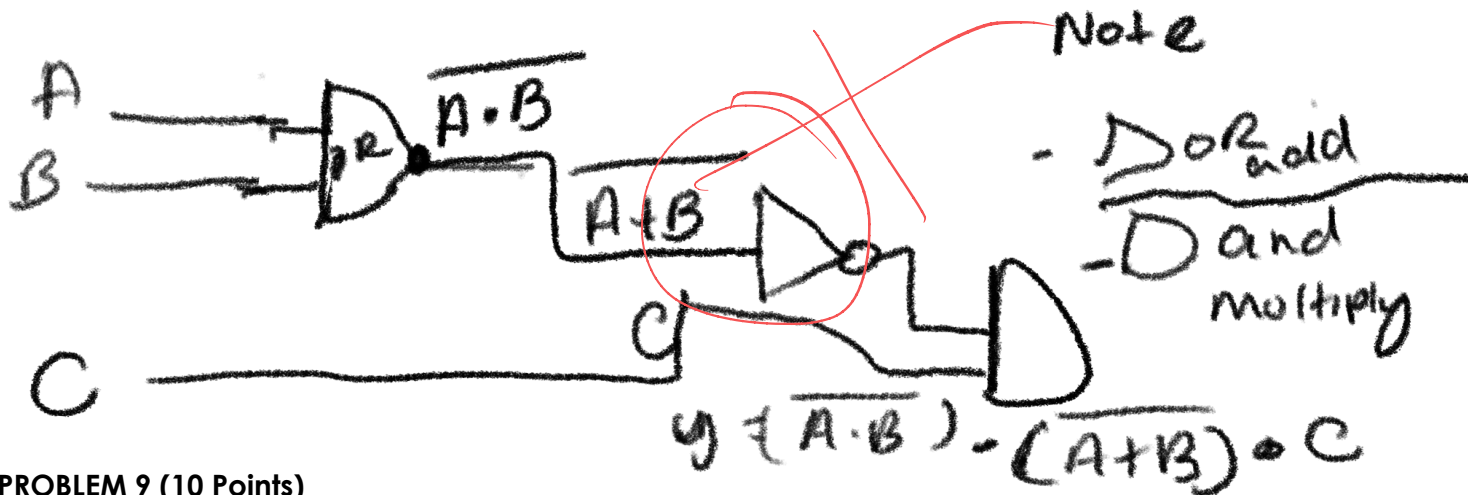
$$= AB + ABC = ABC[1+C] = AB$$

Name: _____

PROBLEM 8 (10 Points)

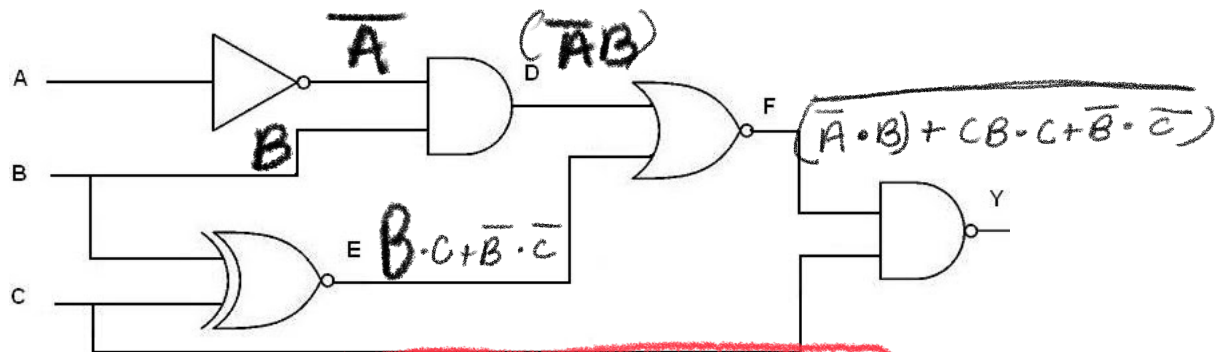
Construct a logic circuit whose output is the following expression:

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



PROBLEM 9 (10 Points)

Compute the output Y for the logic circuit below. Show the output at each stage.



$$Y = (\overline{A} \cdot B) \cdot (B \cdot C + \overline{B} \cdot \overline{C})$$

Show work!

Name: Emmanuel Batwe

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
ROY G. PERRY COLLEGE OF ENGINEERING
PRAIRIE VIEW A&M UNIVERSITY
ELEG 2315 – SPRING 2022
FINAL EXAMINATION
THURSDAY, MAY 5, 2022
Total: 100 Points

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Examination will be released at 8:00 AM on Canvas.

Your work must be submitted by 8:00 PM to Canvas.

Once you access the exam, you will have 3 hours (180 minutes) to submit. Your latest attempt should be no later than 5:00 PM.

Your work must be shown on these sheets. Not on blank paper.

Submissions on blank paper will not be graded.

You are expected to find the information needed on your own.

READ THIS CAREFULLY AND SIGN BELOW

Academic honesty and integrity are essential principles of Prairie View A&M University and engineering as a profession. All PVAMU students are expected to behave as honest and responsible members of an academic community.

Engineering students have an even greater responsibility to maintain the highest level of academic honesty and integrity as they prepare to enter a profession with those principles as a cornerstone.

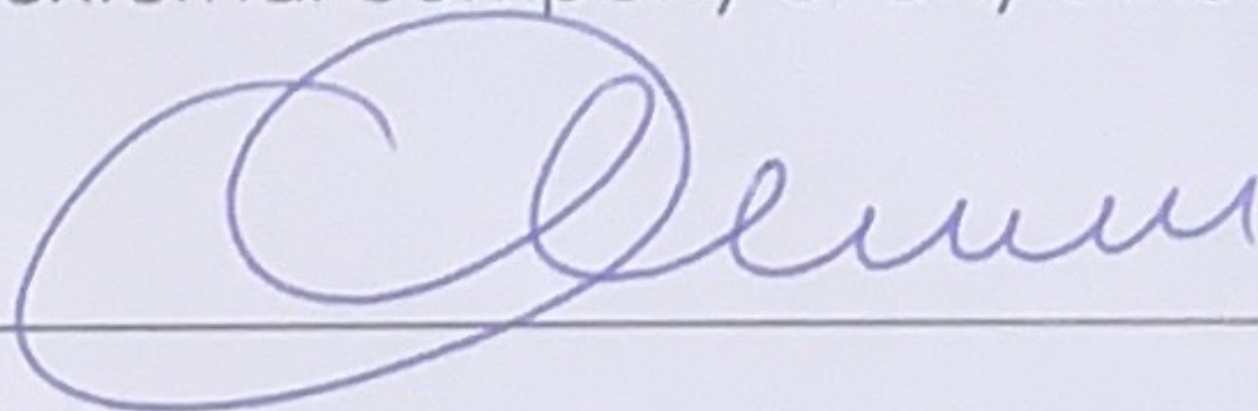
Cheating on exams or projects, plagiarizing or any other form of academic dishonesty are clear violations of these principles.

As a student of the College of Engineering at PVAMU, I solemnly pledge to follow the policies principles, rules, and guidelines of the University with respect to academic honesty.

By signing this pledge I promise to uphold the highest standards of ethics and academic integrity as a future engineer.

I will abide by the rules my instructor has provided for this examination and will not violate the university's policy regarding Academic Misconduct. This means that I will only use the information provided by my instructor and will not use any other outside assistance (an external company or any other people including my peers).

Signature: _____



Name: _____

PROBLEM 1 (20 Points)

Perform the following decimal to binary and binary to decimal conversions. Show your work.

Decimal	Binary
97	1100001
119	1110111
157	10011101
314	100111010
412	110011100
231	11100111
275	100010011
463	111001111
168	10101000
384	110000000

97 - 48 - 1
 48 - 24 - 0
 24 - 12 - 0
 12 - 6 - 0
 6 - 3 - 0
 3 - 1 - 1
 1 - 0 - 1

119 - 59 - 1
 59 - 29 - 1
 29 - 14 - 1
 14 - 7 - 0
 7 - 3 - 1
 3 - 1 - 1
 1 - 0 - 1

157 - 78 - 1
 78 - 39 - 0
 39 - 19 - 1
 19 - 9 - 1
 9 - 4 - 1
 4 - 2 - 0
 2 - 1 - 0
 1 - 0 - 1

314 - 157 - 0
 157 - 78 - 0
 78 - 39 - 0
 39 - 19 - 1
 19 - 9 - 1
 9 - 4 - 1
 4 - 2 - 0
 2 - 1 - 0
 1 - 0 - 1

412 - 206 - 0
 206 - 103 - 0
 103 - 51 - 1
 51 - 25 - 1
 25 - 12 - 1
 12 - 6 - 0
 6 - 3 - 0
 3 - 1 - 1
 1 - 0 - 1

20

Name: _____

SCRATCH SHEET FOR PROBLEM 1

$$\begin{array}{rcl}
 231 & - & 115 & - & 1 \\
 115 & - & 57 & - & 1 \\
 57 & - & 28 & - & 1 \\
 28 & - & 14 & - & 0 \\
 14 & - & 7 & - & 0 \\
 7 & - & 3 & - & 1 \\
 3 & - & 1 & - & 1 \\
 1 & - & 0 & - & 1
 \end{array}$$

$$\begin{array}{rcl}
 275 & - & 137 & - & 1 \\
 137 & - & 68 & - & 1 \\
 68 & - & 34 & - & 0 \\
 34 & - & 17 & - & 0 \\
 17 & - & 8 & - & 1 \\
 8 & - & 4 & - & 0 \\
 4 & - & 2 & - & 0 \\
 2 & - & 1 & - & 0 \\
 1 & - & 0 & - & 1
 \end{array}$$

$$\begin{array}{rcl}
 463 & - & 231 & - & 1 \\
 231 & - & 115 & - & 1 \\
 115 & - & 57 & - & 1 \\
 57 & - & 28 & - & 1 \\
 28 & - & 14 & - & 0 \\
 14 & - & 7 & - & 0 \\
 7 & - & 3 & - & 1 \\
 3 & - & 1 & - & 1 \\
 1 & - & 0 & - & 1
 \end{array}$$

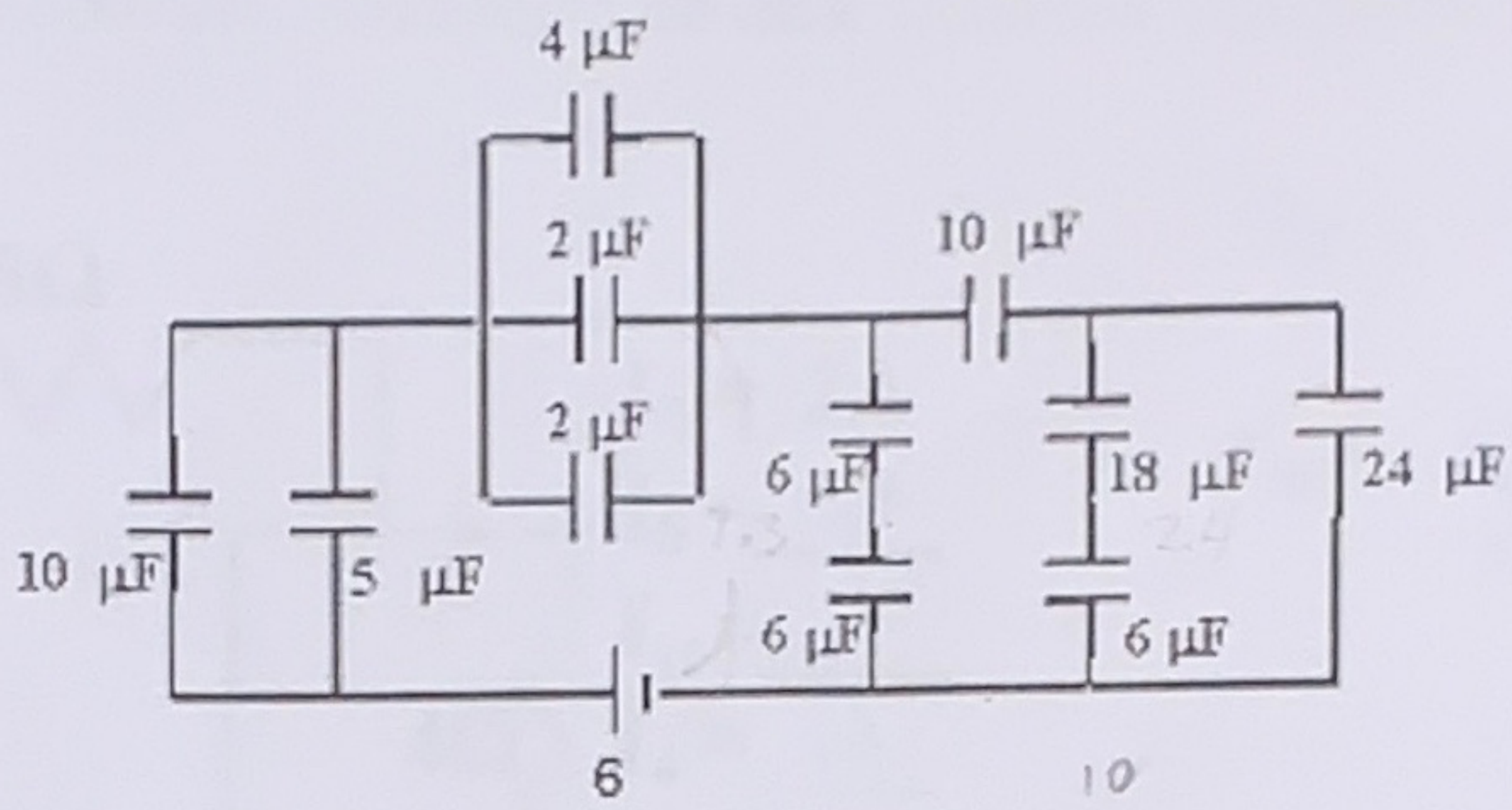
$$\begin{array}{rcl}
 168 & - & 84 & - & 0 \\
 84 & - & 42 & - & 0 \\
 42 & - & 21 & - & 0 \\
 21 & - & 10 & - & 1 \\
 10 & - & 5 & - & 0 \\
 5 & - & 2 & - & 1 \\
 2 & - & 1 & - & 0 \\
 1 & - & 0 & - & 1
 \end{array}$$

$$\begin{array}{rcl}
 384 & - & 192 & - & 0 \\
 192 & - & 96 & - & 0 \\
 96 & - & 48 & - & 0 \\
 48 & - & 24 & - & 0 \\
 24 & - & 12 & - & 0 \\
 12 & - & 6 & - & 0 \\
 6 & - & 3 & - & 0 \\
 3 & - & 1 & - & 1 \\
 1 & - & 0 & - & 1
 \end{array}$$

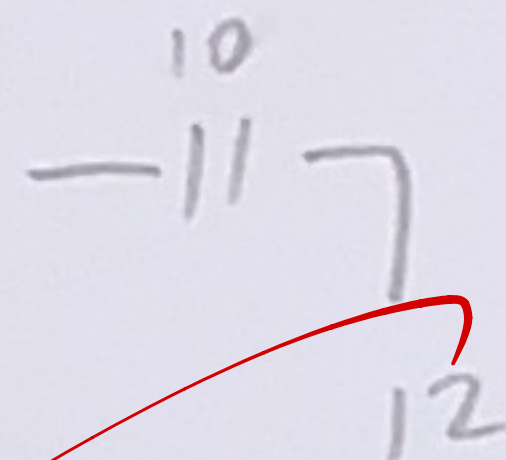
Name: _____

PROBLEM 2 (10 Points)

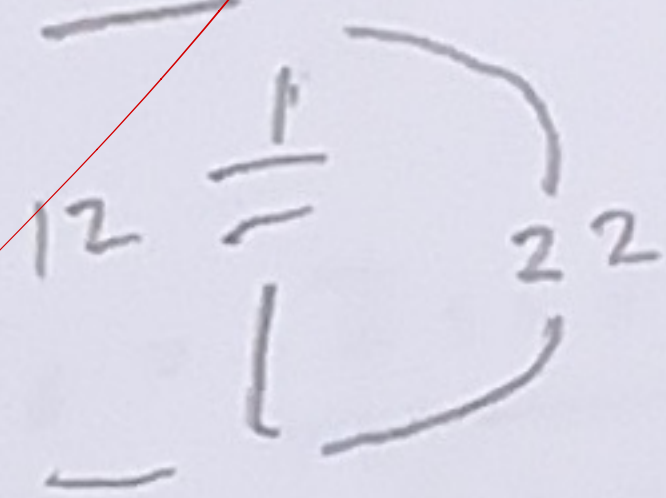
Compute the equivalent capacitance of the following circuit.



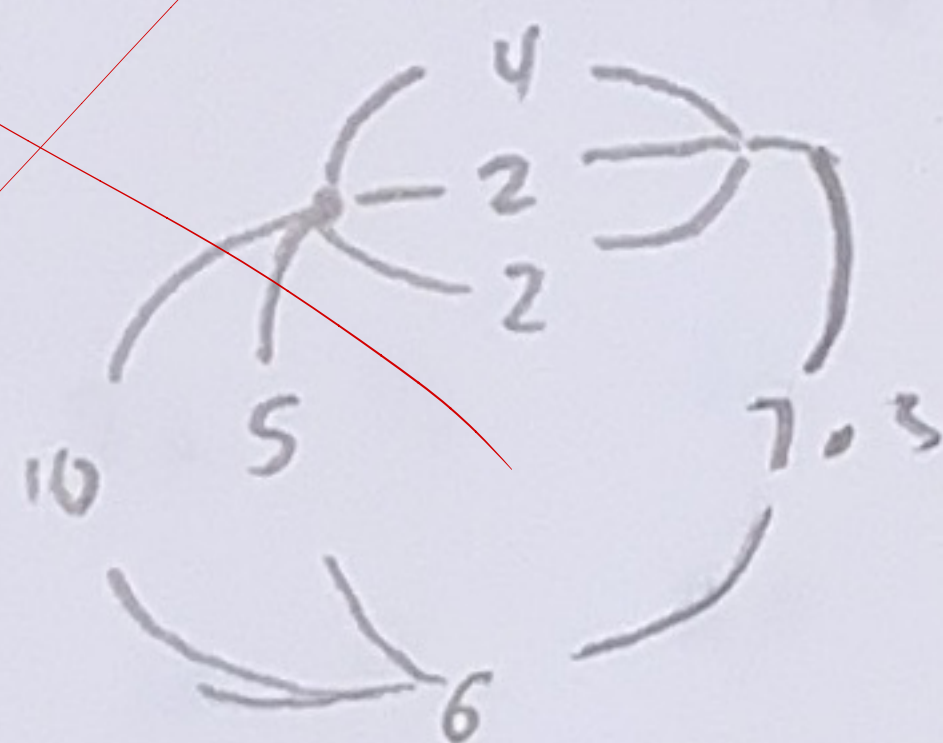
$$\frac{24 \times 24}{24 + 24} = 12$$



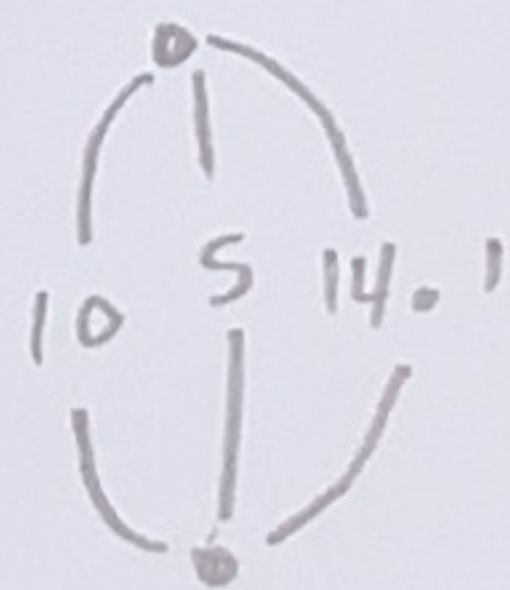
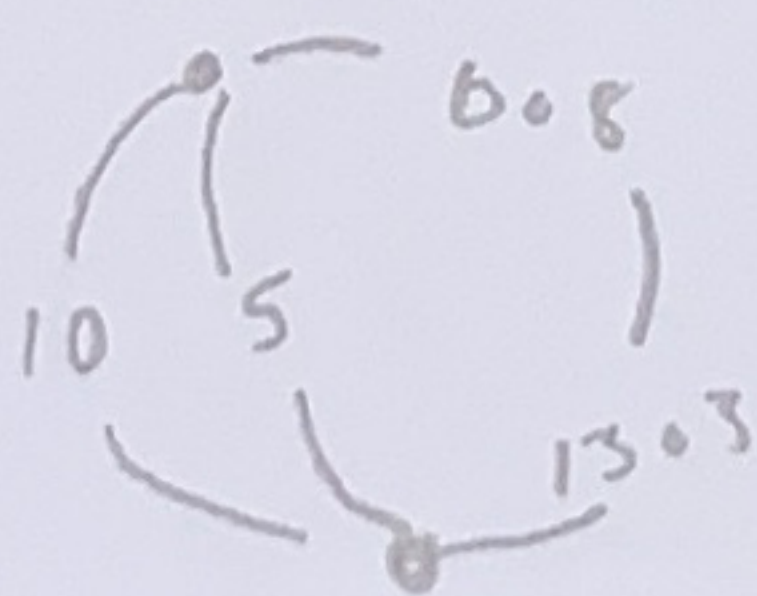
$$22 \mu F$$



$$\frac{12 \times 22}{12 + 22}$$



$$7.3 + 6 = 13.3$$



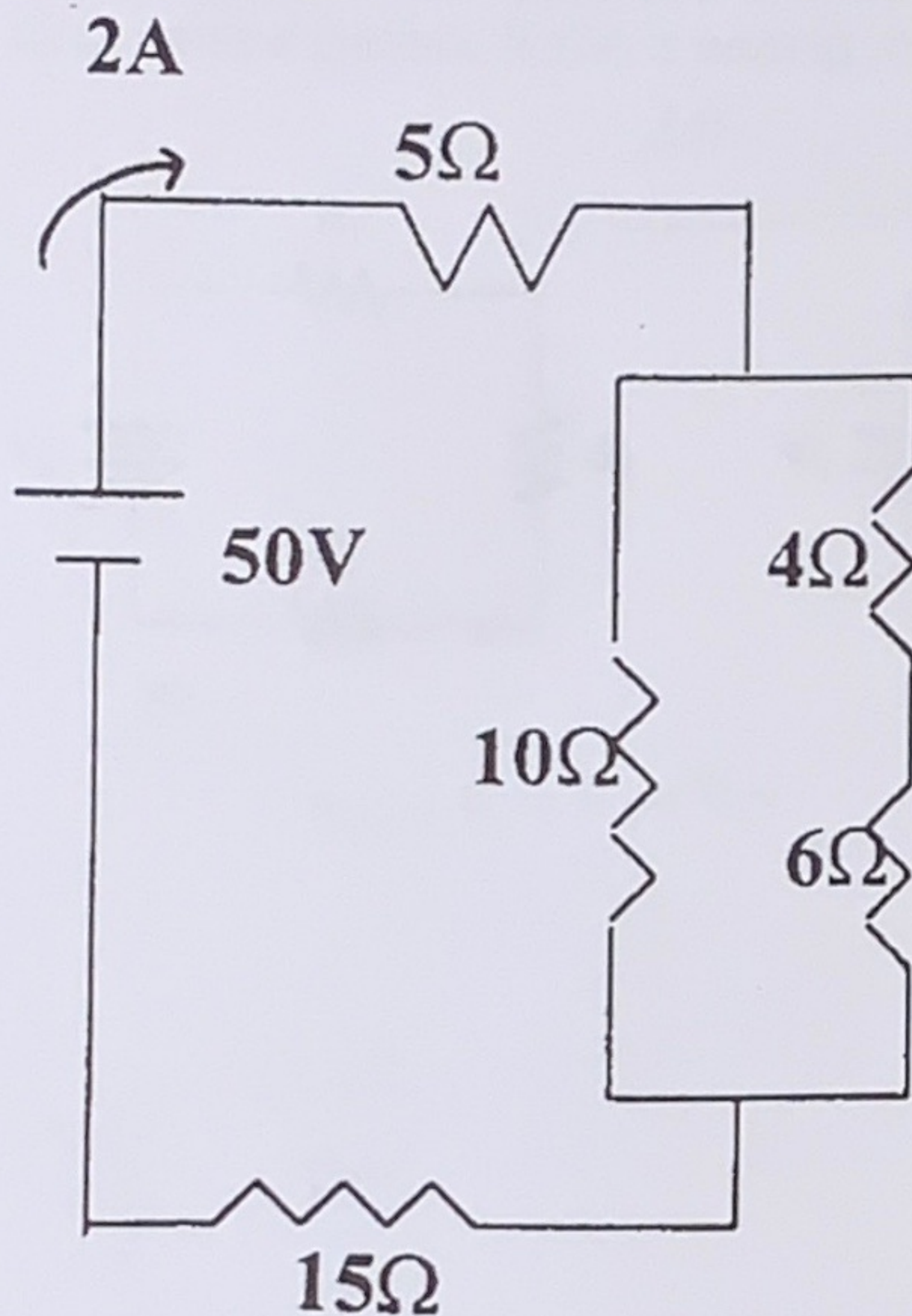
$$\frac{5 \times 14.1}{5 + 14.1} = 3.69$$

$$\frac{10 \times 3.69}{10 + 3.69} = 2.76$$

Name: _____

PROBLEM 3 (10 Points)

In the circuit below, find all the currents. Before you start writing down equations, study the circuit carefully. You should be able to do the calculation in your head.



$$\begin{aligned} I_T &= 2A \\ I_5 &= 2A \\ I_{10} &= 1A \\ I_4 &= 1A \\ I_6 &= 1A \\ I_{15} &= 2A \end{aligned}$$

$$I_5 = I_2 = 2A$$

$$I_{10} = \frac{I_{5\Omega} \times (4+6)}{4+6+10}$$

$$= \frac{2 \times 10}{20} = \frac{20}{20} = 1$$

$$I_{10} = 1$$

$$I_4 = I_6 = \frac{I_{5\Omega} \times 10}{10+4+6} = \frac{20}{20} = 1A$$

$$I_{10} + I_6 = I_{15}$$

$$1A + 1A = 2A$$

$$I_{15} = 2A$$

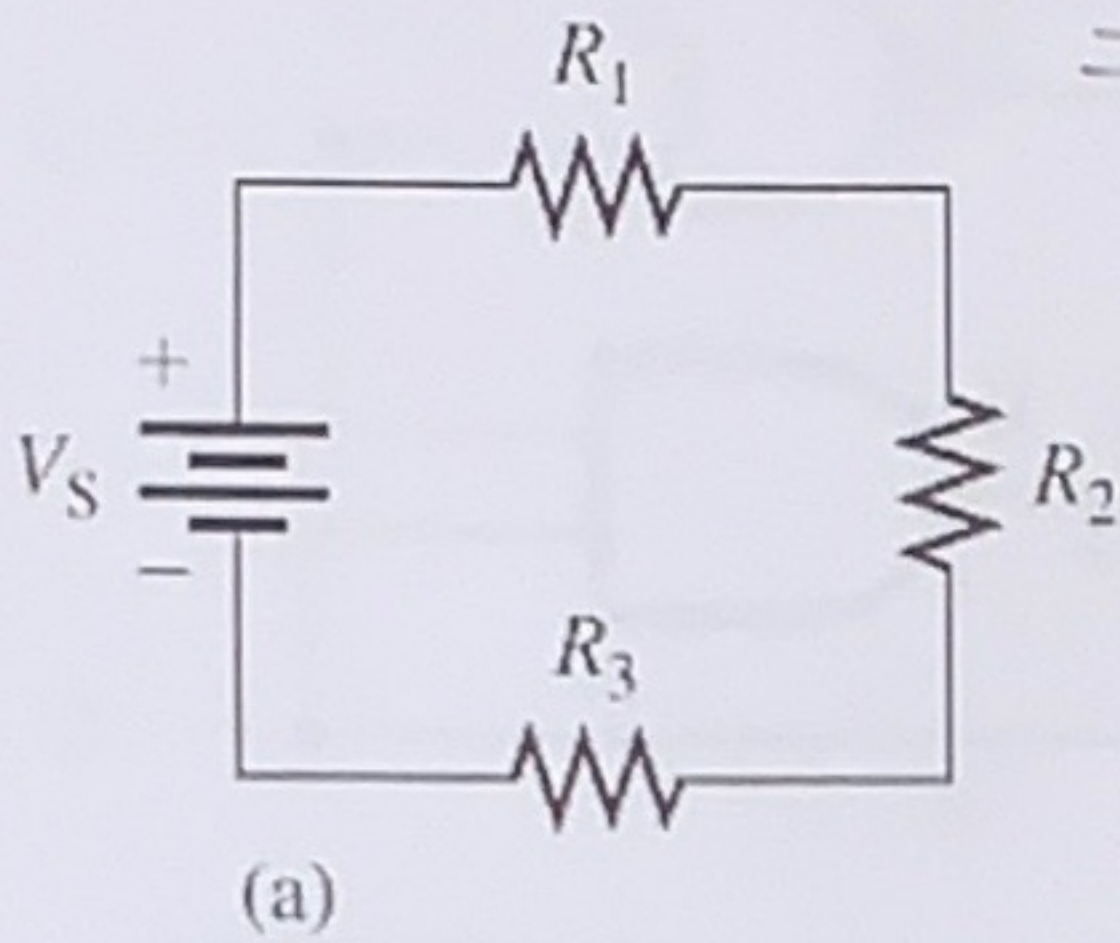
10

Name: _____

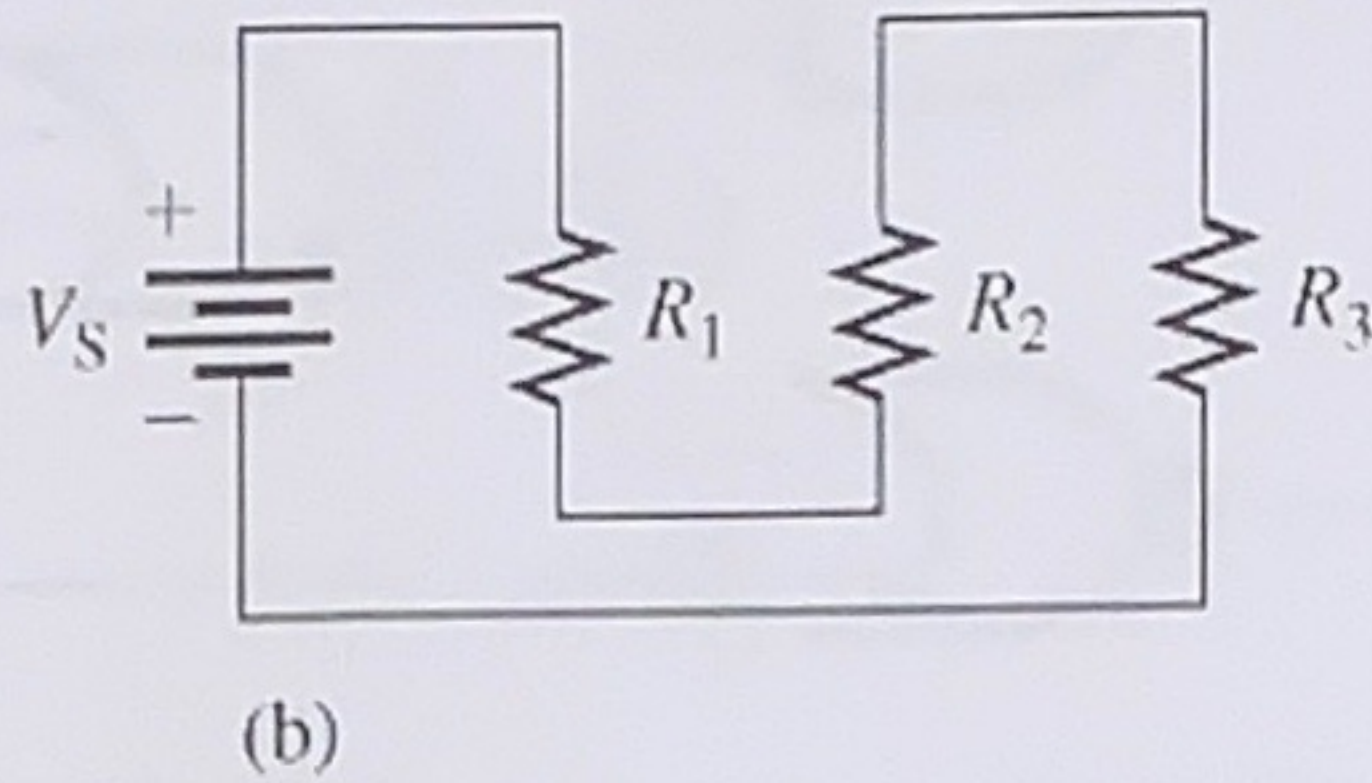
PROBLEM 4 (3 Points)

Look at the circuit below with three connected resistors. A student claims that only one of these circuits has the resistors connected in series while the other two do not. Is she correct? If you think she is, calculate the equivalent resistance for each circuit and write it below. If she is wrong, how would you correct her claim?

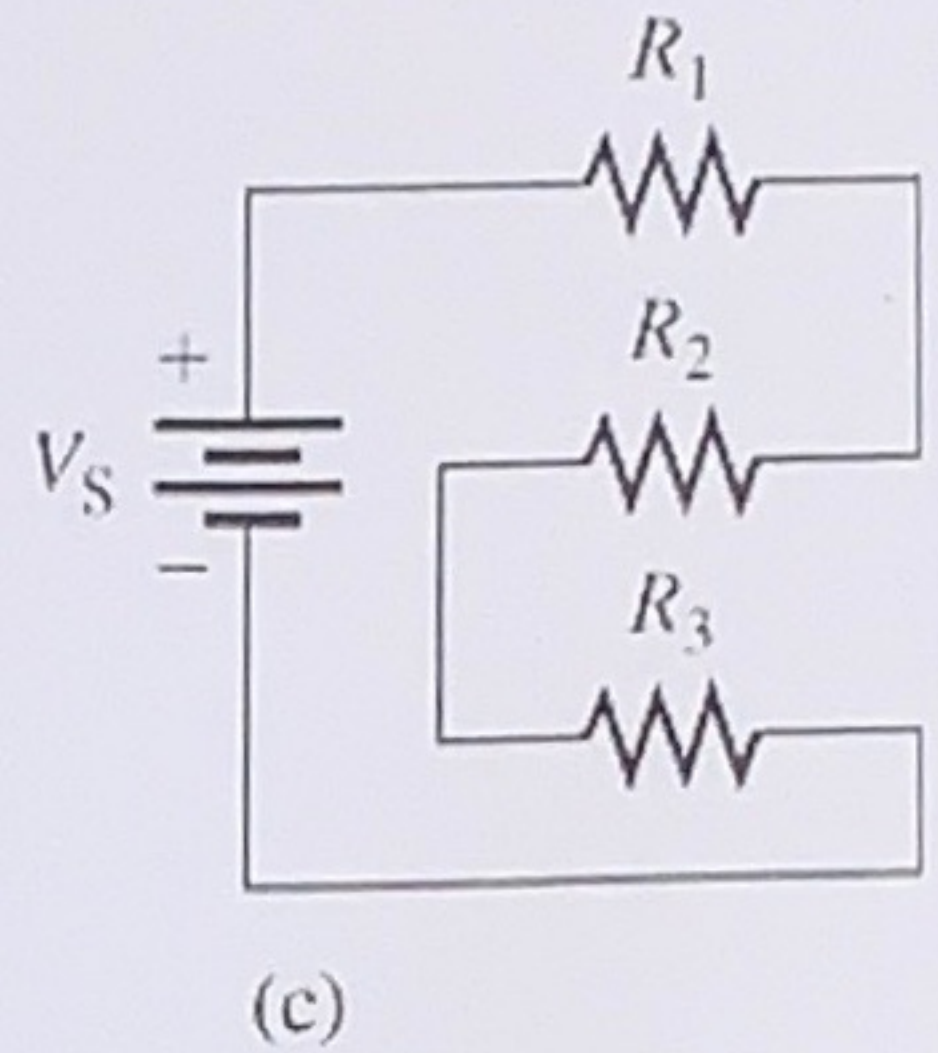
All are series.



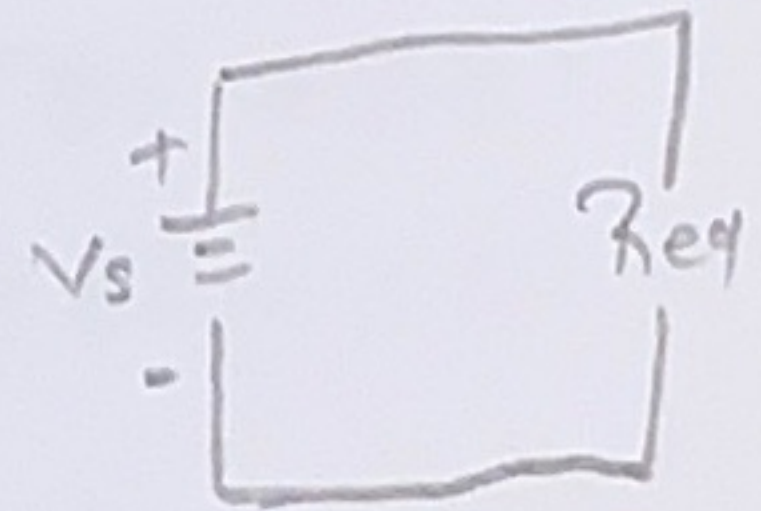
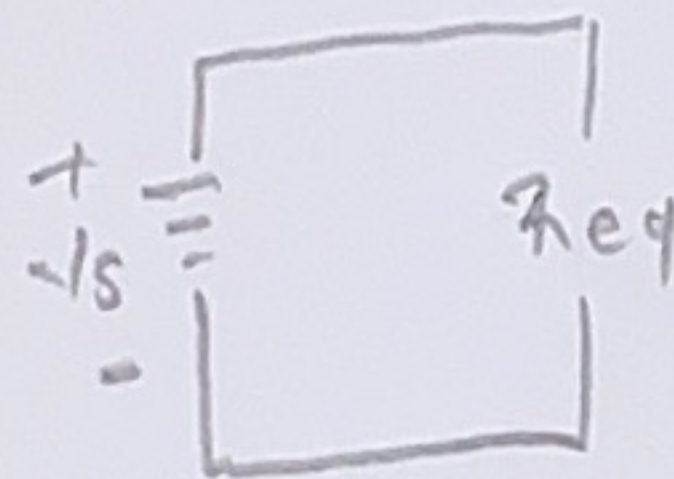
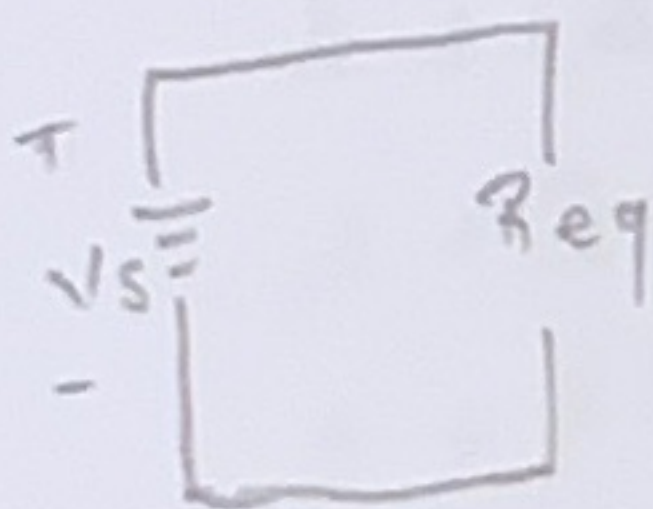
$$R_{eq} = R_1 + R_2 + R_3$$



$$R_{eq} = R_1 + R_2 + R_3$$



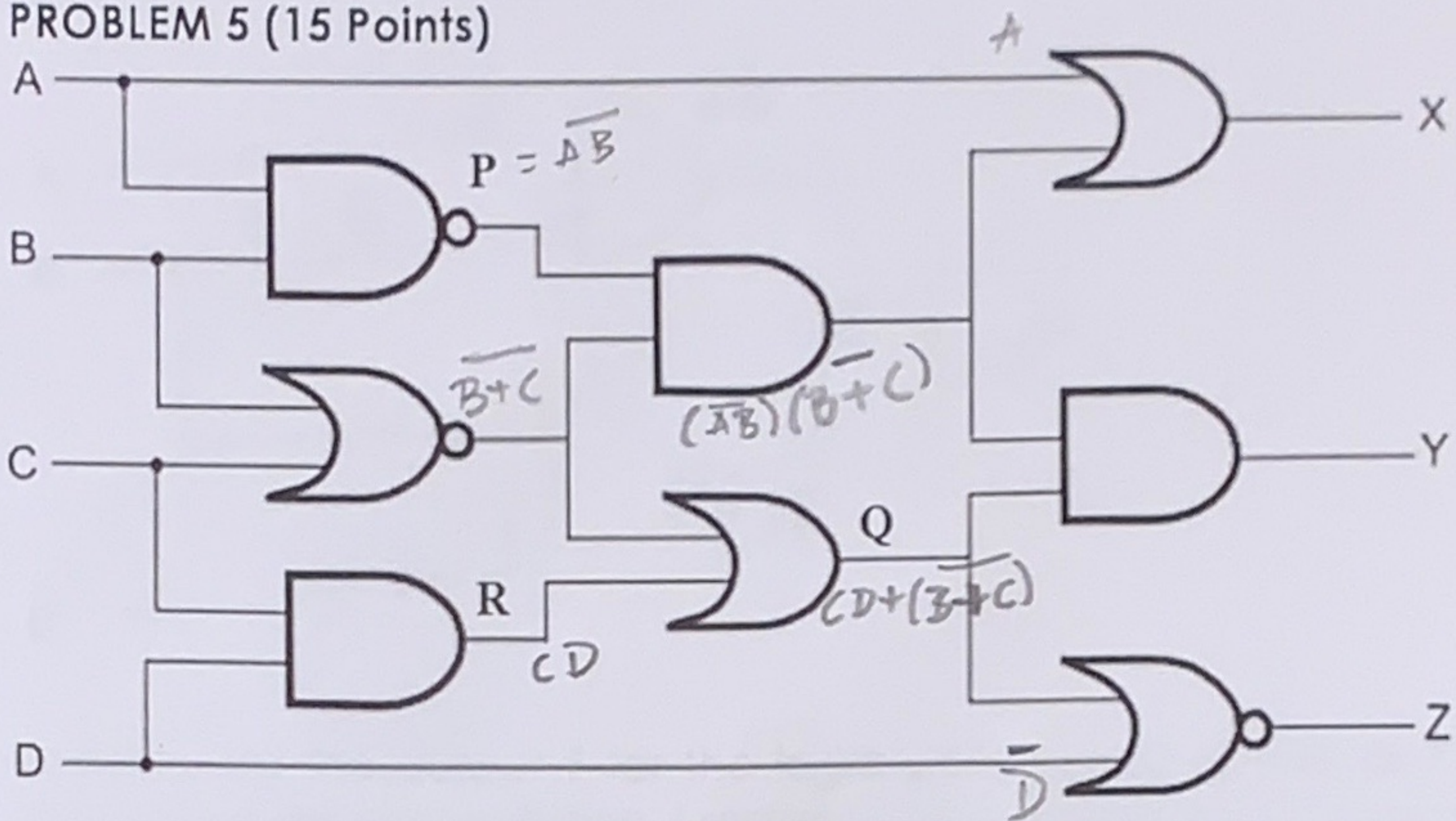
$$R_{eq} = R_1 + R_2 + R_3$$



3

Name: _____

PROBLEM 5 (15 Points)



Write the Boolean expression for output X, Y and Z in terms of the input A, B, C, D.

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

$$A + (\overline{A} + \overline{B})(\overline{B}\overline{C})$$

$$A + \overline{A}\overline{B}\overline{C} + \overline{B}\overline{B}\overline{C}$$

$$A + \overline{A}\overline{B}\overline{C} + \overline{B}\overline{C}$$

$$A + \overline{B}\overline{C}(\overline{A} + 1)$$

$$A + \overline{B}\overline{C} (1)$$

$$X = A + \overline{B}\overline{C}$$

$$Y = (\overline{A}B)(\overline{B} + \overline{C}) \cdot (CD + (\overline{B} + \overline{C}))$$

$$(\overline{A} + \overline{B})(\overline{B}\overline{C})(\overline{B}\overline{C} + CD)$$

$$(\overline{A}\overline{B}\overline{C} + \overline{B}\overline{B}\overline{C})(\overline{B}\overline{C} + CD)$$

$$(\overline{B}\overline{C})(\overline{B}\overline{C} + CD)$$

$$\overline{B}\overline{C}\overline{B}\overline{C} + \overline{B}\overline{C}CD$$

$$\overline{C} \cdot C = 0$$

$$Y = \overline{B}\overline{C}$$

$$Z = \overline{CD + (\overline{B} + \overline{C}) + D}$$

$$= \overline{\overline{B}\overline{C} + CD} \cdot \overline{D}$$

$$(\overline{\overline{B}\overline{C}} \cdot \overline{CD}) \cdot \overline{D}$$

$$(BC \cdot \overline{CD}) \cdot \overline{D}$$

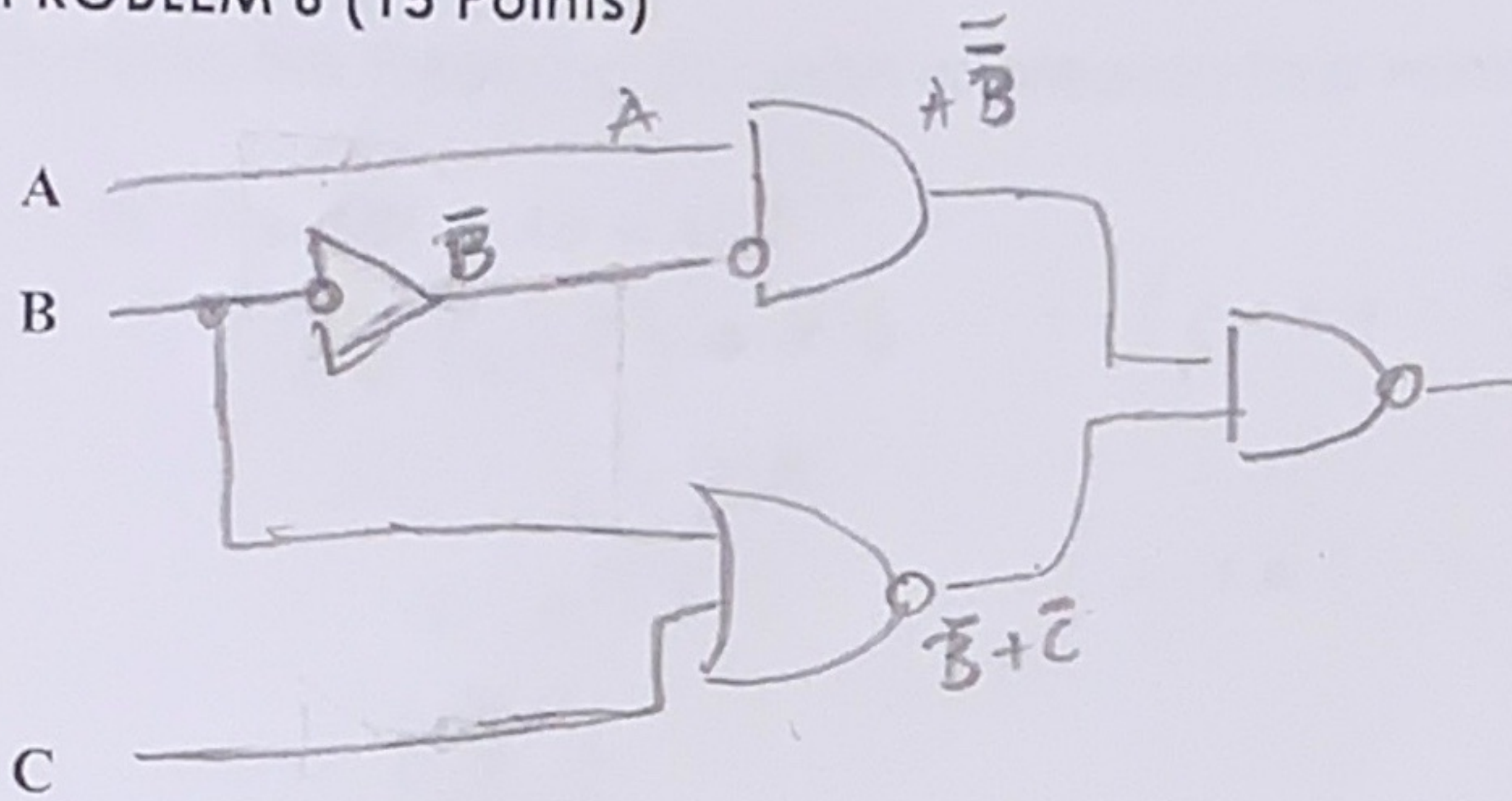
$$Z = \overline{BC \cdot \overline{CD} \cdot \overline{D}}$$

$$C \cdot \overline{C} = 0$$

13

Name: _____

PROBLEM 6 (15 Points)



I computed the output **F** for the logic gate layout above as $F = \overline{A\bar{B}(B + \bar{C})}$. When I rechecked my computation, I realized the expression is incorrect. identify the errors in the expression and write the correct expression for output **F**. Can you spot the error(s) in my first computation?



@

Name: _____

PROBLEM 7 (15 Points)

Simplify the following Boolean expression to a minimum number of literals.

a. $F = ABC + \bar{A}B + ABC\bar{C}$

$$AB(C + \bar{C}) + \bar{A}B \quad (C + \bar{C}) = 1$$

$$AB(1) + \bar{A}B$$

$$B(A + \bar{A})$$

$$(A + \bar{A}) = 1$$

$$\boxed{B}$$

b. $F = \overline{(X + Y)}(\bar{X} + \bar{Y})$

$$(\bar{x}\bar{y})(\bar{x} + \bar{y})$$

$$\bar{x}\bar{y} + \bar{x}\bar{y}$$

$$\boxed{\bar{x}\bar{y}}$$

c. $F = XY + X(WZ + W\bar{Z})$

$$XY + XWZ + XW\bar{Z}$$

$$XY + XW(Z + \bar{Z})$$

$$XY + XW$$

$$\boxed{X(Y + W)}$$

15

Name: _____

Problem 8 (12 Points)

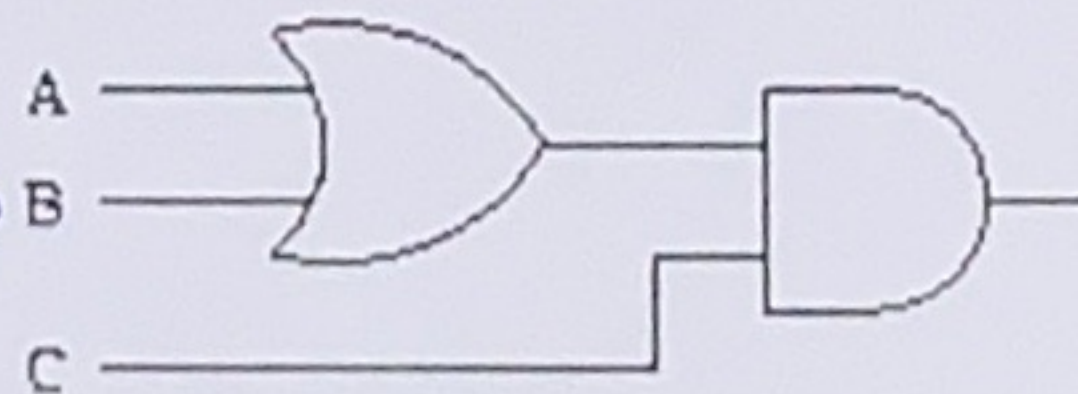
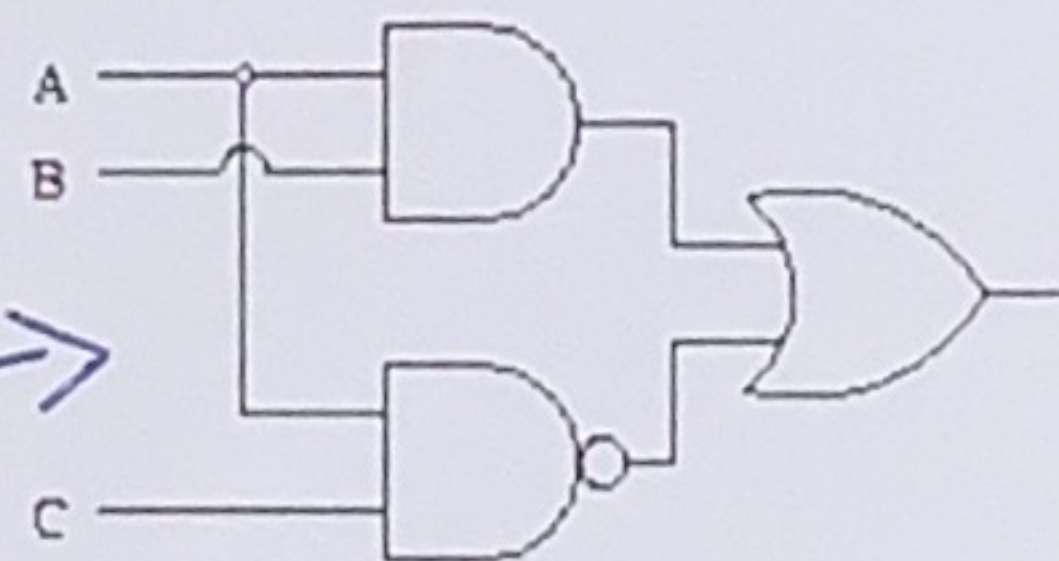
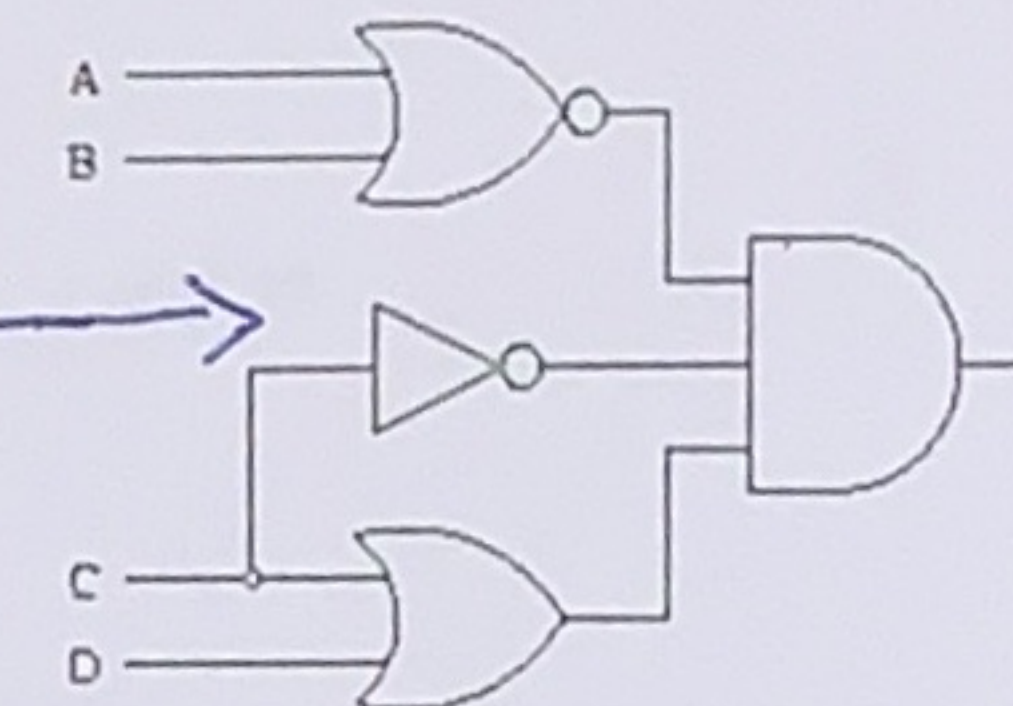
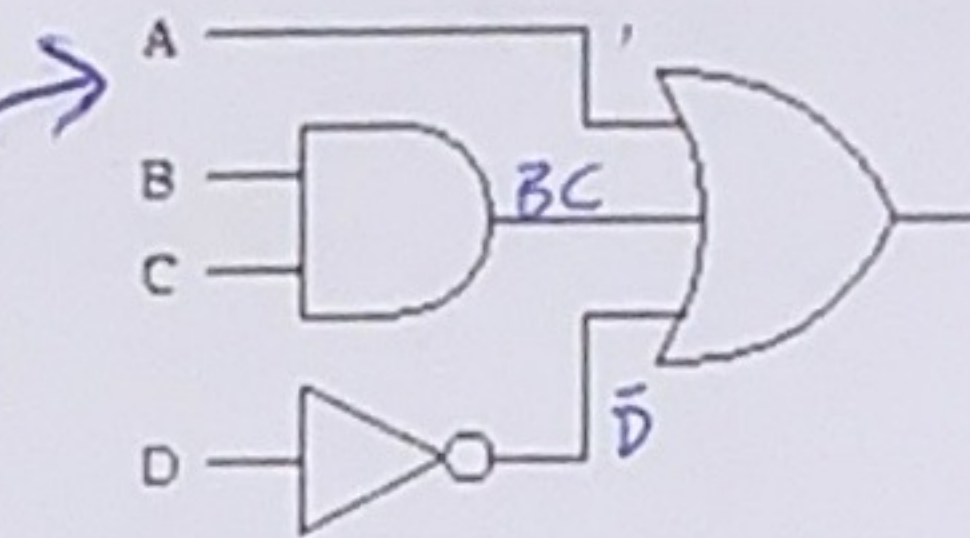
The digital logic circuits, as shown, are mismatched with their corresponding descriptions in the left column. Match the appropriate circuit with its description by drawing arrows.

Draw a logic circuit for $(A + B)C$

Draw a logic circuit for $(A + B)'(C + D)C'$

Draw a logic circuit for $A + BC + D'$

Draw a logic circuit for $AB + (AC)'$

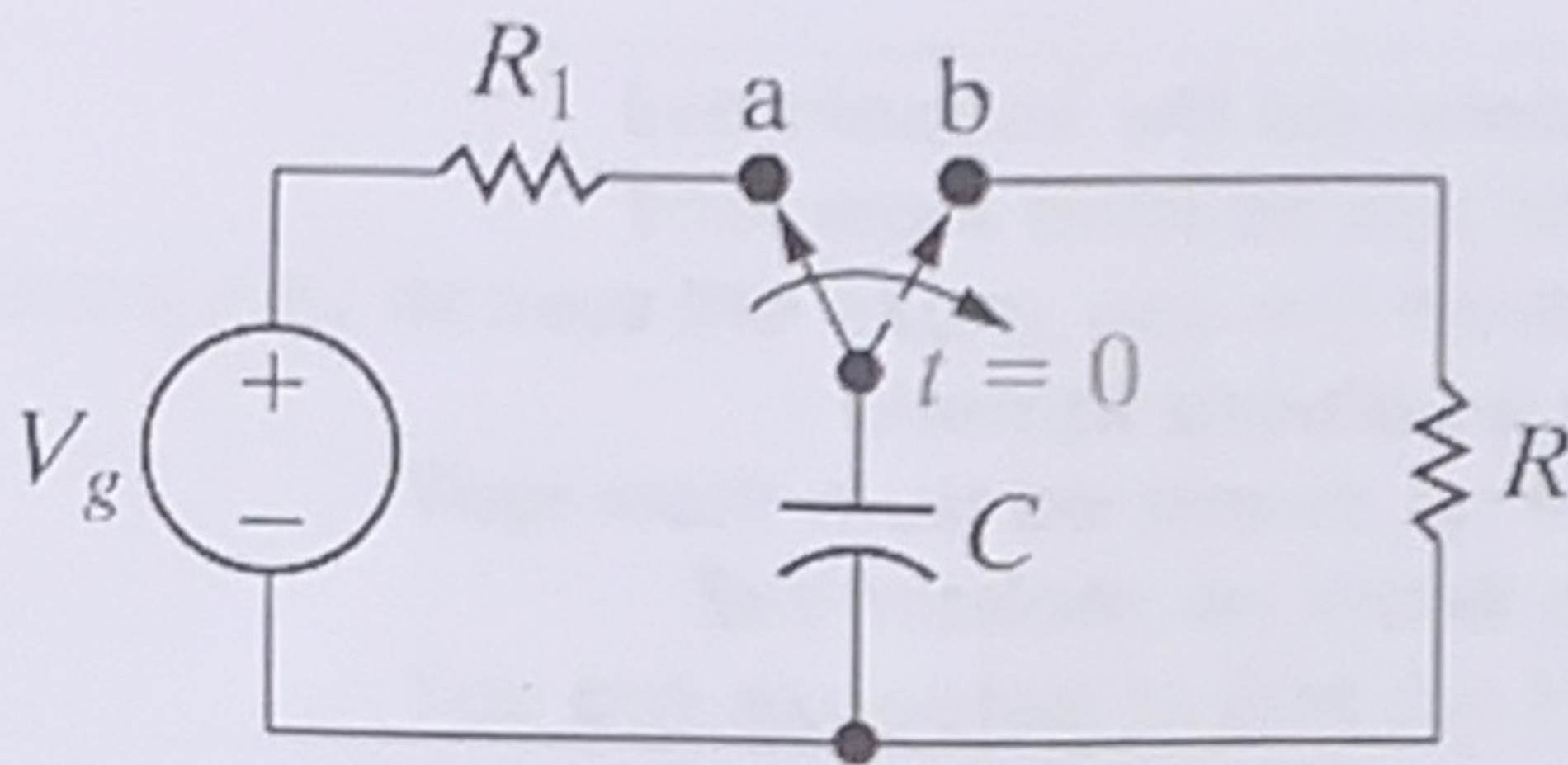


12

Name: _____

BONUS PROBLEM (15 Points)

In the circuit below, the switch has been in position "a" for a long time. At $t=0$, the switch is shifted to position "b". Calculate the time constant and write the appropriate expressions for the voltage across the capacitor below. Choose $V_g = 20$ V, $R_1 = 10$ k Ω , $R = 100$ k Ω , $C = 50$ μ F.

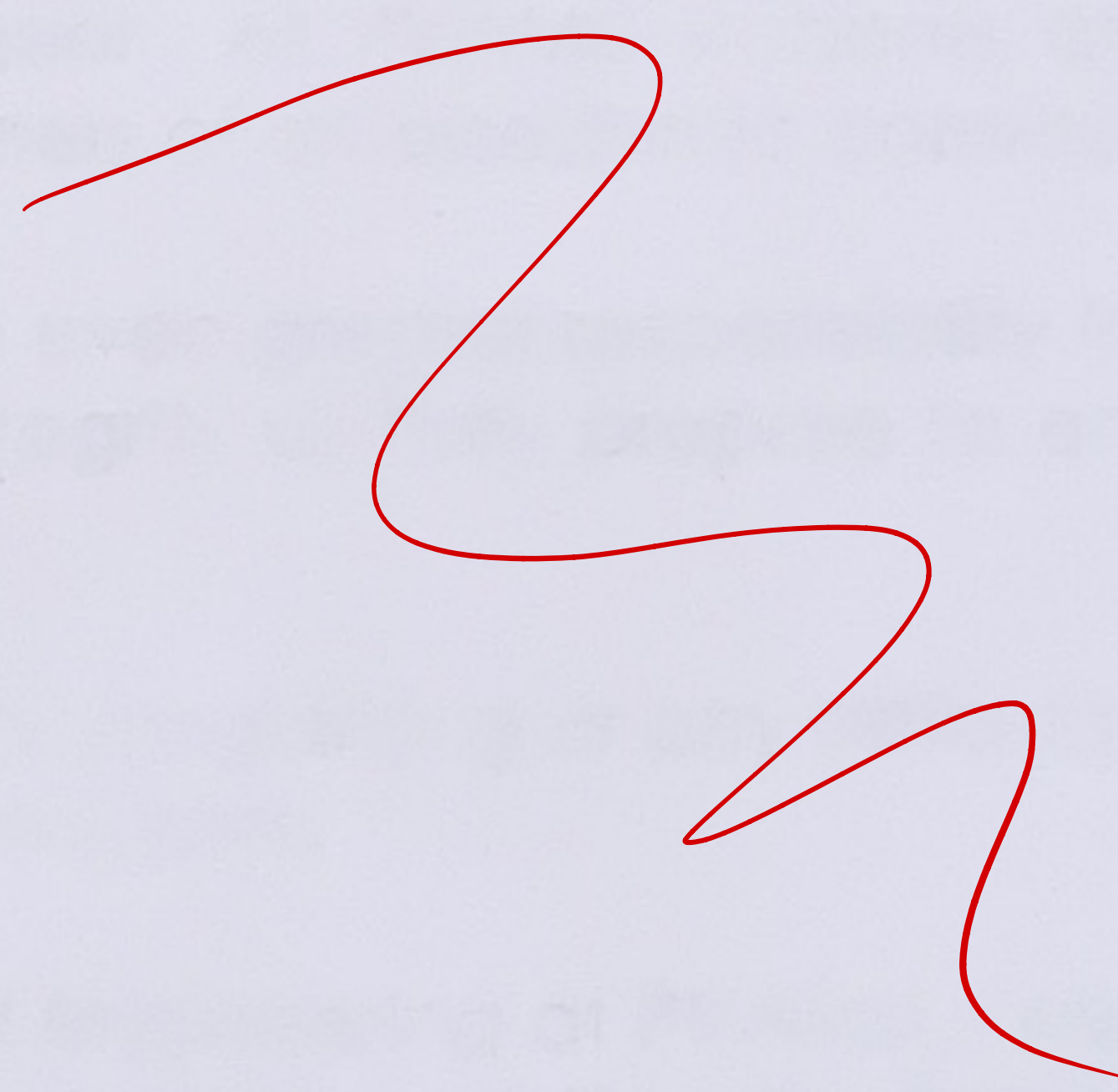


Final Answers:

$$V_c(t \rightarrow 0^-) = \underline{\hspace{2cm}}$$

$$V_c(t \rightarrow 0^+) = \underline{\hspace{2cm}}$$

$$V_c(t \rightarrow \infty) = \underline{\hspace{2cm}}$$



Name: Cameron Brown

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
ROY G. PERRY COLLEGE OF ENGINEERING
PRAIRIE VIEW A&M UNIVERSITY
ELEG 2315 – SPRING 2022
FINAL EXAMINATION
THURSDAY, MAY 5, 2022
Total: 100 Points

(90 + 8)

Examination will be released at 8:00 AM on Canvas.
Your work must be submitted by 8:00 PM to Canvas.
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Your work must be shown on these sheets. Not on blank paper.
Submissions on blank paper will not be graded.
You are expected to find the information needed on your own.

READ THIS CAREFULLY AND SIGN BELOW

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Engineering students have an even greater responsibility to maintain the highest level of academic honesty and integrity as they prepare to enter a profession with those principles as a cornerstone.

Cheating on exams or projects, plagiarizing or any other form of academic dishonesty are clear violations of these principles.

As a student of the College of Engineering at PVAMU, I solemnly pledge to follow the policies principles, rules, and guidelines of the University with respect to academic honesty.

By signing this pledge I promise to uphold the highest standards of ethics and academic integrity as a future engineer.

I will abide by the rules my instructor has provided for this examination and will not violate the university's policy regarding Academic Misconduct. This means that I will only use the information provided by my instructor and will not use any other outside assistance (an external company or any other people including my peers).

Signature: Cameron Brown

Name: _____

PROBLEM 1 (20 Points)

Perform the following decimal to binary and binary to decimal conversions. Show your work.

Decimal	Binary
97	1100001
119	1110111
157	10011101
314	100111010
412	11001100
231	11100111
295	100010011
463	111001111
168	10101000
384	110000000

Q	R
$\frac{97}{2}$	48 1
$\frac{48}{2}$	24 0
$\frac{24}{2}$	12 0
$\frac{12}{2}$	6 0
$\frac{6}{2}$	3 0
$\frac{3}{2}$	1 1
$\frac{1}{2}$	0 1

$\frac{119}{2}$	59 1
$\frac{59}{2}$	29 1
$\frac{29}{2}$	14 1
$\frac{14}{2}$	7 0
$\frac{7}{2}$	3 1
$\frac{3}{2}$	1 1
$\frac{1}{2}$	0 1

$\frac{157}{2}$	78 1
$\frac{78}{2}$	39 0
$\frac{39}{2}$	19 1
$\frac{19}{2}$	9 1
$\frac{9}{2}$	4 1
$\frac{4}{2}$	2 0
$\frac{2}{2}$	1 0
$\frac{1}{2}$	0 1

20

$$\begin{array}{r}
 314 \\
 \hline
 2
 \end{array}
 \begin{array}{r}
 157 \quad 0 \\
 78 \quad 1 \\
 39 \quad 0 \\
 19 \quad 1 \\
 9 \quad 1 \\
 4 \quad 0 \\
 2 \quad 1 \\
 1 \quad 0
 \end{array}
 \begin{array}{r}
 157 \quad 0 \\
 78 \quad 1 \\
 39 \quad 0 \\
 19 \quad 1 \\
 9 \quad 1 \\
 4 \quad 0 \\
 2 \quad 1 \\
 1 \quad 0
 \end{array}$$

Name: _____

SCRATCH SHEET FOR PROBLEM 1

$$\begin{array}{r}
 412 \\
 \hline
 2
 \end{array}
 \begin{array}{r}
 206 \quad 0 \\
 103 \quad 0 \\
 51 \quad 1 \\
 25 \quad 1 \\
 12 \quad 1 \\
 6 \quad 0 \\
 3 \quad 0 \\
 1 \quad 1 \\
 0 \quad 1
 \end{array}$$

$$\begin{array}{r}
 11100111 \\
 2^7 \quad 2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0 \\
 100010011 \\
 2^7 \quad 2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0 \\
 1111001111 \\
 2^8 \quad 2^7 \quad 2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0 \\
 101010000 \\
 2^7 \quad 2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0
 \end{array}$$

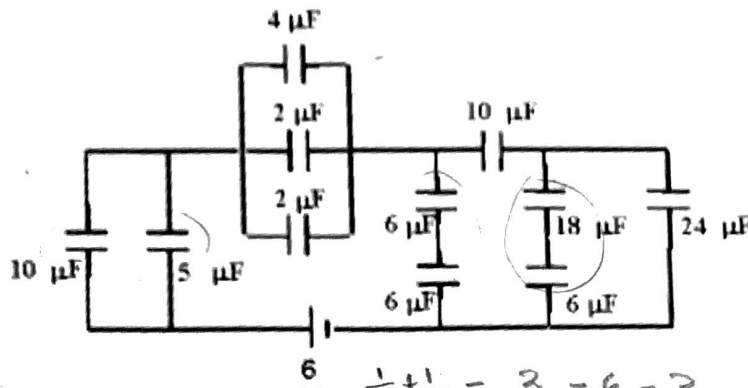
$$\begin{array}{r}
 110000000 \\
 2^6 \quad 2^7 \quad 2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0
 \end{array}$$

Name: _____

PROBLEM 2 (10 Points)

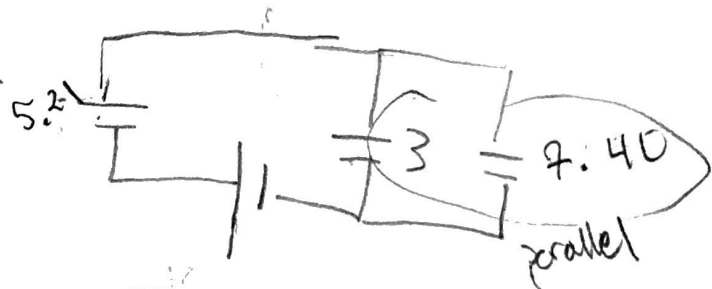
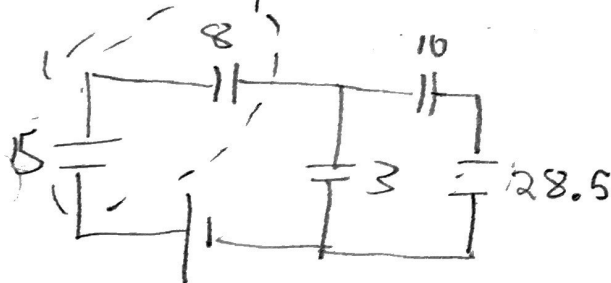
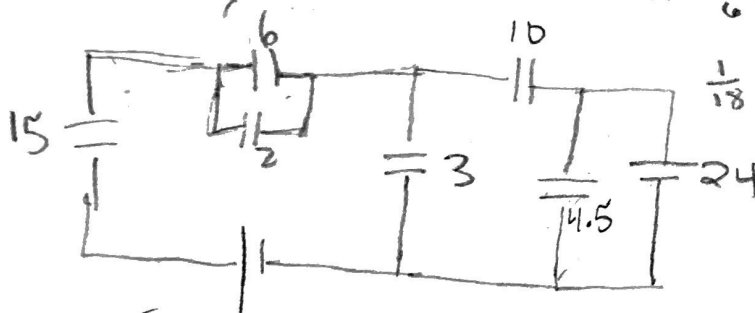
Compute the equivalent capacitance of the following circuit.

Parallel $1 + 2$
Series $\frac{1}{1} + \frac{1}{2}$



$$\frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3} = 3$$

$$\frac{1}{18} + \frac{1}{6} \Rightarrow \frac{1}{18} + \frac{3}{18} = \frac{4}{18} = \frac{18}{44} = 4.5$$



$$C_{eq} = 3.47 \mu F$$

10

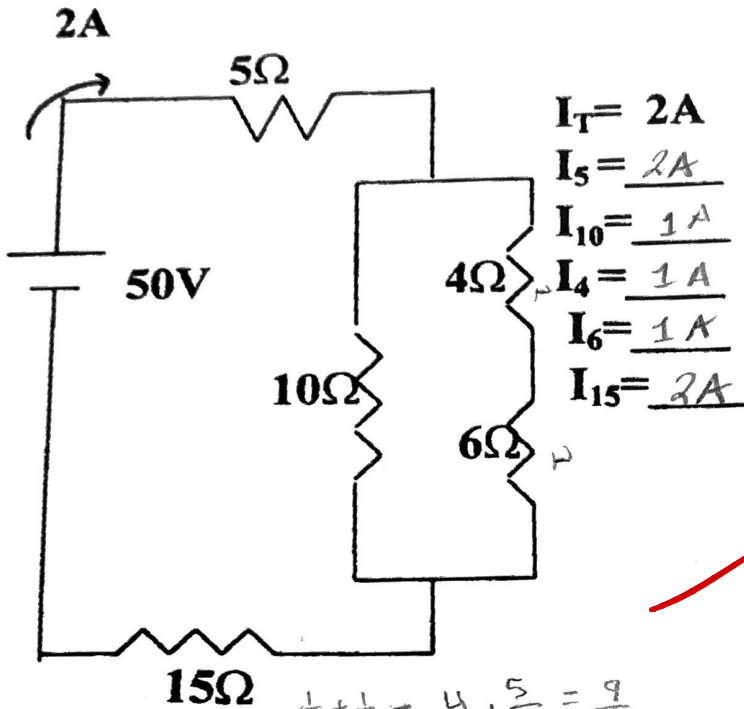
Name: _____

PROBLEM 3 (10 Points)

In the circuit below, find all the currents. Before you start writing down equations, study the circuit carefully. You should be able to do the calculation in your head.

$$V = IR$$

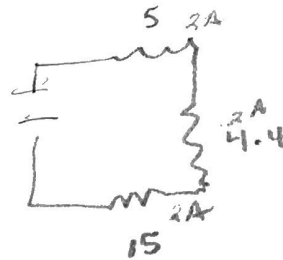
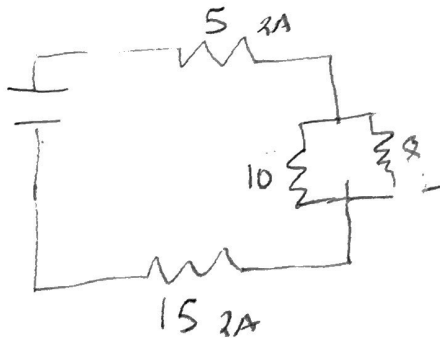
$$I = V/R$$



10

series V split, I same
|| I split

$$\frac{1}{10} + \frac{1}{8} = \frac{4}{40} + \frac{5}{40} = \frac{9}{40}$$

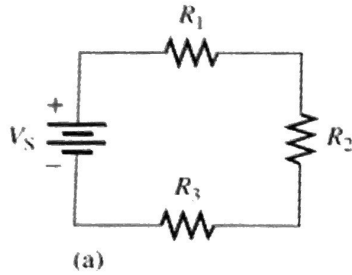


$$= 24.44 = 25 \quad 50/25 = 2A$$

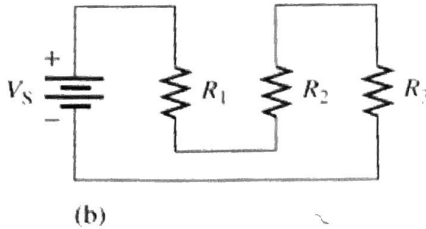
Name: _____

PROBLEM 4 (3 Points)

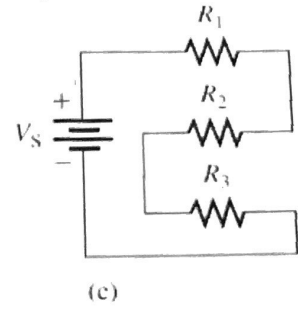
Look at the circuit below with three connected resistors. A student claims that only one of these circuits has the resistors connected in series while the other two do not. Is she correct? If you think she is, calculate the equivalent resistance for each circuit and write it below. If she is wrong, how would you correct her claim?



$$R_{eq} = R_1 + R_2 + R_3$$



$$R_{eq} = R_1 + R_2 + R_3$$



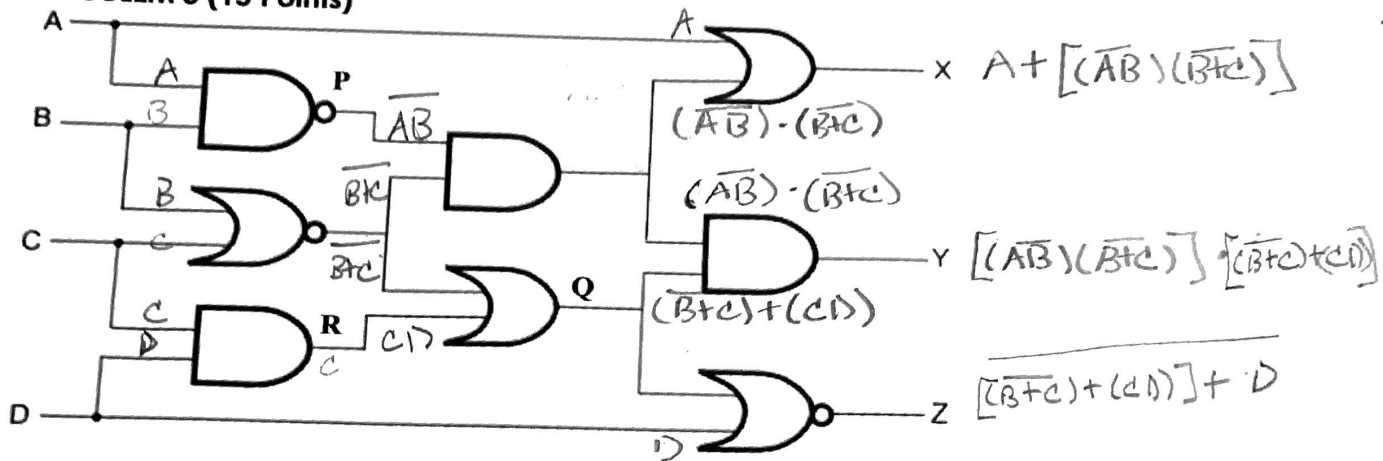
$$R_{eq} = R_1 + R_2 + R_3$$

All the circuits have the resistors connected in series because what flows through one must go through the others.

3

Name: _____

PROBLEM 5 (15 Points)



Write the Boolean expression for output X, Y and Z in terms of the input A, B, C, D.

$$X: A + [(AB)(B+c)]$$

$$Y: [(AB)(B+c)] \cdot [(B+c) + (cD)]$$

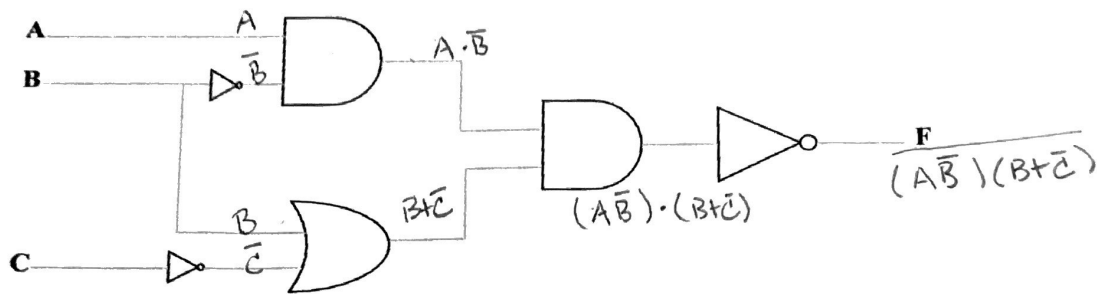
$$Z: [(B+c) + (cD)] + D$$

10

Simplify!

Name: _____

PROBLEM 6 (15 Points)



I computed the output **F** for the logic gate layout above as $F = \overline{A \cdot \overline{B}} \cdot (B + \overline{C})$. When I rechecked my computation, I realized the expression is incorrect. Identify the errors in the expression and write the correct expression for output **F**. Can you spot the error(s) in my first computation?

The correct expression is $F = \overline{A \cdot \overline{B}} \cdot (B + \overline{C})$

- ① The $\overline{B}$ entering the or gate is before $\triangleright$, so it is B not $\overline{B}$.
- ② There was an extra buffer gate added to B multiplied by it.

12

Simplify

Name: _____

PROBLEM 7 (15 Points)

Simplify the following Boolean expression to a minimum number of literals.

a. $F = ABC + \bar{A}B + AB\bar{C}$

~~$AB(C + \bar{A} + \bar{C})$~~ $C + \bar{C} = 1$
 ~~$AB(1 + \bar{A})$~~ $-$

b. $F = \overline{(X+Y)} (\bar{X} + \bar{Y})$

$(\bar{x}\bar{y})(\bar{x} + \bar{y}) = 2 \quad 3$

c. $F = XY + X(WZ + W\bar{Z}) \quad Z + \bar{Z} = 1$

$XY + X(W)$

$X(Y + W)$

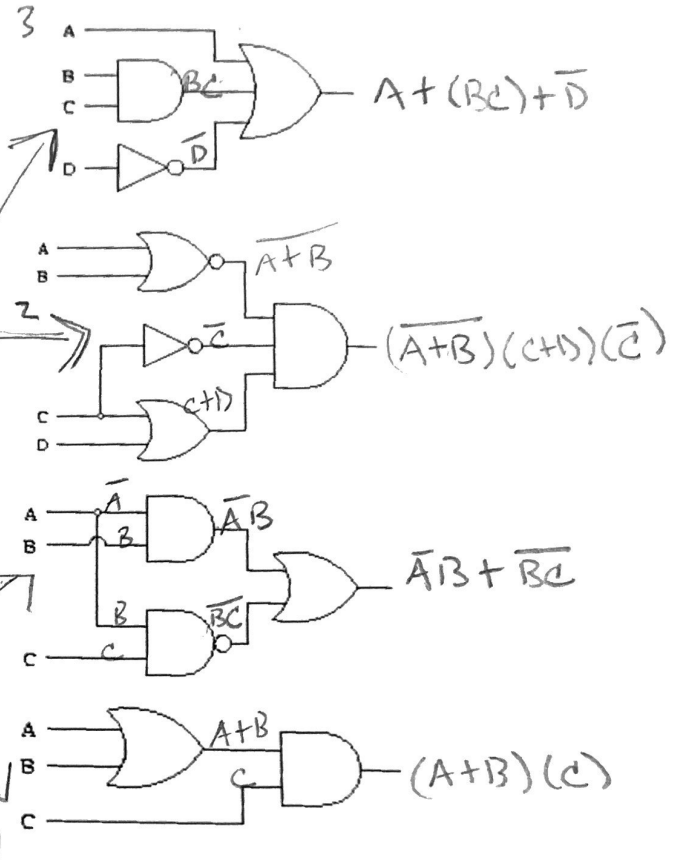
$1 \quad 5$

Name: _____

Problem 8 (12 Points)

The digital logic circuits, as shown, are mismatched with their corresponding descriptions in the left column. Match the appropriate circuit with its description by drawing arrows.

- 1 Draw a logic circuit for $(A + B)C$
- 2 Draw a logic circuit for $(A + B)'(C + D)C'$.
- 3 Draw a logic circuit for $A + BC + D'$.
- 4 Draw a logic circuit for $AB + (AC)'$.

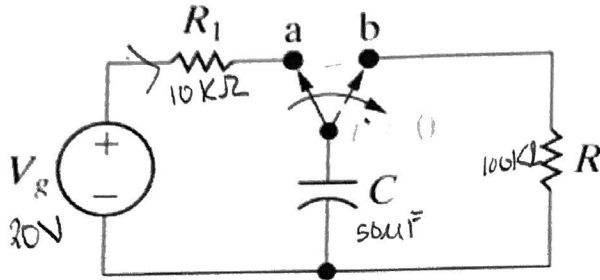


12

Name: _____

BONUS PROBLEM (15 Points)

In the circuit below, the switch has been in position "a" for a long time. At $t=0$, the switch is shifted to position "b". Calculate the time constant and then write the appropriate expressions for the voltage across the capacitor below. Choose $V_g = 20$ V, $R_1 = 10$ k Ω , $R = 100$ k Ω , $C = 50$ μ F.



Final Answers:

$$V_c(t \rightarrow 0^-) = \underline{V_c(t) = V_c(0) [1 - e^{-t/\tau}]} \quad \text{Final Answer}$$

$$V_c(t \rightarrow 0^+) = \underline{V_c(t) = V_c e^{-t/\tau}} \quad \text{Final Answer}$$

$$V_c(t \rightarrow \infty) = \underline{V_c(t \rightarrow \infty) = 20 e^{-t/\tau}} \quad \text{Final Answer}$$

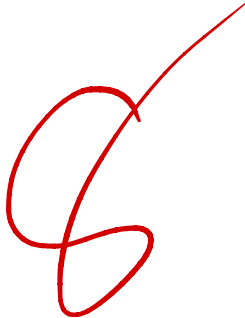
$$\tau = RC$$

$$\tau = (100)(50)$$

$$\tau = 5000$$

$$V_c(t) = V_c(0) e^{-t/\tau} \quad (\text{discharging})$$

$$V_c(t) = 20 e^{-t/\tau}$$



Name: Nash Hamilton

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
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ELEG 2315 – SPRING 2022
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THURSDAY, MAY 5, 2022
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95+13

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Cheating on exams or projects, plagiarizing or any other form of academic dishonesty are clear violations of these principles.

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By signing this pledge I promise to uphold the highest standards of ethics and academic integrity as a future engineer.

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Signature: Nash Hamilton

Name: _____

PROBLEM 1 (20 Points)

Perform the following decimal to binary and binary to decimal conversions. Show your work.

Decimal	Binary
✓ 97	✓ 1100001
✓ 119	✓ 1110111
✓ 157	✓ 10011101
✓ 314	✓ 100111010
✓ 412	✓ 110011100
231 ✓	✓ 11100111
275 ✓	✓ 100010011
463 ✓	✓ 111001111
168 ✓	✓ 10101000
384 ✓	✓ 110000000

128 ✓ 64 ✓ 32 ✓ 16 ✓ 8 ✓ 4 ✓ 2 ✓ 1 ✓
512 256

$$\begin{array}{r} 97 \\ - 64 \\ \hline 33 \\ 32 - \\ \hline 1 \\ 1 - \\ \hline 0 \end{array}$$

(97)

(412)

20

$$\begin{array}{r} 412 \\ - 256 \\ \hline 156 \\ 128 - \\ \hline 28 \\ - 16 \\ \hline 12 \\ 8 - \\ \hline \end{array} \quad \begin{array}{r} 4 \\ - 4 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 119 \\ - 64 \\ \hline \end{array} - (119)$$

$$\begin{array}{r} 55 \\ - 32 \\ \hline \end{array}$$

$$23$$

$$\begin{array}{r} 16 \\ \hline \end{array}$$

$$7$$

$$\begin{array}{r} 4 \\ \hline \end{array}$$

$$3$$

$$\begin{array}{r} 2 \\ \hline \end{array}$$

$$1$$

$$\begin{array}{r} -1 \\ \hline 0 \end{array}$$

$$(157)$$

$$\begin{array}{r} 157 \\ - 128 \\ \hline \end{array}$$

$$29$$

$$\begin{array}{r} 16 \\ \hline \end{array}$$

$$13$$

$$\begin{array}{r} - 8 \\ \hline \end{array}$$

$$5$$

$$4$$

$$\begin{array}{r} 1 \\ \hline \end{array}$$

$$\begin{array}{r} -1 \\ \hline \end{array}$$

$$0$$

$$(314)$$

$$\begin{array}{r} 314 \\ - 256 \\ \hline \end{array}$$

$$58$$

$$\begin{array}{r} 32 \\ \hline \end{array}$$

$$26$$

$$\begin{array}{r} 16 \\ \hline \end{array}$$

$$10$$

$$\begin{array}{r} 8 \\ \hline \end{array}$$

$$2$$

$$\begin{array}{r} -2 \\ \hline 0 \end{array}$$

Name: _____

SCRATCH SHEET FOR PROBLEM 1

Note for Binary $\rightarrow$ Decimal
Used calculator. If I
use one of the numbers
from



128	64	32	16	8	4	2	1
				5	12	256	

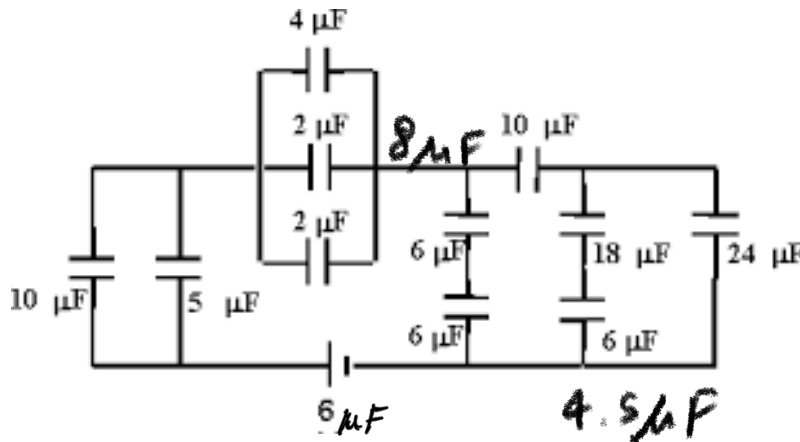
then I'll put "1" if I don't
then "0".

* Learned from Organic Tutor
on youtube.

Name: _____

PROBLEM 2 (10 Points)

Compute the equivalent capacitance of the following circuit.



$$C_{eq} = 4 + 2 + 2 = 8 \mu F$$

$$\frac{1}{C_{eq}} = \frac{1}{18} + \frac{1}{6} = \frac{2}{9}$$

$$C_{eq} = \frac{1}{2/9} = 4.5$$

$$C_{eq} = 4.5 + 24 = 28.5 \mu F$$

$$\frac{1}{C_{eq}} = \frac{1}{10} + \frac{1}{28.5} = .141 \mu F$$

$$C_{eq} = 7.08 \mu F$$

$$\frac{1}{C_{eq}} = \frac{1}{6} + \frac{1}{6} = \frac{1}{3}$$

$$C_{eq} = 3 \mu F$$

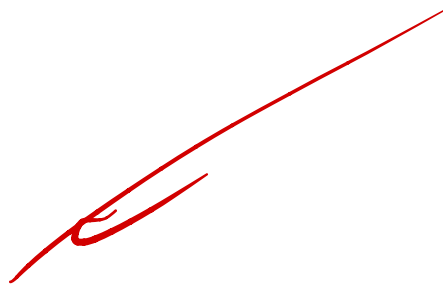
$$C_{eq} = 10 + 5 = 15 \mu F$$

$$C_{eq} = 3 + 7.08 = 10.08 \mu F$$

$$\frac{1}{C_{eq}} = \frac{1}{15} + \frac{1}{8} + \frac{1}{10.08}$$

$= .291$

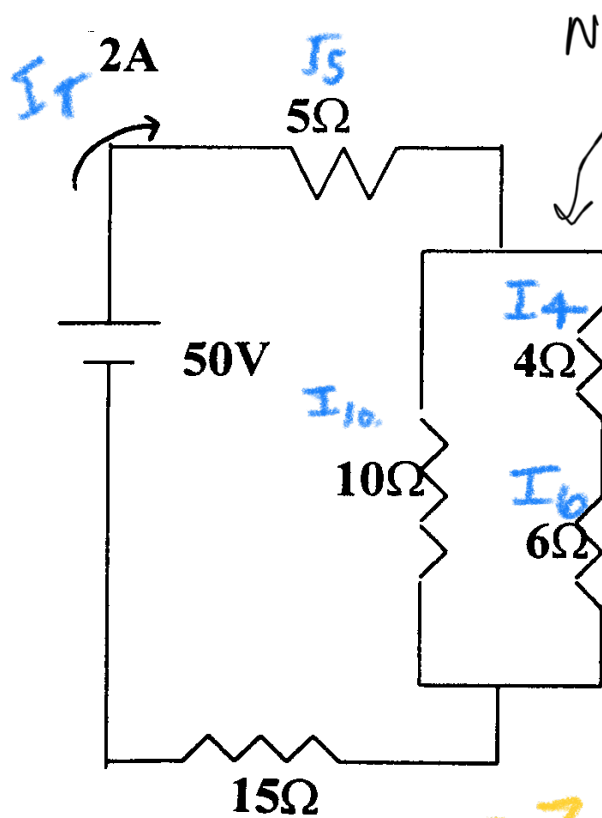
$$C_{eq} = 3.44 \mu F$$



Name: _____

PROBLEM 3 (10 Points)

In the circuit below, find all the currents. Before you start writing down equations, study the circuit carefully. You should be able to do the calculation in your head.



Note: $I_4 = I_6$

$$I_T = 2A$$

$$I_5 = 2A \checkmark$$

$$I_{10} = 1A \checkmark$$

$$I_4 = 1A$$

$$I_6 = 1A$$

$$I_{15} = 2A$$

$$I_4 = I_6$$

$$I_{5\Omega} \times 10$$

$$10 + 4 + 6$$

$$= 1A$$

$$I_4 \text{ and } I_6$$

$$I_{10\Omega} + I_{6\Omega} = I_{15\Omega}$$

$$I_{15\Omega} = 2A$$

$$I_{10} = \frac{I_{5\Omega} \cdot (4 + 6)}{4 + 6 + 10}$$

$$= \frac{2 \times 10}{20}$$

$$I_{10} = 1A$$

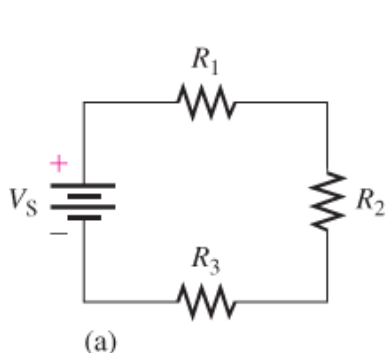
* Note: calculated mentally, but this what I got.

*

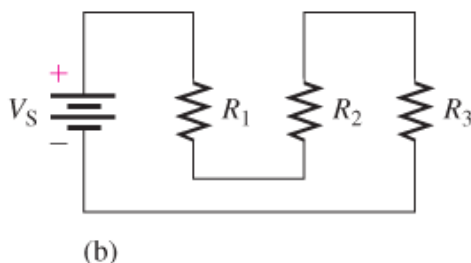
Name: _____

PROBLEM 4 (3 Points)

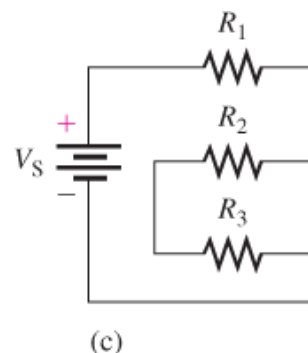
Look at the circuit below with three connected resistors. A student claims that only one of these circuits has the resistors connected in series while the other two do not. Is she correct? If you think she is, calculate the equivalent resistance for each circuit and write it below. If she is wrong, how would you correct her claim?



$$R_{eq} = R_1 + R_2 + R_3$$



$$R_{eq} = R_1 + R_2 + R_3$$



$$R_{eq} = R_1 + R_2 + R_3$$

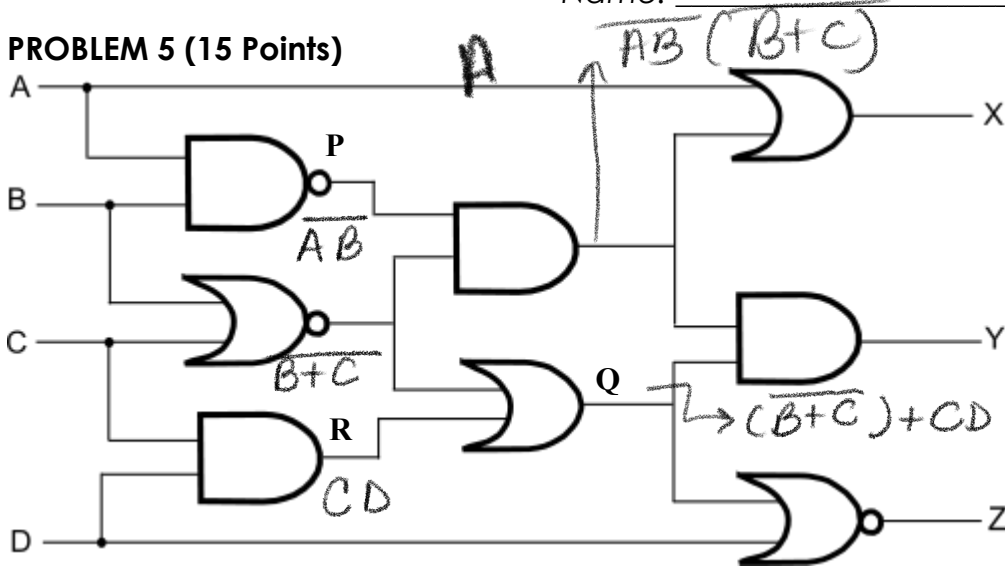
- I believe, all the circuits are connected in series only.

$$S_{eq} = R_{eq} = R_1 + R_2 + R_3$$

3

Name: _____

PROBLEM 5 (15 Points)



Page 1

Write the Boolean expression for output X, Y and Z in terms of the input A, B, C, D.

$$\begin{aligned}
 X &= A + (\overline{A}B)(\overline{B+C}) \\
 &= A + (\overline{A} + \overline{B})(\overline{B} \overline{C}) \\
 &= A + \overline{A} \overline{B} \overline{C} + \overline{B} \overline{B} \overline{C} \\
 &= A + \overline{A} \overline{B} \overline{C} + \overline{B} \overline{C} \\
 &= \underline{A} + \underline{\overline{B} \overline{C}} (\overline{A}) \\
 &= \underline{A} + \underline{\overline{B} \overline{C}}
 \end{aligned}$$

So,

$$\boxed{X = A + \overline{B} \overline{C}}$$

15

y ~

Page 2

$$y = \overline{A}B(\overline{B+C})(\overline{B+C}) + CD$$

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

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

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

$$= (\overline{B}\overline{C})(\overline{B}\overline{C} + CD) = \overline{B}\overline{C}\overline{B}\overline{C} + \overline{B}\overline{C}CD$$

$$= \overline{B}\overline{C}$$

$$\boxed{y = \overline{B} \cdot \overline{C}}$$

Z ↓

Page 3

$$Z = \overline{[CD + (\overline{B+C})] + D}$$

$$= \overline{CD + (\overline{B+C})} \overline{D}$$

$$= [(\overline{CD})(\overline{\overline{B+C}})] \overline{D}$$

$$= [(\overline{C} + \overline{D})(B+C)] \overline{D}$$

$$= [B\overline{C} + B\overline{D} + C\overline{D} + \underline{C}\underline{\overline{C}}] \overline{D}$$

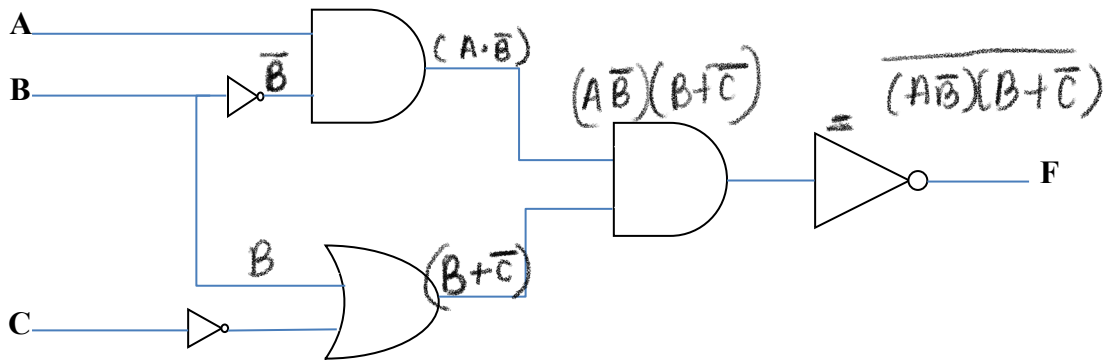
$$= (B\overline{C}\overline{D} + B\overline{D} + C\overline{D})$$

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

$$\boxed{Z = \overline{D}(B+C)}$$

Name: _____

PROBLEM 6 (15 Points)



I computed the output **F** for the logic gate layout above as $F = \overline{A \bar{B}(\bar{B} + \bar{C})}$. When I rechecked my computation, I realized the expression is incorrect. identify the errors in the expression and write the correct expression for output **F**. Can you spot the error(s) in my first computation?

So the equation should

look like

$$F = (A \bar{B})(B + \bar{C})$$

10

Name: Shah Hamid**PROBLEM 7 (15 Points)**

Simplify the following Boolean expression to a minimum number of literals.

a. $F = ABC + \bar{A}B + AB\bar{C}$
 $= AB(C + C') + A'B$
 $= AB + A'B$
 $= B(A + A')$
 $= \boxed{B}$

b. $F = \overline{(X + Y)} (\bar{X} + \bar{Y})$
 $= X'y'(X'y')$
 $= X'y' + X'y'$
 $= \boxed{X'y'}$

c. $F = XY + X(WZ + W\bar{Z})$
 $= XY + X\{W(Z + Z')\}$
 $= XY + WX$
 $= \boxed{X(Y + W)}$

15

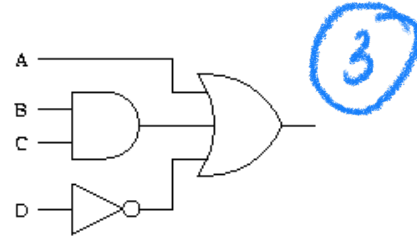
Name: _____

Quah Hamilton

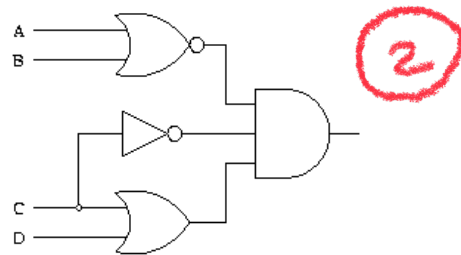
Problem 8 (12 Points)

The digital logic circuits, as shown, are mismatched with their corresponding descriptions in the left column. Match the appropriate circuit with its description by drawing arrows.

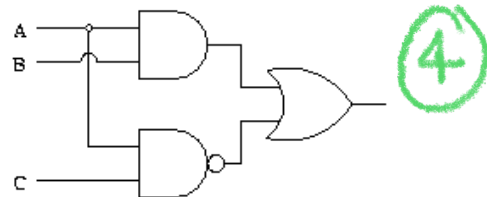
✓ Draw a logic circuit for $(A + B)C$ ①



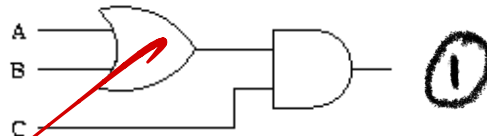
✓ Draw a logic circuit for $(A + B)'(C + D)C'$ ②



✓ Draw a logic circuit for $A + BC + D'$ ③



✓ Draw a logic circuit for $AB + (AC)'$ ④

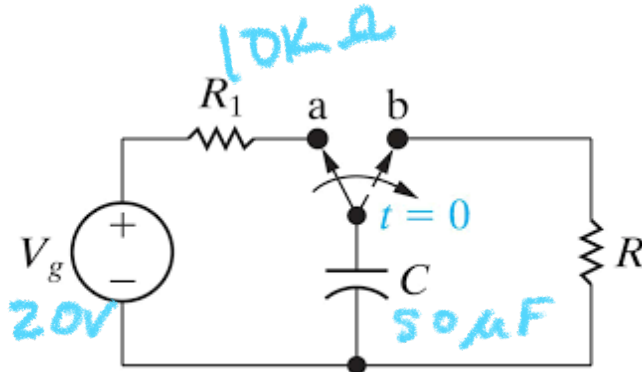


12

Name: _____

BONUS PROBLEM (15 Points)

In the circuit below, the switch has been in position "a" for a long time. At $t=0$, the switch is shifted to position "b". Calculate the time constant and write the appropriate expressions for the voltage across the capacitor below. Choose $V_g = 20$ V, $R_1 = 10$ k Ω , $R = 100$ k Ω , $C = 50$ μ F.



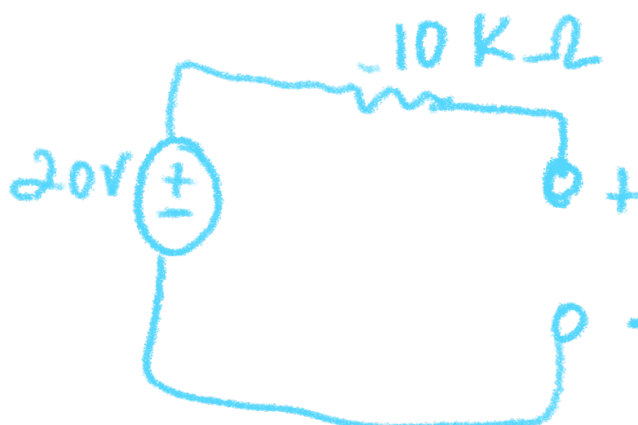
Final Answers:

$$V_c(t \rightarrow 0^-) = 20\text{V}$$

$$V_c(t \rightarrow 0^+) = 20\text{V}$$

$$V_c(t \rightarrow \infty) = 20e^{-\frac{200}{t}}$$

at $(t \rightarrow 0^-)$



$$V_c(0^-) = 20\text{V}$$

Open circuit

at $(t = 0^+)$



Closed circuit

capacitor will short circuit.

$$V_c(t \rightarrow 0^+) = 20\text{V}$$

at sudden change

13

$$V_C(t \rightarrow \infty)$$

$$= 100 (5 \times 10^{-6})$$

$$\tau = 0.005$$

$$= 20e^{-t/-0.05}$$

$$= 20e^{-\frac{1}{0.005}t} = \boxed{20e^{-\frac{200}{t}}}$$

Name: Thomas Carroll III

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
ROY G. PERRY COLLEGE OF ENGINEERING
PRAIRIE VIEW A&M UNIVERSITY
ELEG 2315 – SPRING 2022
FINAL EXAMINATION
THURSDAY, MAY 5, 2022
Total: 100 Points

90+15

Examination will be released at 8:00 AM on Canvas.

Your work must be submitted by 8:00 PM to Canvas.

Once you access the exam, you will have 3 hours (180 minutes) to submit. Your latest attempt should be no later than 5:00 PM.

Your work must be shown on these sheets. Not on blank paper.

Submissions on blank paper will not be graded.

You are expected to find the information needed on your own.

READ THIS CAREFULLY AND SIGN BELOW

Academic honesty and integrity are essential principles of Prairie View A&M University and engineering as a profession. All PVAMU students are expected to behave as honest and responsible members of an academic community.

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Signature: Thomas Carroll III

Name: Thomas Carroll III

PROBLEM 1 (20 Points)

Perform the following decimal to binary and binary to decimal conversions. Show your work.

Decimal	Binary
97	1100001
119	1110111
157	10011101
314	100111010
412	110011100
231	11100111
275	100010011
463	111001111
168	10101000
384	110000000

20

①

97	48	1
48	24	0
24	12	0
12	6	0
6	3	0
3	1	1
1	0	1

②

119	59	1
59	29	1
29	14	1
14	7	0
7	3	1
3	1	1
1	0	1

③

157	78	1
78	39	0
39	19	1
19	9	1
9	4	1
4	2	0
2	1	0
1	0	1

④

314	157	0
157	78	1
78	39	0
39	19	1
19	9	1
9	4	1
4	2	0
2	1	0
1	0	1

⑤

412	206	0
206	103	0
103	51	1
51	25	1
25	12	1
12	6	0
6	3	0
3	1	1
1	0	1

⑥

11100111

$$2^7 + 2^6 + 2^5 + 2^2 + 2^1 + 2^0$$

$$= 231$$

⑦

100010011

$$2^8 + 2^4 + 2^1 + 2^0$$

$$= 275$$

⑧

111001111

$$2^8 + 2^7 + 2^6 + 2^3 + 2^2 + 2^1 + 2^0$$

$$= 463$$

⑨

10101000

$$2^7 + 2^5 + 2^3$$

$$= 168$$

Name: Thomas Carroll^{III}

SCRATCH SHEET FOR PROBLEM 1

⑩

110000000

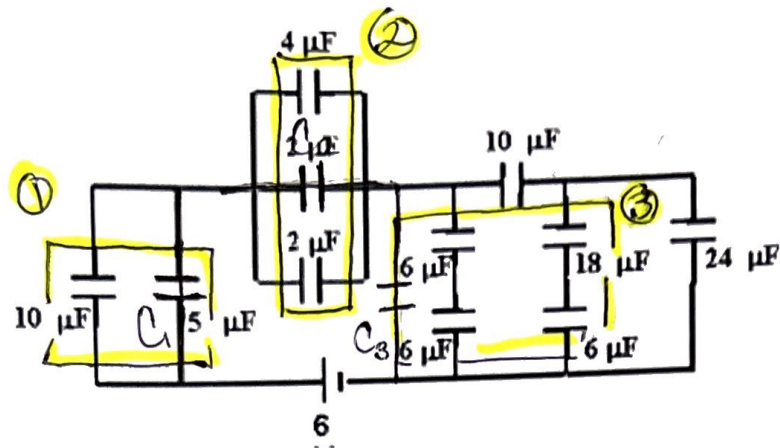
$$2^8 + 2^7$$

$$= 384$$

Name: Thomas Carroll III

PROBLEM 2 (10 Points)

Compute the equivalent capacitance of the following circuit.



$$\textcircled{1} \quad C_1 = (10 + 5) \mu\text{F} \\ = 15 \mu\text{F}$$

$$C_2 = (4 + 2 + 2) \mu\text{F} \\ = 8 \mu\text{F}$$

$$\textcircled{4} \quad \frac{1}{C_{eq}} = \frac{1}{C_4} + \frac{1}{C_2} + \frac{1}{6} + \frac{1}{C_1} \\ = \frac{1}{3.64} + \frac{1}{8} + \frac{1}{6} + \frac{1}{15}$$

$$C_{eq} = 1.58 \mu\text{F}$$

$$\textcircled{2} \quad \frac{1}{C_a} = \frac{1}{6} + \frac{1}{6} \Rightarrow C_a = 3 \mu\text{F}$$

$$\frac{1}{C_b} = \frac{1}{18} + \frac{1}{6} \Rightarrow C_b = 4.5 \mu\text{F}$$

$$C_3 = C_a + C_b = (3 + 4.5) \mu\text{F}$$

$$C_3 = 7.5 \mu\text{F}$$

$$\textcircled{3} \quad \frac{1}{C_4} = \frac{1}{C_3} + \frac{1}{10} + \frac{1}{24} \\ = \frac{1}{7.5} + \frac{1}{10} + \frac{1}{24}$$

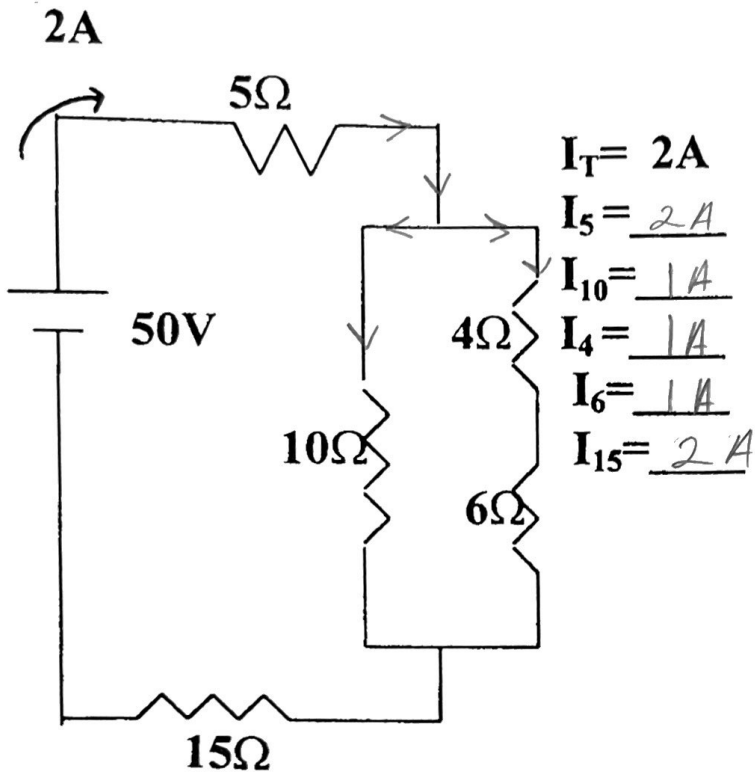
$$C_4 = 3.64 \mu\text{F}$$

10

Name: Thomas Carroll II

PROBLEM 3 (10 Points)

In the circuit below, find all the currents. Before you start writing down equations, study the circuit carefully. You should be able to do the calculation in your head.



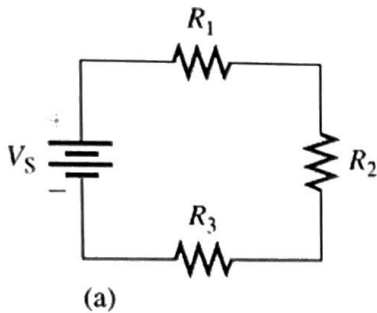
$I_5 = 2A$

10

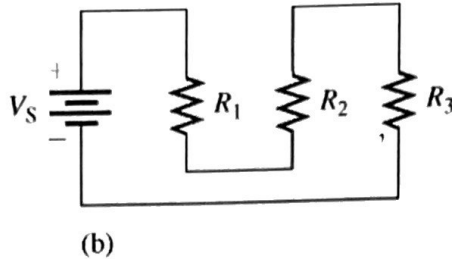
Name: Thomas Carroll III

PROBLEM 4 (3 Points)

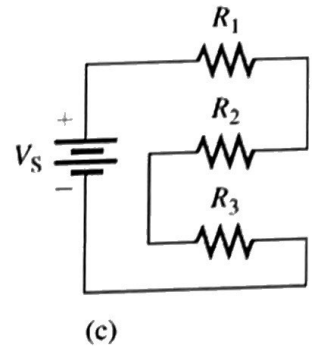
Look at the circuit below with three connected resistors. A student claims that only one of these circuits has the resistors connected in series while the other two do not. Is she correct? If you think she is, calculate the equivalent resistance for each circuit and write it below. If she is wrong, how would you correct her claim?



$R_{eq} =$



$R_{eq} =$



$R_{eq} =$

* I believe she is wrong because if you look at the other two circuits the resistors claimed to be in parallel are actually in series. I believe this because the current can't run through the resistors at the same time & the current can't split off. So, her claim would be wrong & ...

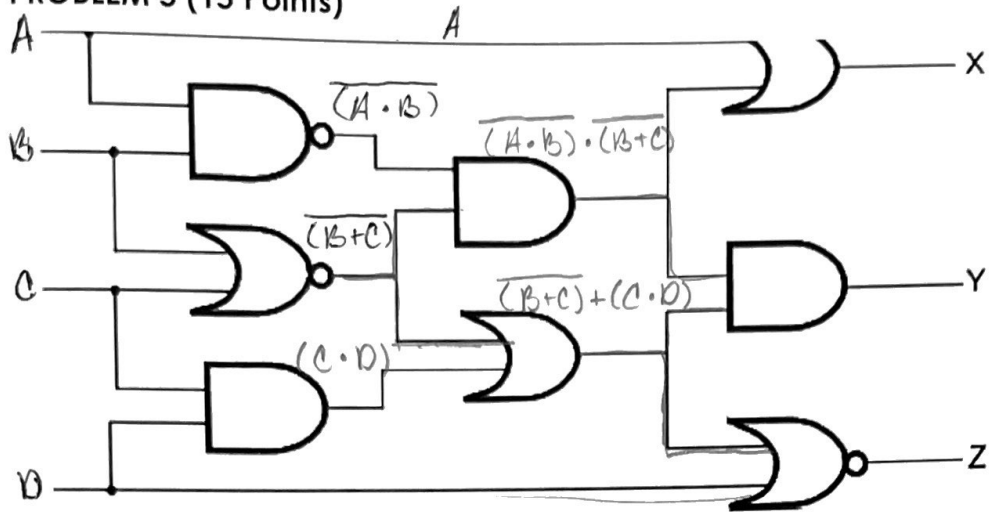
$$R_{eq} = R_1 + R_2 + R_3$$

... for all of them.

(Large red checkmark and number 3)

Name: Thomas Carroll III

PROBLEM 5 (15 Points)



Write the Boolean expression for output X, Y and Z in terms of the input A, B, C, D.

$$X = A + [(A \cdot B) \cdot (B + C)]$$

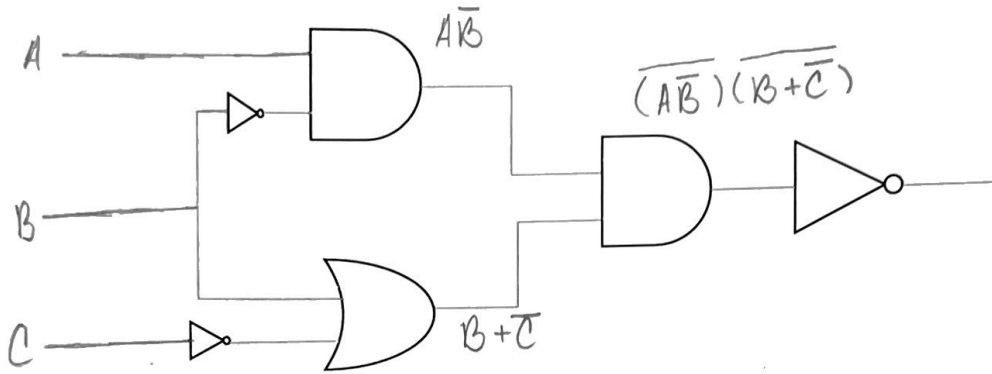
$$Y = [(A \cdot B) \cdot (B + C)] \cdot [(B + C) + (C \cdot D)]$$

$$Z = [(B + C) + (C \cdot D)] + \bar{D}$$

Simplify

6

PROBLEM 6 (15 Points)



I computed the output F for the logic gate layout above as $F = \bar{A}\bar{B}(\bar{B} + \bar{C})$. When I rechecked my computation, I realized the expression is incorrect. Identify the errors in the expression and write the correct expression for output F . Can you spot the error(s) in my first computation?

$$F = \bar{A}\bar{B}(\bar{B} + \bar{C})$$

wrong

⇓

$$F' = \overline{(\bar{A}\bar{B})}(\bar{B} + \bar{C})$$

* B shouldn't have been inverted in the OR gate with B & C .

* I hope that's how it's supposed to look the picture was cut-off & the variables couldn't be seen.

Simplifying

12

Name: Thomas Carroll

PROBLEM 7 (15 Points)

Simplify the following Boolean expression to a minimum number of literals.

a. $F = ABC + \bar{A}B + AB\bar{C}$

$$= \bar{A}B + AB(C + \bar{C})$$

$$= \bar{A}B + AB$$

$$= B(\bar{A} + A)$$

$$\boxed{F = B}$$

b. $F = \overline{(X+Y)}(\bar{X} + \bar{Y})$

$$= \bar{X} \cdot \bar{Y}(\bar{X} + \bar{Y})$$

$$= \bar{X}\bar{Y}\bar{X} + \bar{X}\bar{Y}\bar{Y}$$

$$= \bar{X}\bar{Y} + \bar{X}\bar{Y}$$

$$\boxed{F = \bar{X}\bar{Y}}$$

c. $F = XY + X(WZ + W\bar{Z})$

$$= XY + XW(Z + \bar{Z})$$

$$= XY + XW$$

$$\boxed{F = X(Y + W)}$$

Name: Thomas Carroll II

Problem 8 (12 Points)

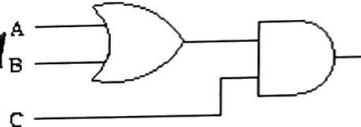
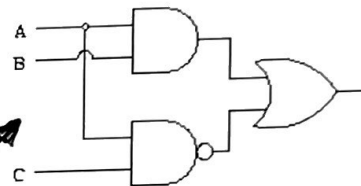
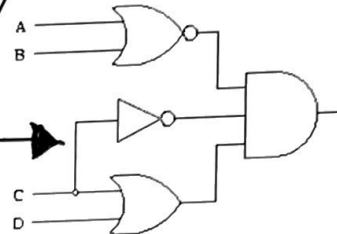
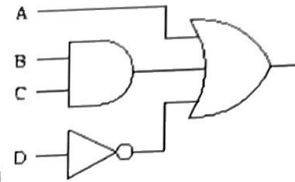
The digital logic circuits, as shown, are mismatched with their corresponding descriptions in the left column. Match the appropriate circuit with its description by drawing arrows.

Draw a logic circuit for $(A + B)C$.

Draw a logic circuit for $(A + B)'(C + D)C'$.

Draw a logic circuit for $A + BC + D'$.

Draw a logic circuit for $AB + (AC)'$.

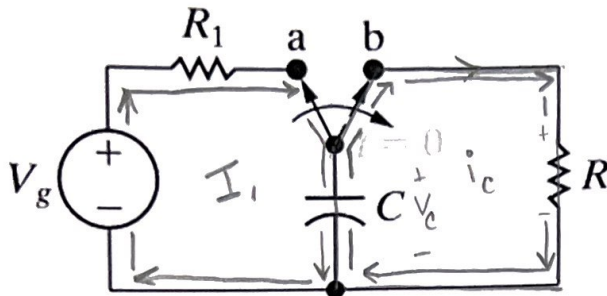


12

Name: Thomas Carroll

BONUS PROBLEM (15 Points)

In the circuit below, the switch has been in position "a" for a long time. At $t=0$, the switch is shifted to position "b". Calculate the time constant and write the appropriate expressions for the voltage across the capacitor below. Choose $V_g = 20$ V, $R_1 = 10$ k Ω , $R = 100$ k Ω , $C = 50$ μ F.



Final Answers:

$$V_c(t \rightarrow 0^-) = \underline{20 \text{ V}}$$

$$V_c(t \rightarrow 0^+) = \underline{20 \text{ V}}$$

$$V_c(t \rightarrow \infty) = \underline{0 \text{ V}}$$

①

$$\tau = RC$$

$$= (100 \times 10^3)(50 \times 10^{-6})$$

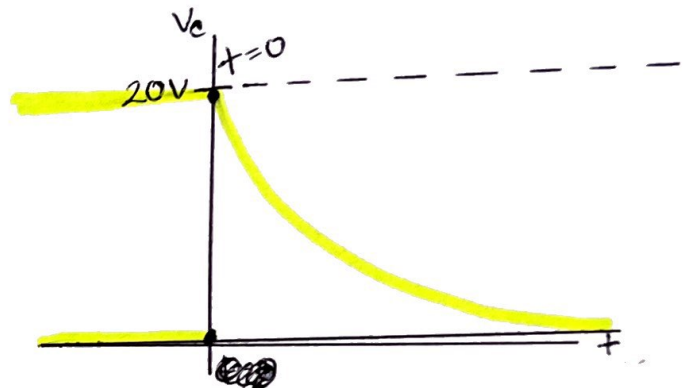
$$\boxed{\tau = 5 \text{ s}}$$

②

$$V_c(t \rightarrow \infty) = V_c(0) e^{-t/\tau}$$

$$= (20 \text{ V}) e^{-t/5}$$

$$\boxed{V_c = 20 e^{-t/5}}$$



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