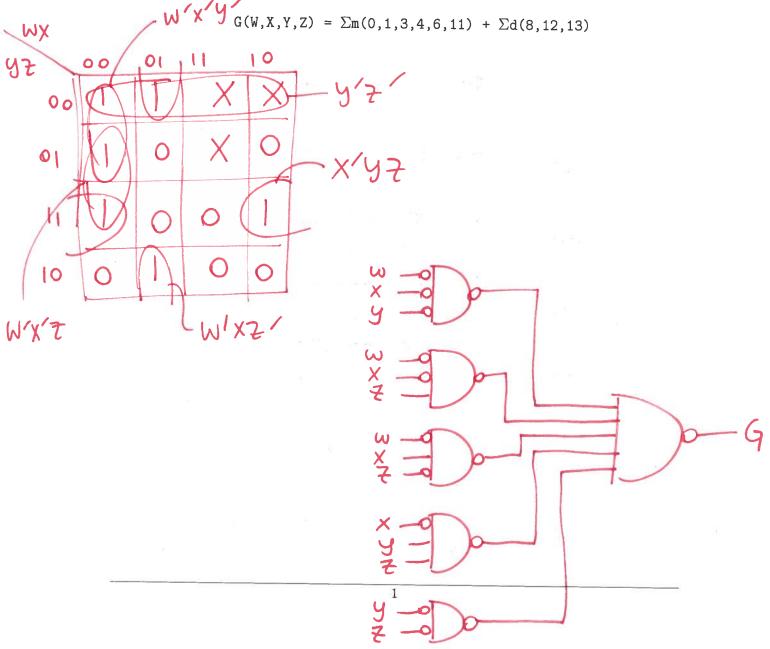
Name:

SOLU TIONS

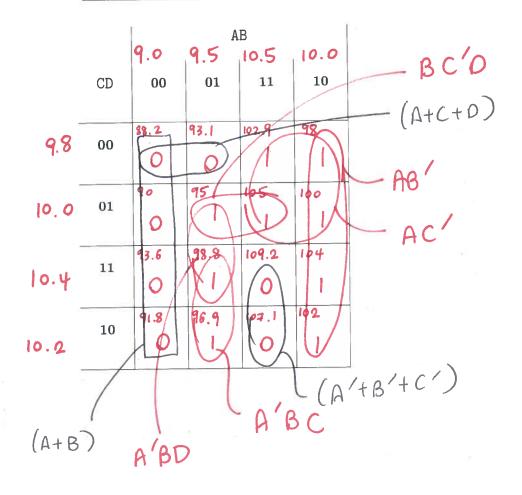
Read each question carefully before answering. Answer all parts. Show all work, calculations, and/or reasoning, otherwise no points will be awarded. Properly labeled loops must be shown on K-maps to receive credit. Assume that you have access to gates with as many inputs as you need. Point values are as indicated. Usage of XOR and XNOR gates is not allowed on this exam!

1. (10 points) Draw the following as a hazard-free NAND-only circuit. Assume that you have access to gates with as many inputs as you need. You may use bubbles on inputs, but not as output inverters!



2. (10 points) A sensor measures the length and width of a piece of machined metal. AB corresponds to the length, and CD corresponds to the width, as indicated in the table below. Use the K-map below to solve for F, which indicates if the area of the piece of metal is between $95 \text{ cm}^2-105 \text{ cm}^2$ (inclusive). Ensure that F is hazard-free. All loops must be labeled to receive credit for this problem.

AB	Length (cm)	CD	Width (cm)	
00	9.0	00	00 9.8	
01	9.5	01	10.0	
10	10.0	10	10.2	
11	10.5	11	10.4	



SOP > F= A'BD+A'BC+ AC'+ AB'+BC'D

3. (2 points) Explain what ROM is and why it is useful in digital electronics.

READ ONLY MEMORY

SAVES ON GATES WHEN MULTIPLE OUTPUT COS AND/OR

MANY CONTROL VARIABLES EXIST

4. (2 points) Explain the difference between UV-erasable EPROM and one-time programmable EPROM.

UV-ERASABLE - CONTENTS CAN BE ERASEO & RE-PROGRAMMED

OTP - CONTENTS CANNOT BE ERASED &

RE - PROGRAMMED

5. (2 points) In what situations would you use UV-erasable EPROM?

PROTOTYPING

6. (2 points) In what situations would you use one-time programmable EPROM?

FINAL DESIGN/IMPLEMENTATION

7. (2 points) You are interested in using the 27C512 EPROM chip, which has 8 bit words and 16 address pins. What is the memory capacity of this chip in bytes?

216 = 65,536 BYTES

8. The following codes are used by a vending machine to determine the item being purchased (represented by the variables DE) and the amount of money inserted into the machine (represented by the variables ABC). The machine has an output, V, which is 1 if enough money has been inserted to pay for the item.

ABC	Money Inserted	DE	Item & Cost
000	\$0.20	00	Snickers – \$0.70
001	\$0.30	01	Coke - \$0.60
010	\$0.40	10	Water - \$0.50
011	\$0.50	11	Chips - \$0.85
100	\$0.60		.4
101	\$0.70		
110	\$0.80		×=
111	\$0.90	2:	

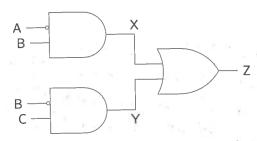
(a) (10 points) Find the minterms of V. (Hint: feel free to use a truth-table or a K-map if it will help you here.)

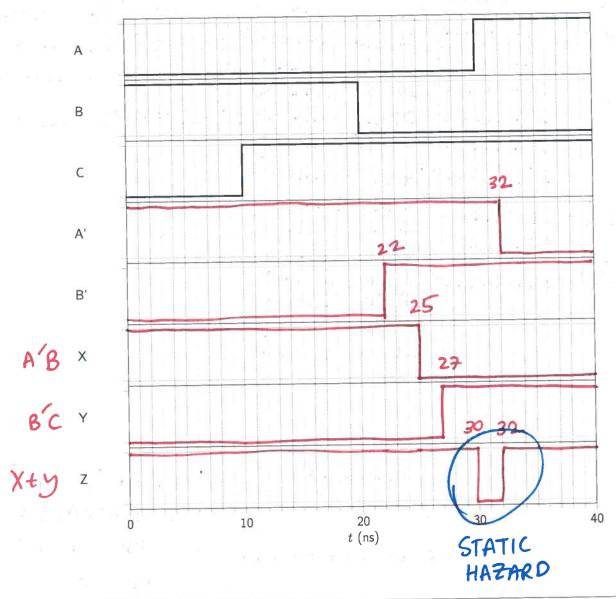
Em (14, 17, 18, 20, 21, 22, 24, 25, 26, 28, 29, 30, 31)

(b) (20 points) Use the Quine-McCluskey method to derive an equation for ${\tt V}.$

TWO. 17. 1000 17-21 10-01 17-21-25-29 101 18. 10010 17-25 -001 17-21-25-29 101 20. 10100 18-22 10-10 18-22-26-30 110 24. 11000 18-26 1-010 20-21 1010 20-22 28-30 1- -0 20-22 10100 20-22 28-30 1- -0 22. 10110 20-28 1-100 24-25 28-29 11-0-25. 1100 24-25 1100 24-26 1100 24-26 1100 24-26 1100 24-28 11-00 28. 11100 21-29 1-101 22-30 1-10 22-30 1-10 22-30 1-10 22-30 11-0 28-29 11-01 28-29 11-01 28-30 11-0			f.			
18. $10010 13-25 1-001 111-25-29 101 20. 10100 18-22 10-10 18-22-26-30 1-10 24. 11000 18-26 1-010 20-21-28-29 1-10-20-22 1010-20-22-28-30 1-1-0 20-22 1010-24-25-28-29 11-0-22. 1010 24-25 1100-24-25-28-30 11-0 24-26 110-01-28-29-30-3 111-0 24-28 11-00 24-28 11-00 24-29 11-01 22-30 1-10 22-30 1-10 22-30 1-10 22-30 1100-28-29 11-01 22-30 1100-28-29 11-01 23-30 1110-28-29 11-01 23-30 1110-28-29 11-01 23-31 111-1 30-31 30-31 3$		Column 1	Colu	mn 2	Column 3	
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					HB	E THLE

9. (20 points) Draw a timing diagram for the following circuit, given gate delays of 2 ns for NOT gates, and 5 ns for AND and OR gates. Indicate any static hazards in the output signal





10. (25 points) Find the optimized implementation of the following two circuits. Show all work. How many gates and/or inputs do you save by implementing circuits together rather than individually?

$$X(A,B,C,D) = \sum m(2,3,4,6,7,10,12)$$

 $Y(A,B,C,D) = \sum m(4,6,7,10,12,14,15)$

