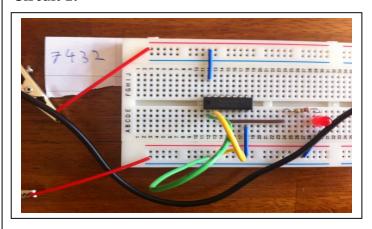
## Task 1: Practical - Build a logic circuit/circuits to show the operation six digital IC's

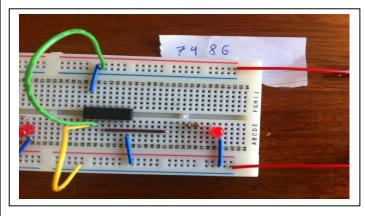
#### Circuit 1:



## Create a truth table for this logic circuit.

р	q	
1	1	1
1	0	1
0	1	1
0	0	0
0	0	0

#### Circuit 2:



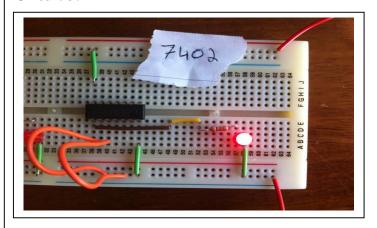
Logic Gate Name: XOR

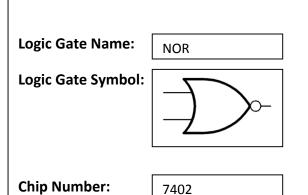
Logic Gate Symbol: 7486

Create a truth table for this logic circuit.

•	Ч	
1	1	0
1	0	1
0	1	1
0	0	0

#### Circuit 3:

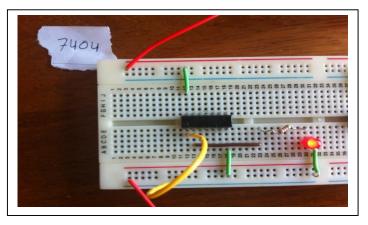


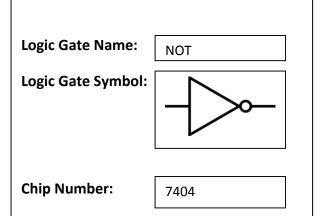


# Create a truth table for this logic circuit.

р	q	
1	1	0
1	0	0
0	1	0
0	0	1

#### Circuit 4:

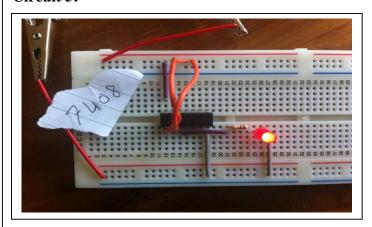


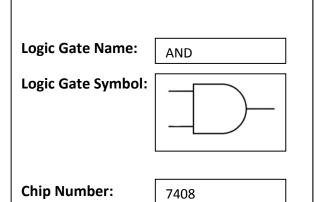


## Create a truth table for this logic circuit.

р	
1	0
0	1

#### Circuit 5:

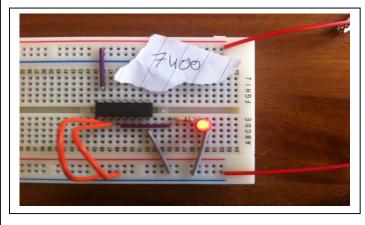


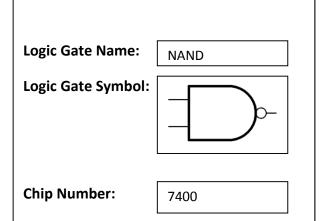


#### Create a truth table for this logic circuit.

р	q	
1	1	1
1	0	0
0	1	0
0	0	0

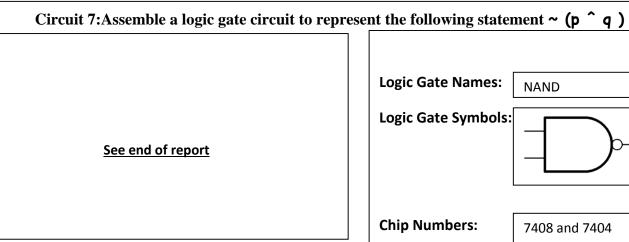
#### Circuit 6:

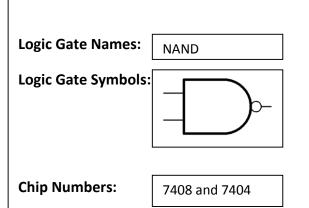




# Create a truth table for this logic circuit.

р	q	
1	1	0
1	0	1
0	1	1
0	0	1
<u> </u>	0	1





# Create a truth table for this logic circuit.

q	p^q	~(p^q)
1	1	0
0	0	1
1	0	1
0	0	1
	q 1 0 1 0	q     p^q       1     1       0     0       1     0       0     0

# Circuit 8: Assemble a logic gate circuit to represent the following statement $r \ v \ (p \ q)$

See end of report

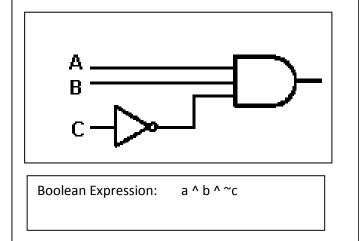
**Logic Gate Names:** AND OR **Logic Gate Symbols: Chip Numbers:** 7408 7432

## Create a truth table for this logic circuit.

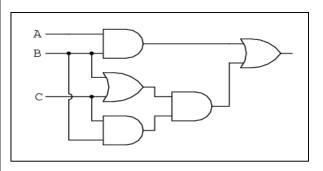
р	q	r	p ^ q	r v (p^q)
1	1	1	1	1
1	1	0	1	1
0	1	1	0	1
1	0	1	0	1
1	0	0	0	0
0	1	0	0	0
0	0	1	0	1
0	0	0	0	0
· · · · · · · · · · · · · · · · · · ·		•		

**Task 2: Problems Solving:** 

1.Write a Boolean expression to represent the following logic gate circuit

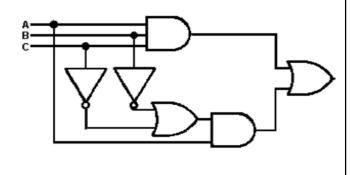


2. Write a Boolean expression to represent the following logic gate circuit



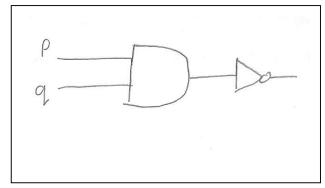
Boolean Expression: (a ^ b) v ((b v c) ^ (b ^ c))

3. Write a Boolean expression to represent the following logic gate circuit

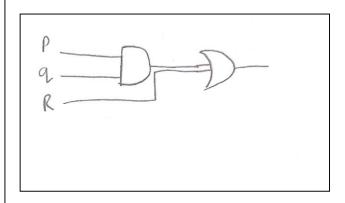


Boolean Expression: (a ^ b ^ c) v (~b v ~c) ^ a

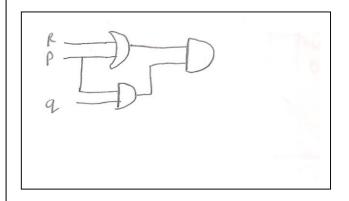
4.Draw the logic gates to represent this Boolean expression.



5.Draw the logic gates to represent this Boolean expression.



6.Draw the logic gates to represent this Boolean expression.



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7. Use a truth table to determine if the following statement is true or false.

р	q	r	qvr	p ^ (q v r)	p ^ q	p ^ r	(p ^ q) v (p ^ r)
1	1	1	1	1	1	1	1
1	1	0	1	1	1	0	1
0	1	1	1	0	0	0	0
1	0	1	1	1	0	1	1
1	0	0	0	0	0	0	0
0	1	0	1	0	0	0	0
0	0	1	1	0	0	0	0
0	0	0	0	0	0	0	0

8. Using truth tables prove de Morgan's law that

р	q	p ^ q	~(p ^ q)		р	q	~p	~q	~p v ~q
1	1	1	0		1	1	0	0	0
1	0	0	1	≡	1	0	0	1	1
0	1	0	1		0	1	1	0	1
0	0	0	1		0	0	1	1	1

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9. Design an interactive worksheet to convert from base 2, 8 and 16 to the base

10 equivalent.

a .Explain the operation of converting a base 2, base 8 and base 16 number to it's decimal equivalent. Include a minimum of 3 worked examples.

To convert from any base to base 10, we use the place values of the binary number as powers. We then multiply each digit of the binary number by the base to the place value power. We then add the results to get the decimal equivalent.

From Base 2 to Base 10:

```
1(4) \quad 0(3) \quad 0(2) \quad 1(1) \quad 1(0) \quad (base 2)
1x2^{4} + 0x2^{3} + 0x2^{2} + 1x2^{1} + 1x2^{0}
= 16 \quad + \quad 0 \quad + \quad 0 \quad + \quad 2 \quad + \quad 1
= 19
```

From Base 8 to Base 10:

```
5(2) 4(1) 5(0) (base 8)

5x8^2 + 4x8^1 + 5x8^0

= (5x64) + (4x8) + (5x1)

= 320 + 32 + 5

= 357
```

From Base 16 to Base 10:

```
1(2) 6(1) 5(0) (base 16)

1x16^2 + 6x16^1 + 5x16^0

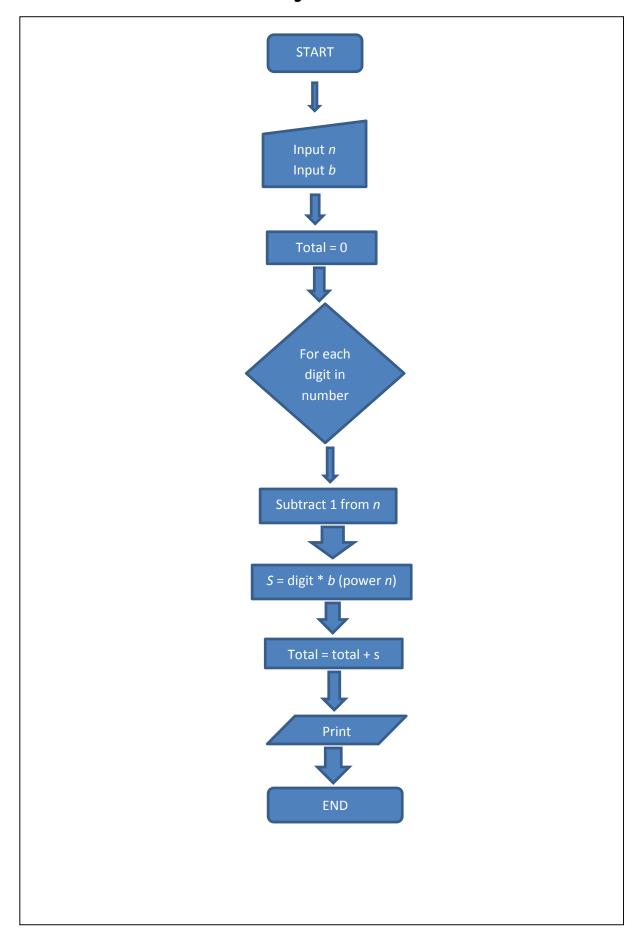
= 256 + 96 + 5

= 357
```

## b . Produce an algorithm of the above task.

1.	Start
2.	Let <i>n</i> be the number of digits in the number
3.	Let b be the base of the number
4.	Set total (s) to zero
5.	For each digit in the number
	a. Subtract 1 from <i>n</i>
	b. Multiply the digit times $b$ to the power of $n$ and add it to $s$
6.	Print total
7.	End procedure

#### c. Produce a flowchart of the above algorithm.



# d. Include screenshots of worksheet showing solutions to problems specified in part a.



Tutor: Carol Ward Assignment 1:

	Α	В		С	
Place Value		=C2*\$L\$3	=D2*\$	II \$3	
Power		7	6		
D		E			
=E2*\$L\$3	=	-2* <b>\$L\$</b> 3			
5	4				
DACE 40:		CUMPROPULATION.	10 D (d.14)		
BASE 10:	=;	SUMPRODUCT(B2:	12,64:14)		
F	: [	G			
		_			
=G2*\$L\$3		H2*\$L\$3			
3	2		ļ		
			ļ.		
H	1	I			
10001.00					
=I2*\$L\$3	1		-		
2	2				
K	L M	N	1	0	Р
BASE: 2			Hexidecima	Table	
-		Base 10 0			Base 16 0
		1 2			1 2
		3			3
		4 5			5
		6			6
		7 8			8
		9			9 A
		11			В
		12 13			D
		14 15			C D E

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10. Design an interactive worksheet that can add and subtract two 6 digit

binary numbers.

a .Explain the operation of adding and subtracting two . Include a minimum of 3 worked examples.

When adding two binary numbers, we must follow a set of rules (1+0=1, 0+0=1) unless both numbers are a 1, in which case we put down a 0 and carry a 1 (as 1+1 in binary is 10(one zero)). If there are three 1's, we then put down a 1 and carry a 1 (as 1+1+1 in binary is 11(one one)).

#### Examples:

When subtracting two binary numbers, we must first get the 1's complement of the number. This is achieved by changing 1's to 0's, and 0's to 1's (e.g. 100110 becomes 011001). We then find the 2's complement of our inverted binary number, this is done by adding 1 to the least significant digit. Once we've done that, we then add our original number to the 2's complement.

#### Example:

	1	0	1	1	1	0	(Original Number)
	0	1	0	0	0	1	(1's Complement)
+	0	0	0	0	(1)0	1	
=	0	1	0	0	1	0	(2's Complement)
	1	0	1	1	1	0	(Original Number)
+	(1)0	(1)1	(1)0	(1)0	1	0	(2's Complement)
=	1 0	0	0	0	0	0	

#### b. Produce an algorithm of the above task.

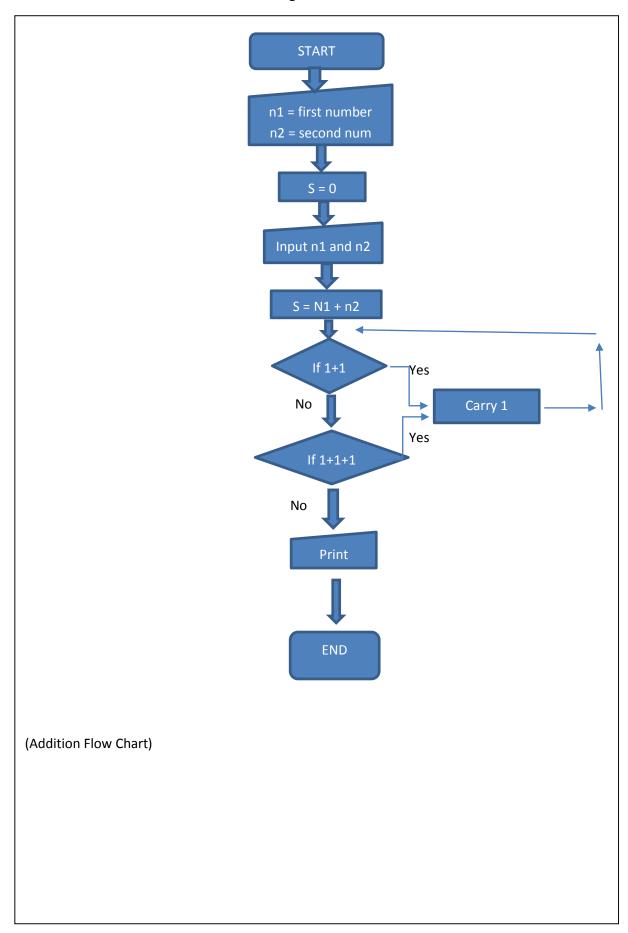
#### Addition:

- 1. Start
- 2. Let *n1* be the first number
- 3. Let *n2* be the second number
- 4. Let s be the total
- 5. Add the two numbers
  - a. Put down 0 and Carry 1 if the sum is 1 + 1
  - b. Put down 1 and Carry 1 if sum is 1 + 1 + 1
- 6. Print result
- 7. End

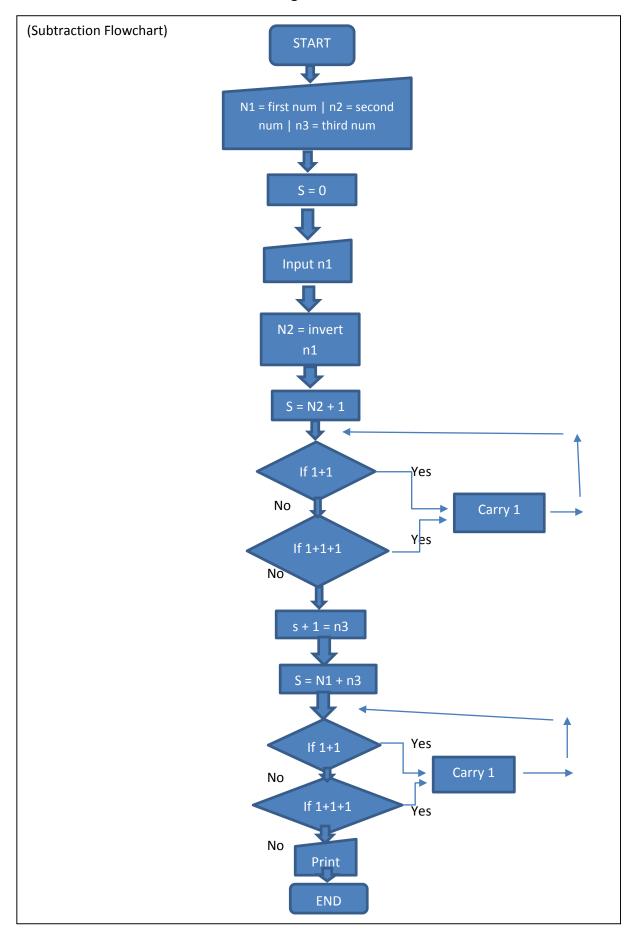
#### Subtraction:

- 1. Start
- 2. Let *n1* be the original number
- 3. Let *n2* be the 1's complement
- 4. Let s = total
- 5. Invert *n*1 to find *n*2
- 6. Add 1 to *n2* to get *n3* 
  - a. Put down 0 and carry 1 if the sum is 1+1
  - b. Put down 1 and carry 1 if the sum is 1+1+1
- 7. Let *n3* be the 2's complement
- 8. Add *n1* and *n3* 
  - a. Put down 0 and carry 1 if the sum is 1+1
  - b. Put down 1 and carry 1 if the sum is 1+1+1
- 9. Print result
- 10. End

#### c. Produce a flowchart of the above algorithm.



#### c. Produce a flowchart of the above algorithm.



# d. Include screenshots of your worksheet showing solutions to problems specified in part a above

٩dc	dition:										
4	Α	В	С		)	Е	F		G	Н	
1											
2											
3											
4											
5	Carry			1	1	0		1	0		
6		_		1	1	1		0	1	1	
7				1	0	1		0	1	0	
8		1		1	0	0		1	0	1	
9			•	1	0	U		-	0		
Sub	traction:										
4	Α	В		С	D	Е	F	=	G	Н	
1											
2											
4											
5		Carry		0	0		0	0	1		
6		<b>Original Nu</b>		1	0		1	1	1	0	
7		1's Compler		0	1		0	0	0	1	
8		-		0	0		0	0	0	1	
9	=	2's Compler	nent	0	1	-	0	0	1	0	
10 11		Carn		1	1		1	1	0		
12		Carry Original Nu	mber	1	0		0	1	1	0	
3		2's Compler		0	1		1	0	1	0	
14			1	0	0		0	0	0	0	
15											
			✓ f <sub>x</sub>								
1 2 3	0 A	* : X		С	D	Е		F	G	Н	
1 2 3					D	E		F	G	Н	
1 2 3 4 5		Carry		0	(	)	0	F 0		0	
1 2 3 4 5		Carry Original Nu		0	(		0	0		0	1
1 2 3 4 5 6	A	Carry Original Nu 1's Comple		0 1 0	(		0 0 1	0 1 0		0	0
1 2 3 4 5 6 7 8	A	Carry Original Nu 1's Comple	ment	0 1 0	(		0 0 1 0	0 1 0 0		0 0 1	0
1 2 3 4 5 6 7 8	A	Carry Original Nu 1's Comple	ment	0 1 0	(		0 0 1	0 1 0		0	0
1 2 3 4 5 6 7 8 9	A	Carry Original Nu 1's Comple	ment	0 1 0 0	(		0 0 1 0	0 1 0 0		0 0 1 0 1	0
1 2 3 4 5 6 7 8 9	A	Carry Original Nu 1's Comple 2's Comple Carry	ment	0 1 0 0 0			0 0 1 0	0 1 0 0		0 0 1 0 1	0 1 1
1	A	Carry Original Nu 1's Comple	ment	0 1 0 0			0 0 1 0	0 1 0 0		0 0 1 0 1	0

Assignment 1:

Tutor: Carol Ward

Addition:
В
=IF(OR(AND(C5=1,C6=1,C7=1),AND(C5=0,C6=1,C7=1),AND(C5=1,C6=1,C7=0),AND(C5=1,C6=0,C7=1)),1,0)
С
=IF(OR(AND(D5=1,D6=1,D7=1),AND(D5=0,D6=1,D7=1),AND(D5=1,D6=1,D7=0),AND(D5=1,D6=0,D7=1)),1,0)
1
1 =IF(OR(AND(C5=0,C6=0,C7=0),AND(C5=0,C6=1,C7=1),AND(C5=1,C6=1,C7=0),AND(C5=1,C6=0,C7=1)),0,1)
D
=IF(OR(AND(E5=1,E6=1,E7=1),AND(E5=0,E6=1,E7=1),AND(E5=1,E6=1,E7=0),AND(E5=1,E6=0,E7=1)),1,0)
<u>1</u> 0
=IF(OR(AND(D5=0,D6=0,D7=0),AND(D5=0,D6=1,D7=1),AND(D5=1,D6=1,D7=0),AND(D5=1,D6=0,D7=1)),0,1)
_
E
=IF(OR(AND(F5=1,F6=1,F7=1),AND(F5=0,F6=1,F7=1),AND(F5=1,F6=1,F7=0),AND(F5=1,F6=0,F7=1)),1,0) 1
1
=IF(OR(AND(E5=0,E6=0,E7=0),AND(E5=0,E6=1,E7=1),AND(E5=1,E6=1,E7=0),AND(E5=1,E6=0,E7=1)),0,1)

		F			
IF(OR(AND(G5=1,G6	-1.G7=1).AND(G5=0	.G6=1.G7=1).AN	D(G5=1.G6=1.G7	7=0).AND(G5=1.	.G6=0.G7=1)).1.0)
	2,0,000	,,, ,	2,00 2,00		
IF(OR(AND(F5=0,F6=	),F7=0),AND(F5=0,F	6=1,F7=1),AND(F	5=1.F6=1.F7=0).	AND(F5=1,F6=0	),F7=1)),O,1)
		G			
IF(AND(H6=1,H7=1),	1,0)				
IF(OR(AND(G5=0,G6	=0,G7=0),AND(G5=0	,G6=1,G7=1),ANI	D(G5=1,G6=1,G7	'=0),AND(G5=1,	G6=0,G7=1)),0,1)
				., .	
	Н				
L					
)					
IF(OR(AND(H	6=0,H7=0),AN	ND(H6=1,H7	7=1)),0,1)		

Subtraction:
В
Carry
Original Number
1's Complement +
= 2's Complement
Carry
Original Number + 2's Complement
= IF(OR(AND(B11=0,B12=0,B7=0),AND(B11=0,B12=1,B13=1),AND(B11=1,B12=1,B13=0),AND(B11=1,B12=0,B13=1)),0,1)
C
=IF(OR(AND(D5=1,D7=1,D8=1),AND(D5=0,D7=1,D8=1),AND(D5=1,D7=1,D8=0),AND(D5=1,D7=0,D8=1)),1,0)
1
=IF(C6=0,1,IF(C6=1,0)) 0
=IF(OR(AND(C5=0,C7=0,C8=0),AND(C5=0,C7=1,C8=1),AND(C5=1,C7=1,C8=0),AND(C5=1,C7=0,C8=1)),0,1)
=IF(OR(AND(D11=1,D12=1,D13=1),AND(D11=0,D12=1,D13=1),AND(D11=1,D12=1,D13=0),AND(D11=1,D12=0,D13=1)),1,0)
1 0
=IF(OR(AND(C11=0,C12=0,C7=0),AND(C11=0,C12=1,C13=1),AND(C11=1,C12=1,C13=0),AND(C11=1,C12=0,C13=1)),0,1)
D
-IE/OD/AND/EE-4 E7-4 F0-4\ AND/EE-0 E7-4 F0-4\ AND/EE-4 E7-4 F0-0\ AND/EE-4 E7-0 F0-4\\4.0\
=IF(OR(AND(E5=1,E7=1,E8=1),AND(E5=0,E7=1,E8=1),AND(E5=1,E7=1,E8=0),AND(E5=1,E7=0,E8=1)),1,0)
=IF(D6=0,1,IF(D6=1,0)) 0
=IF(OR(AND(D5=0,D7=0,D8=0),AND(D5=0,D7=1,D8=1),AND(D5=1,D7=1,D8=0),AND(D5=1,D7=0,D8=1)),0,1)
=IF(OR(AND(E11=1,E12=1,E13=1),AND(E11=0,E12=1,E13=1),AND(E11=1,E12=1,E13=0),AND(E11=1,E12=0,E13=1)),1,0)
0
1 =IF(OR(AND(D11=0,D12=0,D7=0),AND(D11=0,D12=1,D13=1),AND(D11=1,D12=1,D13=0),AND(D11=1,D12=0,D13=1)),0,1)
E
=IF(OR(AND(F5=1,F7=1,F8=1),AND(F5=0,F7=1,F8=1),AND(F5=1,F7=1,F8=0),AND(F5=1,F7=0,F8=1)),1,0)
1 =IF(E6=0,1,IF(E6=1,0))
0
=IF(OR(AND(E5=0,E7=0,E8=0),AND(E5=0,E7=1,E8=1),AND(E5=1,E7=1,E8=0),AND(E5=1,E7=0,E8=1)),0,1)
=IF(OR(AND(F11=1,F12=1,F13=1),AND(F11=0,F12=1,F13=1),AND(F11=1,F12=1,F13=0),AND(F11=1,F12=0,F13=1)),1,0)
1 =IF(OR(AND(E11=0,E12=0,E7=0),AND(E11=0,E12=1,E13=1),AND(E11=1,E12=1,E13=0),AND(E11=1,E12=0,E13=1)),0,1)

F
=IF(OR(AND(G5=1,G7=1,G8=1),AND(G5=0,G7=1,G8=1),AND(G5=1,G7=1,G8=0),AND(G5=1,G7=0,G8=1)),1,0)
1 =IF(F6=0,1,IF(F6=1,0))
)
=IF(OR(AND(F5=0,F7=0,F8=0),AND(F5=0,F7=1,F8=1),AND(F5=1,F7=1,F8=0),AND(F5=1,F7=0,F8=1)),0,1)
=IF(OR(AND(G11=1,G12=1,G13=1),AND(G11=0,G12=1,G13=1),AND(G11=1,G12=1,G13=0),AND(G11=1,G12=0,G13=1)),1,0
=IF(OR(AND(F11=0,F12=0,F7=0),AND(F11=0,F12=1,F13=1),AND(F11=1,F12=1,F13=0),AND(F11=1,F12=0,F13=1)),0,1)
G
=IF(AND(H7=1,H8=1),1,0)
1
=IF(G6=0,1,IF(G6=1,0)) 0
=IF(OR(AND(G5=0,G7=0,G8=0),AND(G5=0,G7=1,G8=1),AND(G5=1,G7=1,G8=0),AND(G5=1,G7=0,G8=1)),0,1)
=IF(AND(H12=1,H13=1),1,0)
1
1 =IF(OR(AND(G11=0,G12=0,G7=0),AND(G11=0,G12=1,G13=1),AND(G11=1,G12=1,G13=0),AND(G11=1,G12=0,G13=1)),0,1
Н
0
=IF(H6=0,1,IF(H6=1,0))
1 -IE/OD/AND/LIZ-0.LIQ-0\ AND/LIZ-1.LIQ-1\\ 0.1\
=IF(OR(AND(H7=0,H8=0),AND(H7=1,H8=1)),0,1)
0
0
=IF(OR(AND(H12=0,H13=0),AND(H12=1,H13=1)),0,1)
11 (01() 112 0,110 0),7 112 1,110 1),5,1)

Computer Science 1B (061XB) Learner Name: Joseph Tierney

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