1 Scratch Check

TakeTwo1 and TakeTwo2. As we know, it is a winning strategy to take blocks so that you have a multiple of 3 blocks left. The closest multiple of 3 that is less than 5 is 3. So we take (5-2)=3. The computer (or the circuit) takes 1 block and then you again take 2 to win the game.

2 Barcode Hopping

Any two products from the same company is ok. Everyone got this right.

3 Missing Barcode Numbers

3.1 A

04119000069x

\[3(0 + 1 + 9 + 0 + 0 + 9) + (4 + 1 + 0 + 0 + 6 + x) = 68 + x\]

The closest multiple of 10 greater than or equal to 68 is 70. So, \(x=70-68=2\).

3.2 B

02x254665163

\[3(0 + x + 5 + 6 + 5 + 5) + (2 + 2 + 4 + 6 + 1 + 3) = 81 + 3x\]

The closest multiple of 10 greater than or equal to 81 is 90. So, \(81 + 3x = 90 \implies x = 3\)

3.3 C

028002156x6

\[3(0 + 8 + 0 + 2 + 5 + x) + (2 + 0 + 0 + 1 + 6 + 6) = 60 + 3x\]

The closest multiple of 10 greater than or equal to 60 is 60. So, \(x=0\).

Some people got it wrong in the following way: The closest multiple of 10 greater than 60 is 70. \(60 + 3x = 70\). This equation doesn’t give an Integer value for \(x\)! So, some just said that \(x=10\).
3.4 D
I just took off 2 points for not making anything with them.

4 True or False?

1. \[ F \text{ and} ((\neg T \text{ or } F) \text{ and } (T \text{ and } F)) \]
   \[= F \text{ and} ((F \text{ or } F) \text{ and } F) \]
   \[= F \text{ and}(F \text{ and } F) \]
   \[= F. \]

2. \[ ((\neg (T \text{ and } F))\text{ and } T) \text{ or } (F \text{ and } not F) \]
   \[= ((\neg F \text{ and } T) \text{ or } F) \text{ or } (F \text{ and } T) \]
   \[= (T \text{ or } F) \text{ or } (F \text{ and } T) \]
   \[= T \text{ or } F \]
   \[= T. \]

3. \[ ((\neg (not \text{ not } T \text{ or } not F)) \text{ or } not F) \text{ and } (not F \text{ or } ((\neg F \text{ and } F) \text{ or } F)) \]
   \[= (( T \text{ or } T) \text{ or } F) \text{ and } (T \text{ or } ((T \text{ and } F) \text{ or } F)) \]
   \[= (T \text{ or } F) \text{ and } (T \text{ or } (F \text{ or } F)) \]
   \[= T \text{ and } (T \text{ or } T) \]
   \[= T \text{ and } T= T \]

The only reason you may have got it wrong is because you either did not do it step by step or you did not apply the operators according to their order of priority. You should work on the () first, then NOT and then AND, OR.

5 Logical Switches
Light = (x AND z) OR (w AND y)
Switches that are in series should be ANDeD with each other. The ones in parallel should be ORed. Some of you wrote the other way round. I also deducted points if you failed to give parentheses. Note that x AND z OR w AND y is ambiguous, you can interpret it as x AND (z OR w) AND y, which is wrong for this circuit.

6 Relay Circuit
Many people got this wrong. Note that the coil of the relay at the bottom is directly connected to the power source. So, the switch is always open. So, input B has no effect on output C. When A=T, the switch in the upper relay is open. So, C is not connected to the Power source. i.e. C= F. If A=F, the switch is closed and C=T. So, C is the inverse of A. So, the entries in the Truth Table should be C = T T F F (from top to bottom).
The required expression is $C = (\text{not } A \text{ and not } B) \text{ or } (\text{not } A \text{ and } B) = \text{not } A$. (you don’t have to simplify to get full points). But I do recommend that you always follow the procedure discussed in the class to get the expression (i.e take the entries in the Truth Table that says T and OR them).

Your mistake in finding the Truth Table did not effect your grades for the expression. I only checked if your expression is consistent with whatever you have in the Table.

I took of 2 point for not giving any name to the gate.

7 What can they be?

Left Table:
$C = (A \text{ and not } B) \text{ or } (A \text{ and } B) = A$

Right Table:
$C = (A \text{ and not } B) \text{ or } (\text{not } A \text{ and } B)$

Please follow the steps and you will hardly make any mistakes.

8 True or False?

1. $(Y \text{ or } (\text{not } C \text{ or } Y)) \text{ and } (X \text{ and } Y) =$
   $(F \text{ or } (\text{not } T \text{ or } F)) \text{ and } (T \text{ and } F)$
   $=(F \text{ or } (F \text{ or } F)) \text{ and } F$
   $=(F \text{ or } F) \text{ and } F$
   $=F$ and $F$
   $=F$

2. $(\text{not not}((x \text{ and } Y) \text{ and } C) \text{ or } \text{not } Y) \text{ or } (Y \text{ and } \text{not } Y)$
   $=(\text{not not}((T \text{ and } F) \text{ and } T) \text{ or } T) \text{ or } F$
   $=((F \text{ and } T) \text{ or } T) \text{ or } T$
   $=(F \text{ or } T)$
   $=T$

3. $((\text{not not} X \text{ or not } Y ) \text{ or } \text{not } Y) \text{ and } (\text{not } Y \text{ or } ((\text{not not } Y \text{ and } Y)\text{or } Y))$
   $=(( X \text{ or not } Y ) \text{ or } \text{not } Y) \text{ and } (\text{not } Y \text{ or } (Y \text{ and } Y)\text{or } Y))$
   $=(( T \text{ or } T) \text{ or } T) \text{ and } (T \text{ or } (Y \text{ or } Y))$
   $=(T \text{ or } T) \text{ and } (T \text{ or } F)$
   $=T \text{ and } T$
   $=T$

9 Pictures and Words

Each image is $3264 \times 2448$ pixels. Each pixel is 24 bits. So , one image is $3264 \times 2448 \times 24$. You can leave your answer just like this.
We record 192 Kilobites (=192000 bits) in one second. We have 350 seconds of recording. That is 192000 × 350 bits. Since we say a thousand words in 350 seconds, we need 192000 × 350 bits to record a thousand words.