

1.

a. Define half adder.

The half adder is a type of combinational logic circuit that adds two of the 1-bit binary digits. It generates carry and sum of both the inputs. The full adder is also a type of combinational logic that adds three of the 1-bit binary digits for performing an addition operation.

b. Draw a truth table for the sum and carry of half adder.

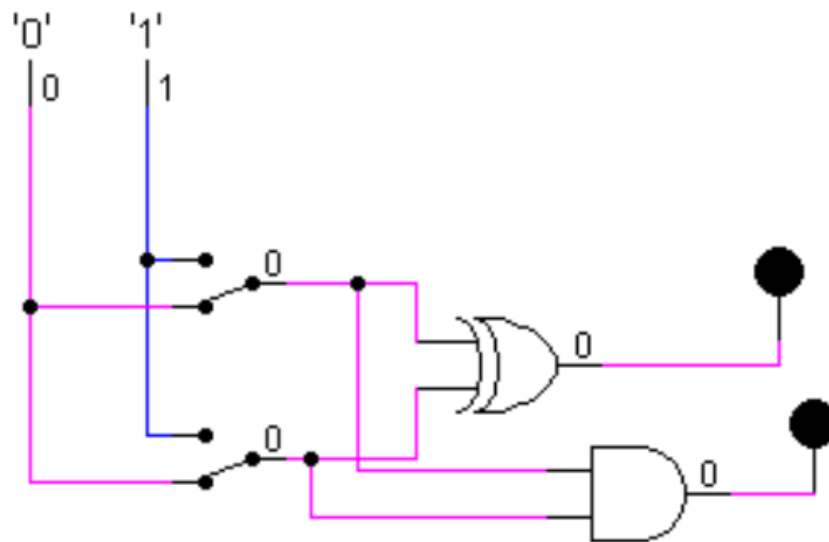
Truth table

-Input A	-input B	-S(Sum)
0	0	0
0	1	1
1	0	1
1	1	0

c. Write the sop expression from the truth table.

-SOP expression sum= $AB' + A'B$ -SOP expression carry= $A'B$

d. Draw the circuit using logsim.



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2.

a. Draw the truth table for the outputs of the full adder

- e. Write the corresponding sop expression for sum and carry of full adder and simplify the expression

-A full adder circuit is central to most digital circuit that perform addition or subtraction. It is so called because it adds together two binary digits, plus a carry-in digit to produce a sum and carry-out digit. 1. It therefore has three inputs and two outputs. Truth Table for full Adder:

A	B	C	Sum	Carry Out
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	1
1	0	0	0	0
1	0	1	1	1
1	1	0	0	1
1	1	1	1	1

SOP expression carry = $A'BC + AB'C + ABC' + A'B'C'$

$$= A'BC + ABC + ABC + AB'C + ABC' + ABC'$$

$$= BC(A+A) + AC(B-B') + AB(C-C')$$

$$= AB + BC + AC$$

SOP expression sum = $A'B'C + AB'C + A'BC' + ABC$

$$= A'(B'C + BC') + A(B'C' + BC)$$

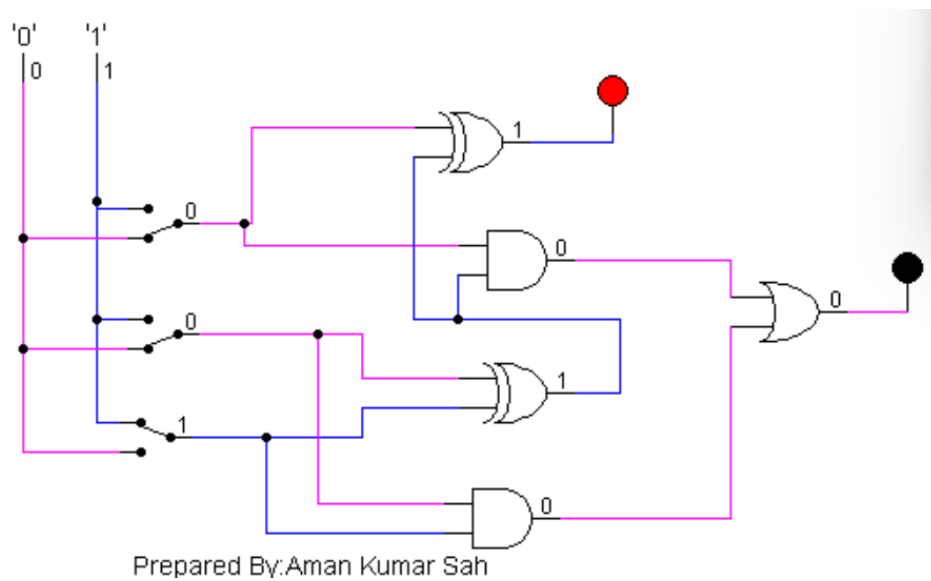
$$= A'X + AX'$$

$$= A \text{ OR } B \text{ OR } C$$

$$= (B'C + BC - B \text{ OR } C)$$

$$= (B \text{ OR } C - X)$$

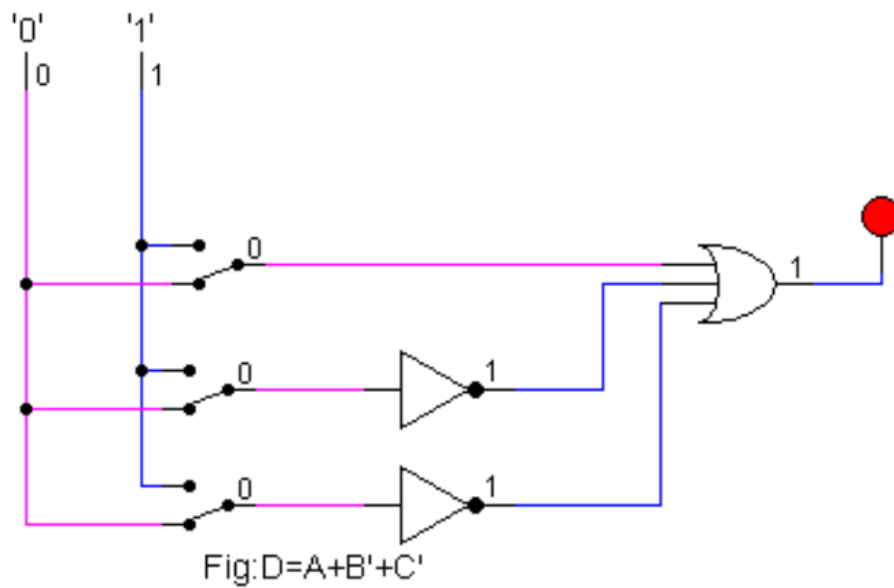
Draw full adder using two half adder and an OR gate



3. Using the three stages of design, construct the circuits for the following input /output values. Here A, B and C are the inputs whereas D, E, F, G, H and I are outputs. *Note: Draw circuit diagram using logsim corresponding to the simplified expression of outputs D, E, F, G, H and I.*

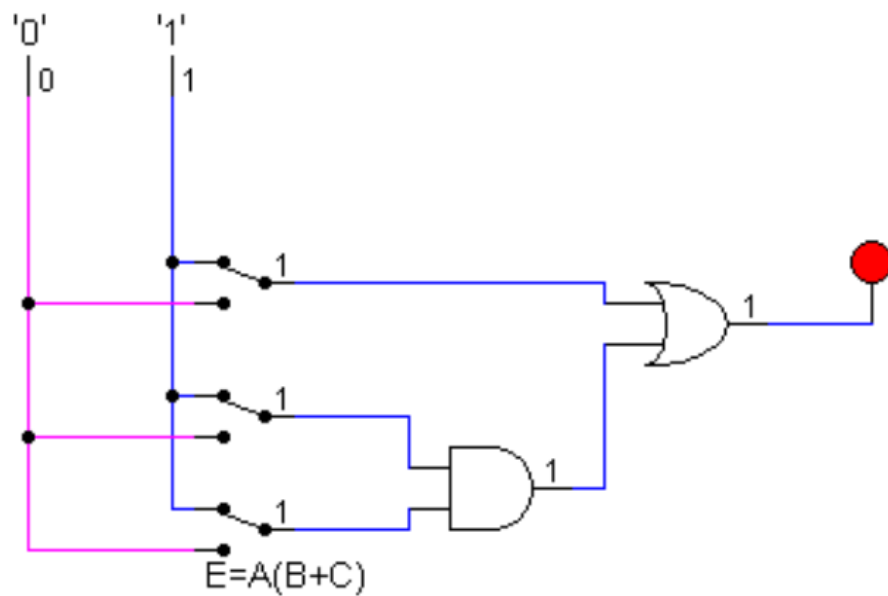
A	B	C	D	E	F	G	H	I
0	0	0	1	0	1	0	1	1
0	0	1	1	0	1	1	0	1
0	1	0	1	0	1	1	1	1
1	0	0	1	0	0	1	0	1
1	1	1	1	1	1	1	1	1
1	1	0	1	1	0	1	0	1
1	0	1	1	1	1	1	1	0
0	1	1	0	0	0	1	1	1

1) $D = A + B' + C'$



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- 2) $E = ABC + ABC' + AB'C$
 $= ABC + ABC' + ABC + AB'C$
 $= AB + AC$
 $= A(B + C)$

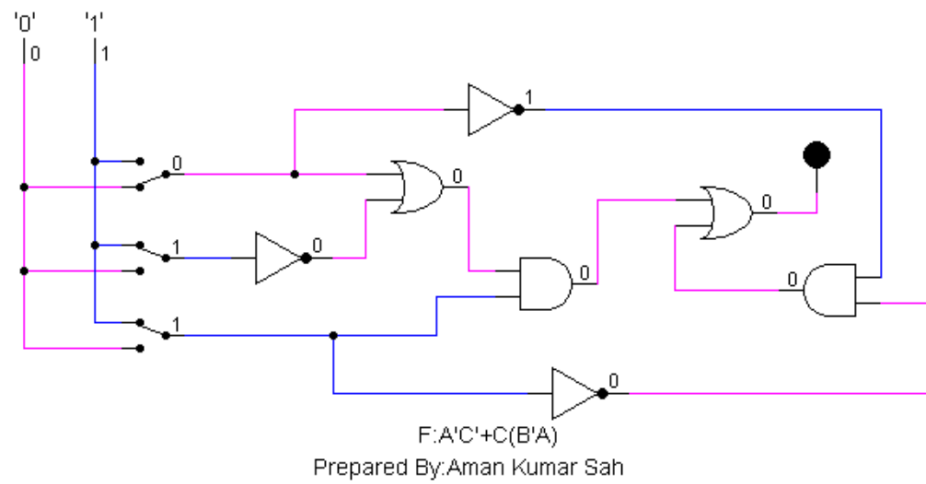


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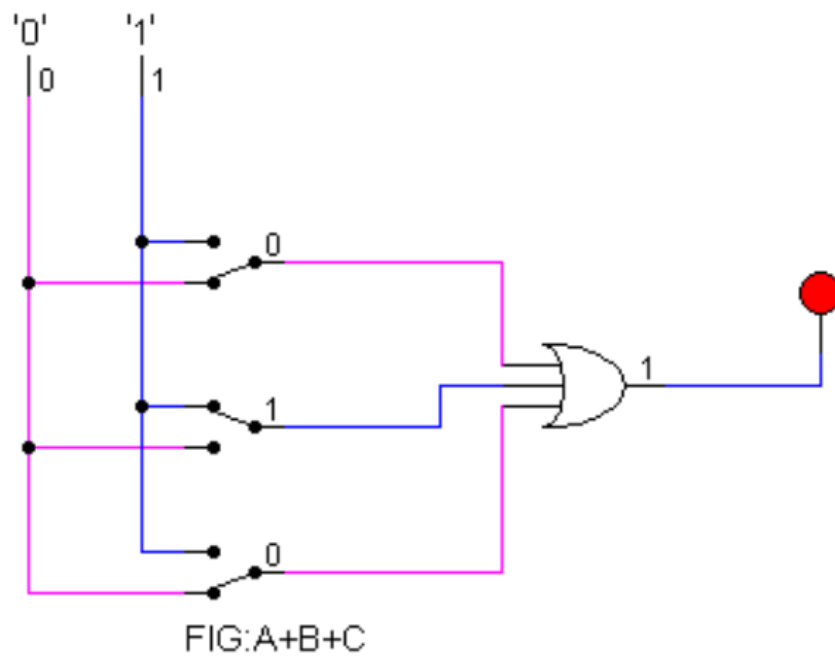
- 3) $F = A'BC' + AB'C = A'BC' + AB'C$
 $= A'C'(B' + B) + B'C(A' + A) + ABC$
 $= A'C' + B'C + ABC$
 $= A'C' + C'(B + AB)$

$$=A'C'+C(B'+A)(B'+B)$$

$$=A'C'+(B'+A)$$



$$4) G = A + B + C$$

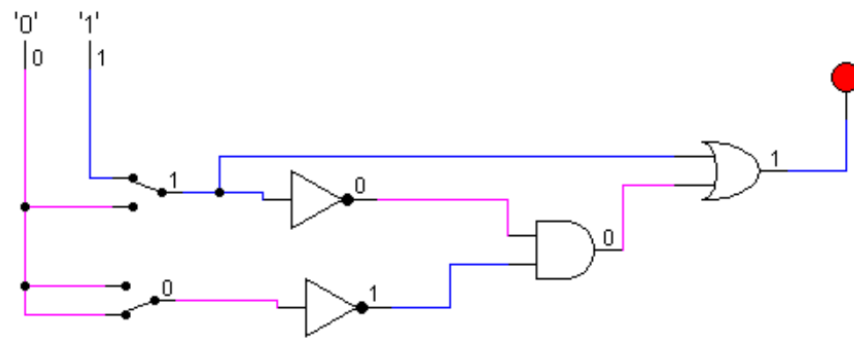


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$$5) H = A'B'C' + A'BC' + ABC + AB'C + AB'C'$$

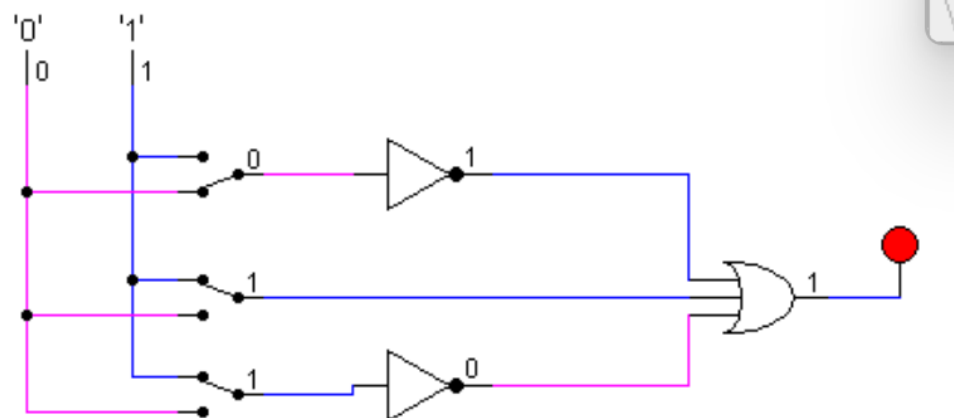
$$= A'C'(B+B') + AC(B+B') + A(B'C+BC)$$

$$=A'C'+A$$

H: $A'C' + A$

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$$6) I = A' + B + C'$$

Fig: $A' + B + C'$

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