[CS M51A Fall 15] Quiz 1

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- The quiz is closed book, and closed notes (30mins).
- Please show all your work and write legibly, otherwise no partial credit will be given.
- **This should strictly be your own work; any form of collaboration will be penalized.**

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Quiz Problems (50 points total)

Problem 1 (10 points)

Find x and y such that the following conditions are satisfied and show all the steps of your work.

1. **(5 points)** $(818)_9 = (x)_3$

convert to base 10

↓

divide by powers of 3 until remainder 0

$8 \cdot 9^2 + 8 \cdot 9^1 + 8 \cdot 9^0 =$

$81 \cdot 8 + 9 \cdot 8 + 8 =$

$81 \cdot 3 = 243$, 729

$648 + 72 + 8$ = 728

3^0 3^1 3^2 3^3 3^4 3^5 $729 = 3^6$

$\boxed{(222222)_3}$ =

$2 \cdot 243 + 2 \cdot 81 + 2 \cdot 27 + 2 \cdot 9 + 2 \cdot 3 + 2$

because in base 3,

729 = 1000000

728 is 1 less → = 1000000 − 1 =

222 222

2. **(5 points)** What is the largest number y that can be represented with 4 digit-vector in radix 5. Show y in radix 5 and decimal.

4 digits in radix 5 = abcd

$(a \cdot 5^3 + b \cdot 5^2 + c \cdot 5^1 + d \cdot 5^0)_{10} =$

largest digit in radix 5 is 4, so

$a = b = c = d = 4$

$\boxed{y = (4444)_5}$ largest number

$4 \cdot 5^3 + 4 \cdot 5^2 + 4 \cdot 5^1 + 4 \cdot 5^0 =$

$125 \cdot 4 + 25 \cdot 4 + 20 + 4 =$

$500 + 100 + 20 + 4 = (624)_{10}$

$\boxed{y = (624)_{10}}$

Problem 2 (16 points)

Solve the following problems using the postulates and theorems of Boolean algebra. **Do not use a truth table.**

1. **(8 points)** The Boolean function f is defined as $f(a,b,c) = ac' + a'b$ and the Boolean function g is defined as $g(a,b,c) = ac + b'c + a'b'$. Show that $g(a,b,c)' = f(a,b,c)$.

$g(a,b,c)' = (ac + b'c + a'b')' = (ac + b'c)'(a'b')' = (ac)'(b'c)'(a'b')' =$

$(a' + c')(b + c')(a + b) = \quad a(a' + c')(b + c') + b(b + c')(a' + c') =$

$a(c')(b + c') + b(a' + c')$

$ac' + a'b + bc' =$

$c' + (ab) + (a'b) =$

$c' + b + (a + a') = \boxed{c' + b}$

$f(a,b,c) = ac' + a'b =$

$\boxed{c' + b}$

-4

$xy'|$

$x\&y' \mid y'$

$(x'+y)(x)$

$x(x'+y)' =$

$(xy)' = x'+y'$

2. **(8 points)** Simplify the following expression.

$$xyzw' + xyz' + xy' + x'$$

$xy(zw' + z')$

$xy(z' + w') =$

$xyz' + xyw' + x' + y' =$

$xy(z'+w') + (xy)' =$

$(xy)' + (z'+w') =$

$\boxed{x' + y' + w' + z'}$

$ak + a'$

Problem 3 (24 points)

F is a function that accepts inputs $x \in \{0, 1, 2\}$, $y \in \{1, 2, 3\}$, and outputs $z = max(x^2, y)$. Suppose you use binary code to encode x, y, and z. x is encoded as x_1x_0, y is encoded as y_1y_0, z is encoded as $z_2z_1z_0$.

1. **(16 points)** Fill in the table below.

x_1	x_0	y_1	y_0	z_2	z_1	z_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	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	1
1	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	–	–	–
1	1	0	1	–	–	–
1	1	1	0	–	–	–
1	1	1	1	–	–	–

2. **(8 points)** Fill in the sets in the forms specified below.

$$
\begin{aligned}
z_2 &= \sum m(\ 9, 10, 11 \qquad) \\
z_1 &= \sum m(\ 2, 3, 6, 7 \qquad) \\
z_0 &= \prod M(\ 2, 6, 9, 10, 11 \ ) \\
dc - set\ of\ z_1 &= dc(\ \Sigma\, m(0, 4, 8, 12, 13, 14, 15
\end{aligned}
$$