21W-COMSCIM51A-1 Homework 3

CHARLES ZHANG

TOTAL POINTS

86 / 90

QUESTION 1

1 12 pts

1.1 a 4 / 4

✓ **- 0 pts** Correct.

- 2 pts (a) should be $$\Sigma m(2,3,5,7)$$

- 2 pts (a) should be $$\Pi M(0,1,4,6)$$

1.2 b 4 / 4

✓ **- 0 pts** Correct

- 2 pts (b) should be $$\Sigma m(3)$$

- 2 pts (b) should be $$\Pi M(0,1,2,4,5,6,7)$$

1.3 c 4 / 4

✓ **- 0 pts** Correct

- 2 pts (b) should be $$\Sigma m(0,1,2,3,4,6,7)$$

- 2 pts (b) should be $$\Pi M(5)$$

QUESTION 2

2 18 pts

2.1 a 6 / 6

✓ **- 0 pts** Correct

- 1.5 pts Error in first 4 rows

- 1.5 pts Error in second 4 rows

- 1.5 pts Error in third 4 rows

- 1.5 pts Error in last 4 rows

2.2 b 12 / 12

✓ **- 0 pts** Correct

- 1.5 pts z0 incorrect sum of minterms

- 1.5 pts z0 incorrect product of maxterms

- 1.5 pts z1 incorrect sum of minterms

- 1.5 pts z1 incorrect product of maxterms

- 1.5 pts z2 incorrect sum of minterms

- 1.5 pts z2 incorrect product of maxterms

QUESTION 3

3 12 pts

3.1 a 6 / 6

✓ **- 0 pts** Correct

![Screen_Shot_2021-01-22_at_2.32.41_PM.png](/files/d039ecd2-4760-48b9-94da-9e644f6a672d)

- 2 pts AB branch is wrong

- 2 pts B'C' branch is wrong

- 2 pts A'C branch is wrong

- 6 pts other answers

3.2 b 6 / 6

✓ **- 0 pts** Correct

![Screen_Shot_2021-01-22_at_2.35.04_PM.png](/files/e60a774f-7d2e-425c-ae66-364d14253743)

- 2 pts (AB)' branch is wrong

- 2 pts (B'C')' branch is wrong

- 2 pts (A'C)' branch is wrong

- 6 pts other answers

QUESTION 4

4 4 8 / 8

✓ **- 0 pts** Correct

- 2 pts Incorrect initial expression for F

- 1 pts Minor error for sum of minterms

- 1 pts Minor error for product of maxterms

- 3 pts Incorrect sum of minterms

- 3 pts Incorrect product of maxterms

QUESTION 5

5 8 pts

5.1 a 4 / 4

✓ - **0 pts** Correct

   - **1 pts** 1.0V: should be LOW or 0

   - **1 pts** 4.5V: should be HIGH or 1

   - **1 pts** 2.0V: should be undetermined/undecided/NA, etc

   - **1 pts** -1.0V: should be undetermined/undecided/NA, etc

5.2 b **4 / 4**

✓ - **0 pts** Correct

   - **4 pts** should be XOR/exclusive-OR gate

QUESTION 6

6 16 pts

6.1 a **14 / 14**

✓ - **0 pts** Correct

   - **2 pts** 1st row of Z incorrect

   - **2 pts** 2nd row of Z incorrect

   - **2 pts** 3rd row of Z incorrect

   - **2 pts** 4th row of Z incorrect

   - **1 pts** Q1 incorrect

   - **1 pts** Q2 incorrect

   - **1 pts** Q3 incorrect

   - **1 pts** Q4 incorrect

   - **1 pts** Q5 incorrect

   - **1 pts** Q6 incorrect

6.2 b **2 / 2**

✓ - **0 pts** Correct

   - **1 pts** Partially correct

   - **2 pts** Incorrect

   - **2 pts** Blank

QUESTION 7

7 8 pts

7.1 a **2 / 4**

   - **0 pts** Correct

![Screen_Shot_2021-01-22_at_2.40.33_PM.png](/files/3648c0f6-adc3-4cfd-896e-9c1201463e85)

   - **2 pts** Without the NOT gate on the right most

   - **2 pts** valid, but more than 8 gates

✓ - **2 pts** other answers; common mistakes: connect the A of nMOS to VDD/connect the B of pMOS to GND

![Screen_Shot_2021-01-22_at_2.47.10_PM.png](/files/d899cfb6-aeeb-46b4-a83b-7166b86e1857)

   - **4 pts** blank

7.2 b **4 / 4**

✓ - **0 pts** Correct

![Screen_Shot_2021-01-22_at_2.43.08_PM.png](/files/1b6630cc-7633-4aad-83d0-6f774ac6c25d)

   - **2 pts** valid, but more than 6 gates

   - **2 pts** other answers; common mistakes: connect the A of nMOS to VDD/connect the B of pMOS to GND

![Screen_Shot_2021-01-22_at_2.47.10_PM.png](/files/3ca318c5-6ca6-4d20-863d-b151117addec)

   - **4 pts** blank

QUESTION 8

8 8 pts

8.1 a **4 / 4**

✓ - **0 pts** Correct

   - **4 pts** Incorrect algebra function

8.2 b **2 / 4**

   - **0 pts** Correct

✓ - **2 pts** PMOS should be connected to VDD and NMOS should be connected to GND.

   - **1 pts** Minor error

   - **1 pts** 1 extra transistors used

   - **2 pts** 2 extra transistors used

   - **3 pts** 3 or more extra transistors used

   - **2 pts** Use A' or B' as input

   - **2 pts** Other major error

   - **4 pts** Blank

ıl gradescope

Charles Zheng
305 413 659
Academic Honesty: 3ᵍ

CS M51A HW#3

1a) $A'B + AC + BC$

$A'B(C+C') + AC(B+B') + BC(A+A')$ — Complement

$A'BC + A'BC' + ABC + AB'C + ABC + A'BC$ — Distributivity

$A'BC' + ABC + AB'C + A'BC$ — Idempotency

$010 + 111 + 101 + 011$

$M_2 + M_7 + M_5 + M_3$

$\boxed{\Sigma m(2,3,5,7)}$

$\boxed{\Pi M(0,1,4,6)}$

1b) $A'B(AB+C)(B+A'C')$

$(A'BAB + A'BC)(B+A'C')$ — Distributivity

$A'BC(B+A'C')$ — Complement

$A'BBC + A'A'BCC'$ — Distributivity + Associativity

$A'BC$ — Complement + Idempotency

011

M_3

$\boxed{\Sigma m(3)}$

$\boxed{\Pi M(0,1,2,4,5,6,7)}$

1c) $A' + A(A'B + B'C)'$

$A' + (A'B + B'C)'$ — Simplification

$A' + (A'B)'(B'C)'$ — De Morgan's

$A' + (A+B')(B+C')$ — De Morgan's

$A' + (A+B')B + (A+B')(C')$ — Distributivity

$A' + AB + BB' + AC' + B'C'$ — Distributivity

$A' + AB + AC' + B'C'$ — Complement

$A' + B + AC' + B'C'$ — Simplification

$A' + B + C'$ — Simplification + Associativity

$1 + 0 + 1 = M_5$

$\boxed{\Pi M(5)}$

$\boxed{\Sigma m(0,1,2,3,4,6,7)}$

1.1 a 4 / 4

✓ **- 0 pts** Correct.

   - 2 pts (a) should be $$\Sigma m(2,3,5,7)$$

   - 2 pts (a) should be $$\Pi M(0,1,4,6)$$

Charles Zhang
305 413 659
Academic Honesty: 3&

CS M51A HW#3

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$A'BC + A'BC' + ABC + AB'C + ABC + A'B'C$ — Distributivity

$A'BC' + ABC + AB'C + A'BC$ — Idempotency

$010 + 111 + 101 + 011$

$M_2 + M_7 + M_5 + M_3$

$$\boxed{\Sigma m(2,3,5,7)}$$

$$\boxed{\Pi M(0,1,4,6)}$$

1b) $A'B(AB+C)(D+A'C')$

$(A'BAB + A'BC)(B+A'C')$ — Distributivity

$A'BC(B+A'C')$ — Complement

$A'BBC + A'A'BCC'$ — Distributivity + Associativity

$A'BC$ — Complement + Idempotency

011

M_3

$$\boxed{\Sigma m(3)}$$

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$A' + AB + BB' + AC' + B'C'$ — Distributivity

$A' + AB + AC' + B'C'$ — Complement

$A' + B + AC' + B'C'$ — Simplification

$A' + B + C'$ — Simplification + Associativity

$1 + 0 + 1 = M_5$

$$\boxed{\Pi M(5)}$$

$$\boxed{\Sigma m(0,1,2,3,4,6,7)}$$

1.2 b 4 / 4

✓ **- 0 pts** Correct

    - 2 pts (b) should be $$\Sigma m(3)$$

    - 2 pts (b) should be $$\Pi M(0,1,2,4,5,6,7)$$

CS M51A HW#3

1a) $A'B + AC + BC$

$A'B(C+C') + AC(B+B') + BC(A+A')$ — Complement

$A'BC + A'BC' + ABC + AB'C + ABC + A'BC$ — Distributivity

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$010 + 111 + 101 + 011$

$M_2 + M_7 + M_5 + M_3$

$\boxed{\Sigma m(2,3,5,7)}$

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$(A'BAB + A'BC)(B+A'C')$ — Distributivity

$A'BC(B+A'C')$ — Complement

$A'BBC + A'A'BCC'$ — Distributivity + Associativity

$A'BC$ — Complement + Idempotency

011

M_3

$\boxed{\Sigma m(3)}$

$\boxed{\Pi M(0,1,2,4,5,6,7)}$

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$A' + (A+B')(B+C')$ — De Morgan's

$A' + (A+B')B + (A+B')(C')$ — Distributivity

$A' + AB + BB' + AC' + B'C'$ — Distributivity

$A' + AB + AC' + B'C'$ — Complement

$A' + B + AC' + B'C'$ — Simplification

$A' + B + C'$ — Simplification + Associativity

$1 + 0 + 1 = M_5$

$\boxed{\Pi M(5)}$

$\boxed{\Sigma m(0,1,2,3,4,6,7)}$

1.3 C 4 / 4

✓ **- 0 pts** Correct

    - 2 pts (b) should be $$\Sigma m(0,1,2,3,4,6,7)$$

    - 2 pts (b) should be $$\Pi M(5)$$

2a)

x_1	x_0	y_1	y_0	z_2	z_1	z_0
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	0	0	1	0
0	0	1	1	0	1	1
0	1	0	0	0	0	0
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	1
1	0	0	0	0	0	0
1	0	0	1	1	0	0
1	0	1	0	1	0	0
1	0	1	1	1	0	0
1	1	0	0	0	0	0
1	1	0	1	0	0	0
1	1	1	0	0	0	0
1	1	1	1	0	0	0

$x \in \{0, 1, 2\}$
$y \in \{1, 2, 3\}$
$z = \max(x^2, y)$

2b) $z_2 = x_1 x_0' y_1' y_0 + x_1 x_0' y_1 y_0' + x_1 x_0' y_1 y_0$

$= 1001 + 1010 + 1011$

$= M_9 + M_{10} + M_{11}$

$\boxed{z_2 = \Sigma m(9, 10, 11) = \Pi M(0,1,2,3,4,5,6,7,8,12,13,14,15)}$

$z_1 = 0010 + 0011 + 0110 + 0111$

$z_1 = M_2 + M_3 + M_6 + M_7$

$\boxed{z_1 = \Sigma m(2,3,6,7) = \Pi M(0,1,4,5,8,9,10,11,12,13,14,15)}$

$z_0 = 0001 + 0011 + 0101 + 0111$

$z_0 = M_1 + M_3 + M_5 + M_7$

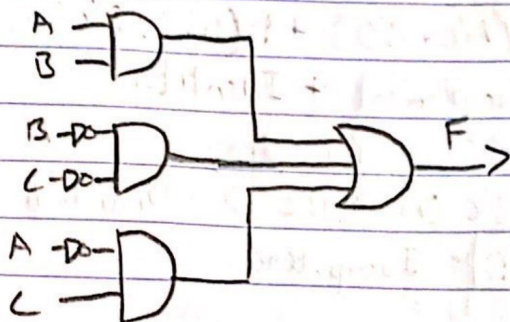$\boxed{z_0 = \Sigma m(1,3,5,7) = \Pi M(0,2,4,6,8,9,10,11,12,13,14,15)}$

2.1 a 6 / 6

✓ **- 0 pts** Correct

- 1.5 pts Error in first 4 rows

- 1.5 pts Error in second 4 rows

- 1.5 pts Error in third 4 rows

- 1.5 pts Error in last 4 rows

2a)

x_1	x_0	y_1	y_0	z_2	z_1	z_0
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	0	0	1	0
0	0	1	1	0	1	1
0	1	0	0	0	0	0
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	1
1	0	0	0	0	0	0
1	0	0	1	1	0	0
1	0	1	0	1	0	0
1	0	1	1	1	0	0
1	1	0	0	0	0	0
1	1	0	1	0	0	0
1	1	1	0	0	0	0
1	1	1	1	0	0	0

$x \in \{0, 1, 2\}$

$y \in \{1, 2, 3\}$

$z = \max(x^2, y)$

2b)

$z_2 = x_1 x_0' y_1' y_0 + x_1 x_0' y_1 y_0' + x_1 x_0' y_1 y_0$

$= 1001 + 1010 + 1011$

$= M_9 + M_{10} + M_{11}$

$\boxed{z_2 = \Sigma m(9, 10, 11) = \Pi M(0,1,2,3,4,5,6,7,8,12,13,14,15)}$

$z_1 = 0010 + 0011 + 0110 + 0111$

$z_1 = M_2 + M_3 + M_6 + M_7$

$\boxed{z_1 = \Sigma m(2,3,6,7) = \Pi M(0,1,4,5,8,9,10,11,12,13,14,15)}$

$z_0 = 0001 + 0011 + 0101 + 0111$

$z_0 = M_1 + M_3 + M_5 + M_7$

$\boxed{z_0 = \Sigma m(1,3,5,7) = \Pi M(0,2,4,6,8,9,10,11,12,13,14,15)}$

2.2 b 12 / 12

✓ **- 0 pts** Correct

- **1.5 pts** z_0 incorrect sum of minterms

- **1.5 pts** z_0 incorrect product of maxterms

- **1.5 pts** z_1 incorrect sum of minterms

- **1.5 pts** z_1 incorrect product of maxterms

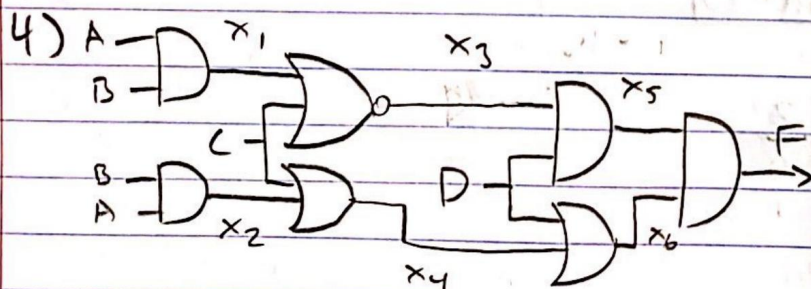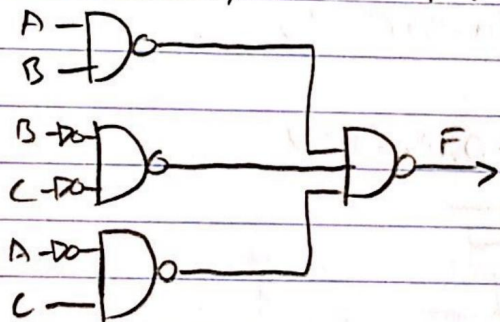- **1.5 pts** z_2 incorrect sum of minterms

- **1.5 pts** z_2 incorrect product of maxterms

ıl gradescope

3a) $F = AB + \bar{B}\bar{C} + \bar{A}C$

3b) $F = AB + B'C' + A'C = ((AB)'(B'C')'(A'C)')'$

$x_2' = AB,\ x_1' = B'C',\ x_0' = A'C$

$x_2 = (AB)',\ x_1 = (B'C')',\ x_0 = (A'C)'$

4)

$F = x_5 x_6 \qquad x_5 = x_3 D \qquad x_6 = x_4 + D$

$x_3 = (x_1 + C)' \qquad x_4 = x_2 + C$

$x_1 = AB \qquad x_2 = BA$

$x_3 = (AB + C)' \qquad x_4 = AB + C$

$x_5 = (AB + C)'D \qquad x_6 = AB + C + D$

$F = ((AB+C)'D)(AB+C+D)$

$F = ((AB)'C'D)(AB+C+D)$ — De Morgan's Law

$F = ((A'+B')C'D)(AB+C+D)$ — De Morgan's Law
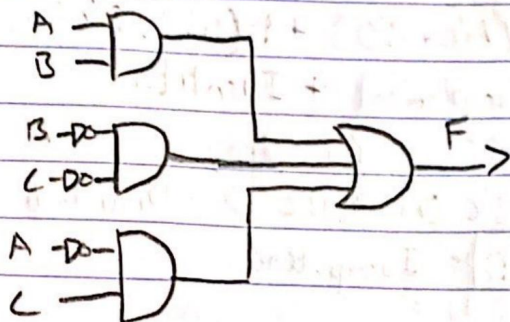
$F = (A'C'D + B'C'D)(AB+C+D)$ — Distributivity

3.1 a 6 / 6

✓ - **0 pts** Correct

![Screen_Shot_2021-01-22_at_2.32.41_PM.png](/files/d039ecd2-4760-48b9-94da-9e644f6a672d)

- **2 pts** AB branch is wrong

- **2 pts** B'C' branch is wrong

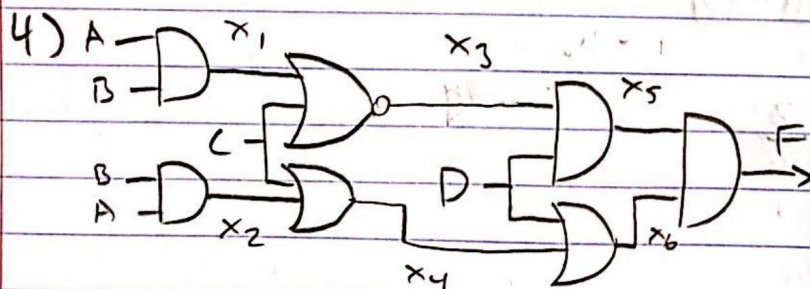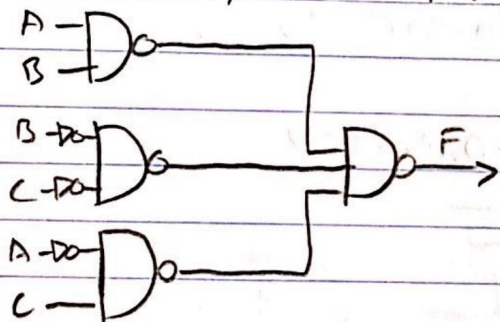- **2 pts** A'C branch is wrong

- **6 pts** other answers

3a) $F = AB + \bar{B}\bar{C} + \bar{A}C$

3b) $F = AB + B'C' + A'C = ((AB)'(B'C')'(A'C)')'$

$x_2' = AB, \ x_1' = B'C', \ x_0' = A'C$

$x_2 = (AB)', \ x_1 = (B'C')', \ x_0 = (A'C)'$

4)

$F = x_5 x_6 \quad x_5 = x_3 D \quad x_6 = x_4 + D$

$x_3 = (x_1 + C)' \quad x_4 = x_2 + C$

$x_1 = AB \quad x_2 = BA$

$x_3 = (AB + C)' \quad x_4 = AB + C$

$x_5 = (AB + C)' D \quad x_6 = AB + C + D$

$F = ((AB + C)' D)(AB + C + D)$

$F = ((AB)'C'D)(AB + C + D) - $ De Morgan's Law

$F = ((A' + B')C'D)(AB + C + D) - $ De Morgan's Law

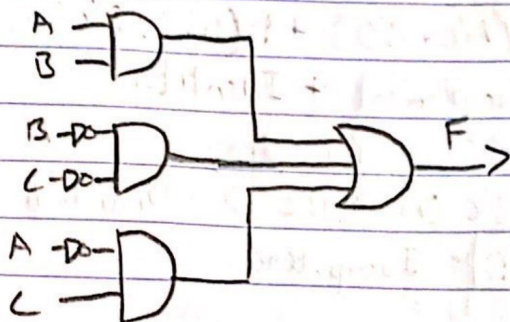$F = (A'C'D + B'C'D)(AB + C + D) - $ Distributivity

3.2 b 6 / 6

✓ **- 0 pts** Correct

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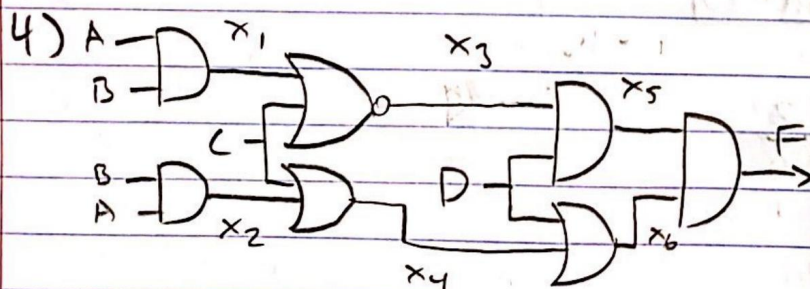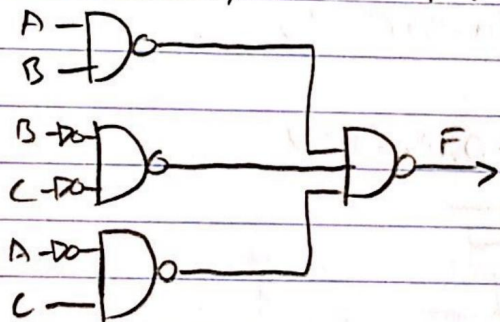- **2 pts** (AB)' branch is wrong

- **2 pts** (B'C')' branch is wrong

- **2 pts** (A'C)' branch is wrong

- **6 pts** other answers

gradescope

3a) $F = AB + \overline{B}\overline{C} + \overline{A}C$

3b) $F = AB + B'C' + A'C = ((AB)'(B'C')'(A'C)')'$

$x_2' = AB,\ x_1' = B'C',\ x_0' = A'C$

$x_2 = (AB)',\ x_1 = (B'C')',\ x_0 = (A'C)'$

4)

$F = x_5 x_6 \quad x_5 = x_3 D \quad x_6 = x_4 + D$

$x_3 = (x_1 + C)' \quad x_4 = x_2 + C$

$x_1 = AB \quad x_2 = BA$

$x_3 = (AB + C)' \quad x_4 = AB + C$

$x_5 = (AB + C)'D \quad x_6 = AB + C + D$

$F = ((AB + C)'D)(AB + C + D)$

$F = ((AB)'C'D)(AB + C + D)$ – De Morgan's Law

$F = ((A' + B')C'D)(AB + C + D)$ – De Morgan's Law

$F = (A'C'D + B'C'D)(AB + C + D)$ – Distributivity

$$F = AB(A'C'D + B'C'D) + C(A'C'D + D'C'D) + D(A'C'D + B'C'D)$$
$$F = AA'BC'D + ABB'C'D + CC'(A'D + B'D) + D(A'C' + B'C')$$
$$F = A'C'D + B'C'D \quad - \text{Complement + Identity}$$
$$F = A'C'D(B+B') + B'C'D(A+A') \quad - \text{Complement}$$
$$F = A'BC'D + A'B'C'D + AB'C'D + A'D'C'D \quad - \text{Distributivity}$$
$$\boxed{F = A'BC'D + A'D'CD + AB'C'D} \quad - \text{Idempotency}$$
$$F = 0101 + 0001 + 1001$$
$$F = m_1 + m_5 + m_9$$
$$F = M_0 M_2 M_3 M_4 M_6 M_7 M_8 M_{10} M_{11} M_{12} M_{13} M_{14} M_{15}$$
$$\boxed{\begin{aligned} F = &(A+B+C+D)(A+B+C'+D)(A+B+C'+D')(A+B'+C+D)(A+B'+C'+D) \\ &(A+B'+C'+D')(A'+B+C+D)(A'+B+C'+D)(A'+B+C'+D')(A'+B'+C+D) \\ &(A'+B'+C+D')(A'+B'+C'+D)(A'+B'+C'+D') \end{aligned}}$$

5a) High = 3.5V – 5.0V, Low = 0.0V ÷ 1.5V

1.0V = $\boxed{0}$

4.5V = $\boxed{1}$

2.0V = $\boxed{\text{Undefined}}$

–1.0V = $\boxed{\text{Undefined}}$

5b)

x	y	z
0	0	0
0	1	1
1	0	1
1	1	0

$\boxed{\text{XOR gate}}$

4 4 8 / 8

✓ **- 0 pts** Correct

    - 2 pts Incorrect initial expression for F

    - 1 pts Minor error for sum of minterms

    - 1 pts Minor error for product of maxterms

    - 3 pts Incorrect sum of minterms

    - 3 pts Incorrect product of maxterms

✓ **- 0 pts** Correct

    - 2 pts Incorrect initial expression for F

gradescope

$$F = AB(A'C'D + B'C'D) + C(A'C'D + D'C'D) + D(A'C'D + B'C'D)$$
$$F = AA'BC'D + ABB'C'D + CC'(A'D + B'D) + D(A'C' + B'C')$$
$$F = A'C'D + B'C'D \quad - \text{Complement + Identity}$$
$$F = A'C'D(B + B') + B'C'D(A + A') \quad - \text{Complement}$$
$$F = A'BC'D + A'B'C'D + AB'C'D + A'D'C'D \quad - \text{Distributivity}$$
$$\boxed{F = A'BC'D + A'D'CD + AB'C'D} \quad - \text{Idempotency}$$
$$F = 0101 + 0001 + 1001$$
$$F = m_1 + m_5 + m_9$$
$$F = M_0 M_2 M_3 M_4 M_6 M_7 M_8 M_{10} M_{11} M_{12} M_{13} M_{14} M_{15}$$
$$\boxed{\begin{array}{l} F = (A+B+C+D)(A+B+C'+D)(A+B+C'+D')(A+B'+C+D)(A+B'+C'+D) \\ (A+B'+C'+D')(A'+B+C+D)(A'+B+C'+D)(A'+B+C'+D')(A'+B'+C+D) \\ (A'+B'+C+D')(A'+B'+C'+D)(A'+B'+C'+D') \end{array}}$$

5a) High = 3.5V - 5.0V, Low = 0.0V ÷ 1.5V

$1.0V = \boxed{0}$

$4.5V = \boxed{1}$

$2.0V = \boxed{\text{Undefined}}$

$-1.0V = \boxed{\text{Undefined}}$

5b)

X	y	z
0	0	0
0	1	1
1	0	1
1	1	0

$\boxed{\text{XOR gate}}$

5.1 a 4 / 4

✓ **- 0 pts** Correct

  - 1 pts 1.0V: should be LOW or 0

  - 1 pts 4.5V: should be HIGH or 1

  - 1 pts 2.0V: should be undetermined/undecided/NA, etc

  - 1 pts -1.0V: should be undetermined/undecided/NA, etc

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$F = AB(A'C'D + B'C'D) + C(A'C'D+D'C'D) + D(A'C'D+B'C'D)$

$F = AA'BC'D + ABB'C'D + CC'(A'D+B'D) + D(A'C'+B'C')$

$F = A'C'D + B'C'D \quad - \text{Complement} + \text{Identity}$

$F = A'C'D(B+B') + B'C'D(A+A') - \text{Complement}$

$F = A'BC'D + A'B'C'D + AB'C'D + A'D'C'D - \text{Distributivity}$

$\boxed{F = A'BC'D + A'D'CD + AB'C'D} - \text{Idempotency}$

$F = 0101 + 0001 + 1001$

$F = m_1 + m_5 + m_9$

$F = M_0 M_2 M_3 M_4 M_6 M_7 M_8 M_{10} M_{11} M_{12} M_{13} M_{14} M_{15}$

$\boxed{\begin{aligned} F = &(A+B+C+D)(A+B+C'+D)(A+B+C'+D')(A+B'+C+D)(A+B'+C'+D) \\ &(A+B'+C'+D')(A'+B+C+D)(A'+B+C'+D)(A'+B+C'+D')(A'+B'+C+D) \\ &(A'+B'+C+D')(A'+B'+C'+D)(A'+B'+C'+D') \end{aligned}}$

5a) High = $3.5U - 5.0U$, Low = $0.0U \div 1.5U$

$1.0V = \boxed{0}$

$4.5V = \boxed{1}$

$2.0U = \boxed{\text{Undefined}}$

$-1.0U = \boxed{\text{Undefined}}$

5b)

X	y	z
0	0	0
0	1	1
1	0	1
1	1	0

$\boxed{\text{XOR gate}}$

5.2 b 4 / 4

✓ **- 0 pts** Correct

  - 4 pts should be XOR/exclusive-OR gate

6a)

A	B	Q₁						Z

A	B	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Z
0	0	L	H	L	H	H	L	0
0	1	H	L	L	H	H	H	–
1	0	L	H	H	L	L	L	✗
1	1	H	L	H	L	L	H	1

6b) It is poor design to use a transistor configuration that is capable of resulting in float or short, as both results are indeterminant. This means the transistor configuration would be inconsistent and likely lead to errors during use.
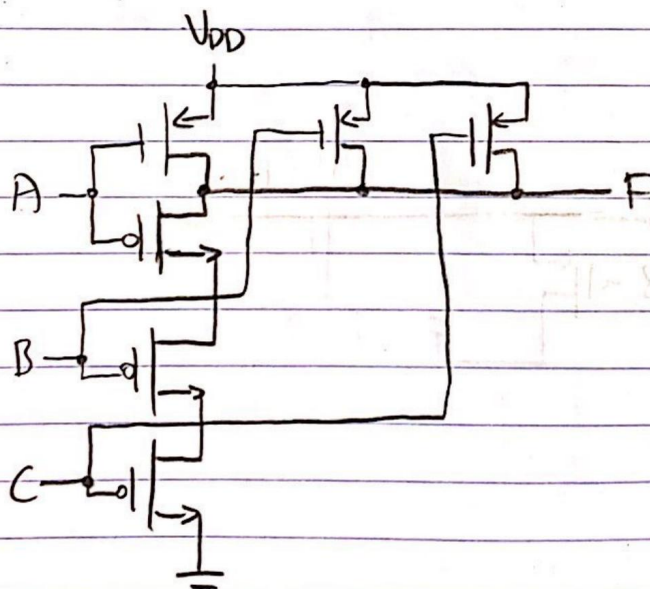
7a) $F = A + B + C$

6.1 a 14 / 14

✓ **- 0 pts** Correct

  - 2 pts 1st row of Z incorrect

  - 2 pts 2nd row of Z incorrect

  - 2 pts 3rd row of Z incorrect

  - 2 pts 4th row of Z incorrect

  - 1 pts Q1 incorrect

  - 1 pts Q2 incorrect

  - 1 pts Q3 incorrect

  - 1 pts Q4 incorrect

  - 1 pts Q5 incorrect

  - 1 pts Q6 incorrect

✓ **- 0 pts** Correct

  - 2 pts 1st row of Z incorrect

  - 2 pts 2nd row of Z incorrect

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6a)

A	B	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Z
0	0	L	H	L	H	H	L	0
0	1	H	L	L	H	H	H	—
1	0	L	H	H	L	L	L	*
1	1	H	L	H	L	L	H	1

6b) It is poor design to use a transistor configuration that is capable of resulting in float or short, as both results are indeterminant. This means the transistor configuration would be inconsistent and likely lead to errors during use.

7a) $F = A + B + C$

6.2 b 2 / 2
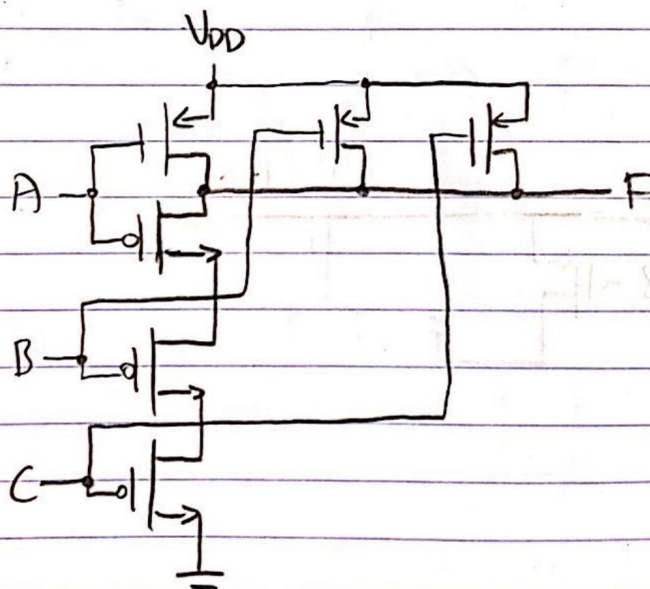
✓ **- 0 pts** Correct

- 1 pts Partially correct

- 2 pts Incorrect

- 2 pts Blank

6a)

A	B	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Z
0	0	L	H	L	H	H	L	0
0	1	H	L	L	H	H	H	—
1	0	L	H	H	L	L	L	✻
1	1	H	L	H	L	L	H	1

6b) It is poor design to use a transistor configuration that is capable of resulting in float or short, as both results are indeterminant. This means the transistor configuration would be inconsistent and likely lead to errors during use.

7a) F = A + B + C

7.1 a 2 / 4

    - 0 pts Correct

![Screen_Shot_2021-01-22_at_2.40.33_PM.png](/files/3648c0f6-adc3-4cfd-896e-9c1201463e85)

    - 2 pts Without the NOT gate on the right most

    - 2 pts valid, but more than 8 gates
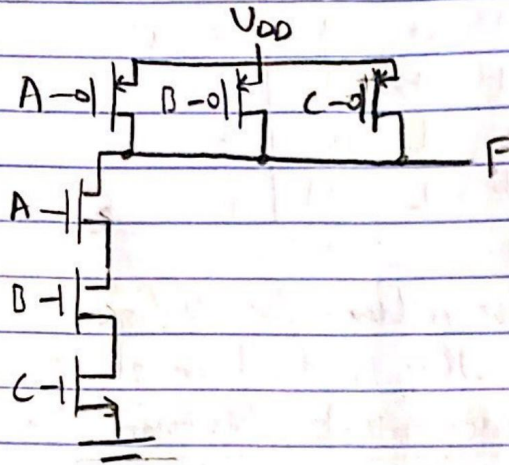
✓ **- 2 pts** other answers; common mistakes: connect the A of nMOS to VDD/connect the B of pMOS to GND

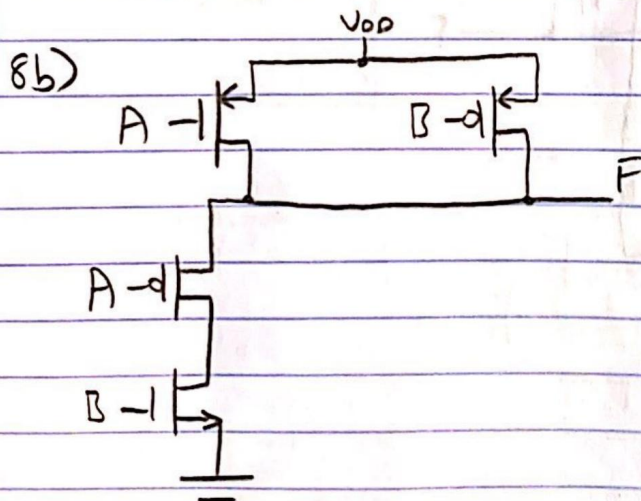![Screen_Shot_2021-01-22_at_2.47.10_PM.png](/files/d899cfb6-aeeb-46b4-a83b-7166b86e1857)

    - 4 pts blank

    - 0 pts Correct

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7b) $F = (A' + B' + C')$ → NAND gate

V_{DD}

A —o‖   B —o‖   C —o‖

F

A —‖

B —‖

C —‖

8a)

A	B	F
0	0	1
0	1	0
1	0	1
1	1	1

$F = A + B'$

V_{DD}

8b)

A —‖   B —o‖

F

A —o‖

B —‖

7.2 b **4 / 4**

✓ **- 0 pts** Correct

![Screen_Shot_2021-01-22_at_2.43.08_PM.png](/files/1b6630cc-7633-4aad-83d0-6f774ac6c25d)

   - 2 pts valid, but more than 6 gates
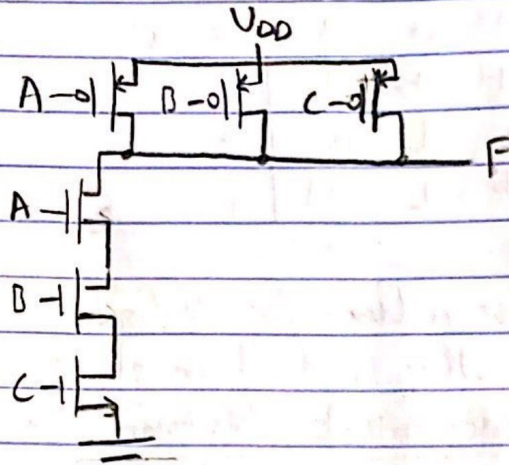
   - 2 pts other answers; common mistakes: connect the A of nMOS to VDD/connect the B of pMOS to GND

![Screen_Shot_2021-01-22_at_2.47.10_PM.png](/files/3ca318c5-6ca6-4d20-863d-b151117addec)
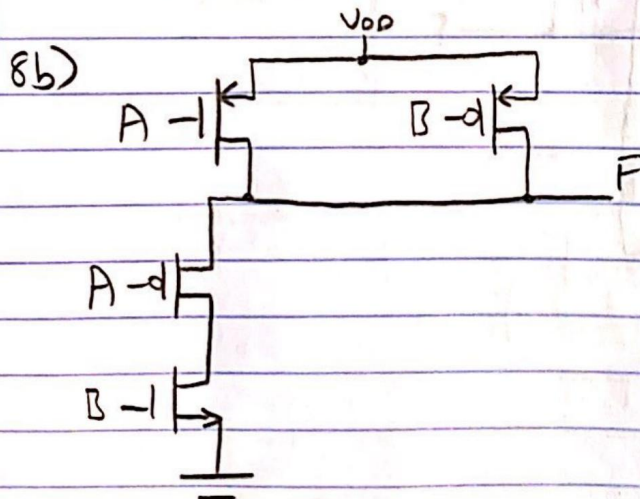
   - 4 pts blank

7.2 b **4 / 4**

✓ **- 0 pts** Correct

![Screen_Shot_2021-01-22_at_2.43.08_PM.png](/files/1b6630cc-7633-4aad-83d0-6f774ac6c25d)

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7b) $F = (A' + B' + C') \rightarrow$ NAND gate

V_{DD}

A —o[B —o[C —o[

F

A —[

B —[

C —[

8a)

A	B	F
0	0	1
0	1	0
1	0	1
1	1	1

$$F = A + B'$$

8b)

V_{DD}

A —[B —o[

F

A —o[

B —[

8.1 a 4 / 4

✓ **- 0 pts** Correct

- 4 pts Incorrect algebra function

7b) $F = (A' + B' + C') \rightarrow$ NAND gate

8a)

A	B	F
0	0	1
0	1	0
1	0	1
1	1	1

$$F = A + B'$$

8b)

8.2 b 2 / 4

- **0 pts** Correct
✓ **- 2 pts** PMOS should be connected to VDD and NMOS should be connected to GND.
- **1 pts** Minor error
- **1 pts** 1 extra transistors used
- **2 pts** 2 extra transistors used
- **3 pts** 3 or more extra transistors used
- **2 pts** Use A' or B' as input
- **2 pts** Other major error
- **4 pts** Blank

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- **2 pts** PMOS should be connected to VDD and NMOS should be connected to GND.