A 1)
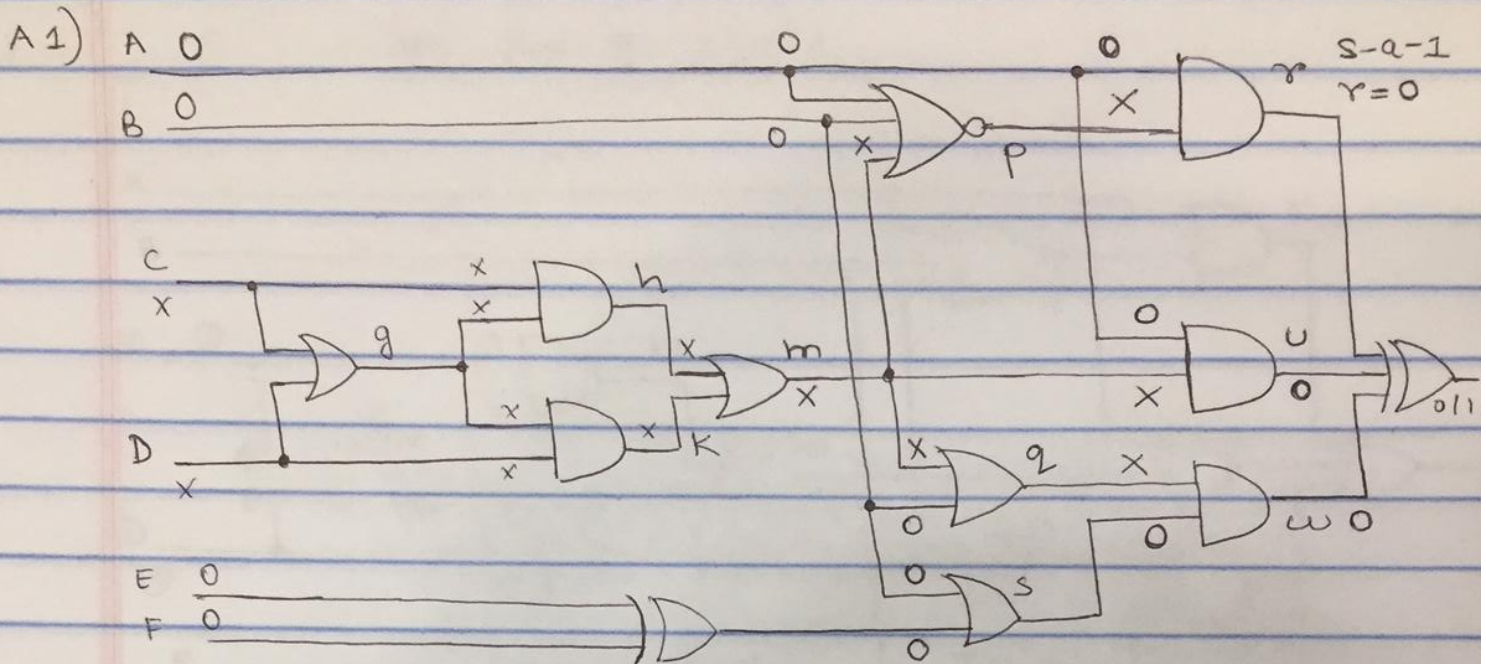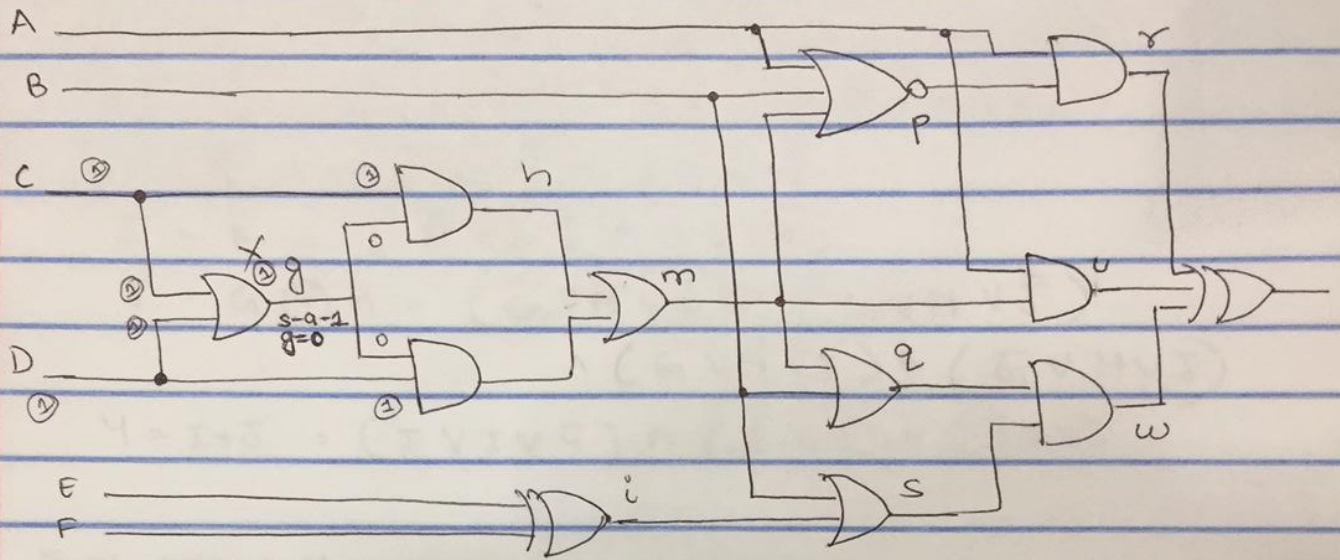

Test for the fault r s-a-1
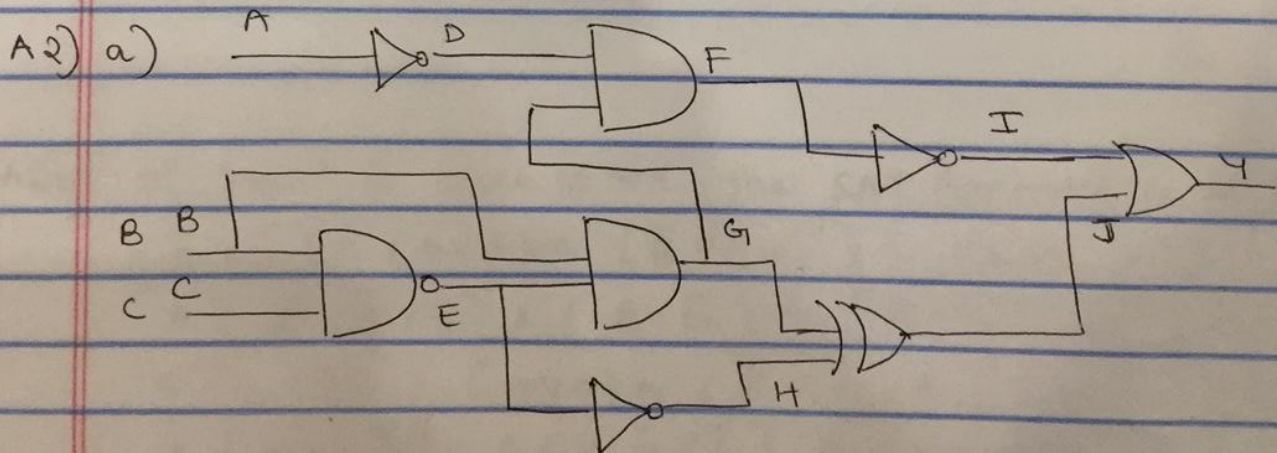
- For r stuck at 1, we initially take r=0
- In order to allow r to change and output change be detected both u and w is made as 0 and following the circuit path the input vector is arrived at.

- There are two possibilities of input vectors for the circuit above which are 00××00 or 00××11 since for the last E & F inputs to the XOR gate need to be either both 0 (E=0 and F=0) or 1 (E=1 and F=1).

1 b)

Test for g s-a-1

As shown in above figure when g s-a-1, we
put g=0 in order to propagate through the circuit and
we see that there is no such input vector.

A 2) a)

Applying Tseitin Transformation :-

$$D = \bar{A} = (\bar{A} \vee \bar{D}) \wedge (A \vee D)$$

$$E = \overline{B.C} = (\bar{B} \vee \bar{C} \vee \bar{E}) \wedge (B \vee E) \wedge (C \vee E)$$

$$G = BE = (\bar{B} \vee \bar{E} \vee G) \wedge (B \vee \bar{G}) \wedge (E \vee \bar{G})$$

$$F = DG = (\bar{D} \vee \bar{G} \vee F) \wedge (D \vee \bar{F}) \wedge (G \vee \bar{F})$$

$$H = \bar{E} = (\bar{E} \vee \bar{H}) \wedge (E \vee H)$$

$$I = \bar{F} = (\bar{F} \vee \bar{I}) \wedge (F \vee I)$$

$$J = G \oplus H = (\bar{G} \vee \bar{H} \vee \bar{J}) \wedge (G \vee H \vee \bar{J})$$
$$\wedge (G \vee \bar{H} \vee J) \wedge (\bar{G} \vee H \vee J)$$

$$Y = I + J = (I \vee J \vee \bar{Y}) \wedge (\bar{I} \vee Y) \wedge (\bar{J} \vee Y)$$

∴ Final output Y =

$$(\bar{A} \vee \bar{D}) \wedge (A \vee D) \wedge (\bar{B} \vee \bar{C} \vee \bar{E}) \wedge (B \vee E) \wedge (C \vee E) \wedge (\bar{B} \vee \bar{E} \vee G)$$
$$\wedge (B \vee \bar{G}) \wedge (E \vee \bar{G}) \wedge (\bar{D} \vee \bar{G} \vee F) \wedge (D \vee \bar{F}) \wedge (G \vee \bar{F})$$
$$\wedge (\bar{E} \vee \bar{H}) \wedge (E \vee H) \wedge (\bar{F} \vee \bar{I}) \wedge (F \vee I) \wedge (\bar{G} \vee \bar{H} \vee \bar{J})$$
$$\wedge (G \vee H \vee \bar{J}) \wedge (G \vee \bar{H} \vee J) \wedge (\bar{G} \vee H \vee J) \wedge (I \vee J \vee \bar{Y})$$
$$\wedge (\bar{I} \vee Y) \wedge (\bar{J} \vee Y) \wedge Y$$

A2b) If net F is stuck at one. The SAT formula is as follows:-

$$(\bar{A} \vee \bar{D}) \wedge (A \vee D) \wedge (\bar{B} \vee \bar{C} \vee \bar{E}) \wedge (B \vee E) \wedge (C \vee E)$$
$$\wedge (\bar{B} \vee \bar{E} \vee G) \wedge (B \vee \bar{G}) \wedge (E \vee \bar{G}) \wedge (\bar{D} \vee \bar{G} \vee 1)^{1}$$
$$\wedge (D \vee 0) \wedge (G \vee 0) \wedge (\bar{E} \vee \bar{H}) \wedge (E \vee H) \wedge (0 \vee \bar{I})$$
$$\wedge (1 \vee I)^{1} \wedge (\bar{G} \vee \bar{H} \vee \bar{J}) \wedge (G \vee H \vee \bar{J}) \wedge (G \vee \bar{H} \vee J)$$
$$\wedge (\bar{G} \vee H \vee J) \wedge (I \vee J \vee \bar{Y}) \wedge (\bar{I} \vee Y) \wedge (\bar{J} \vee Y) \wedge Y$$

$$\Rightarrow (\bar{A} \vee \bar{D}) \wedge (A \vee D) \wedge (\bar{B} \vee \bar{C} \vee \bar{E}) \wedge (B \vee E) \wedge (C \vee E)$$
$$\wedge (\bar{B} \vee \bar{E} \vee G) \wedge (B \vee \bar{G}) \wedge (E \vee \bar{G}) \wedge (D) \wedge (G)$$
$$\wedge (\bar{E} \vee \bar{H}) \wedge (E \vee H) \wedge (\bar{I}) \wedge (G \vee \bar{H} \vee \bar{J}) \wedge$$
$$(G \vee H \vee \bar{J}) \wedge (G \vee \bar{H} \vee J) \wedge (\bar{G} \vee H \vee J) \wedge (I \vee J \vee \bar{Y})$$
$$\wedge (\bar{I} \vee Y) \wedge (\bar{J} \vee Y) \wedge Y$$

A &

A	B	C	D	E	G	H	I	J	Y
1	2	3	4	5	6	7	8	9	10

$\bar{A} \vee \bar{D}$	-1 -4 0		$G \vee H \vee \bar{J}$	6 7 -9 0
$A \vee D$	1 4 0		$G \vee \bar{H} \vee J$	6 -7 9 0
$\bar{B} \vee \bar{C} \vee \bar{E}$	-2 -3 -5 0		$\bar{G} \vee H \vee J$	-6 7 9 0
$B \vee E$	2 5 0		$I \vee J \vee \bar{Y}$	8 9 -10 0
$C \vee E$	3 5 0		$\bar{I} \vee Y$	-8 10 0
$\bar{B} \vee \bar{E} \vee G$	-2 -5 6 0		$\bar{J} \vee Y$	-9 10 0
$B \vee \bar{G}$	2 -6 0		Y	10 0
$E \vee \bar{G}$	5 -6 0			
D	4 0			
G	6 0		gt is satisfiable,
$\bar{E} \vee \bar{H}$	-5 -7 0		and input vector
$E \vee H$	5 7 0		is 010.
$\bar{I}$	-8			
$G \vee \bar{H} \vee \bar{J}$	-6 -7 -9 0			

A2c) $(\bar{A} \vee \bar{D}) \wedge (A \vee D) \wedge (\bar{B} \vee \bar{C} \vee \bar{E}) \wedge (B \vee E) \wedge (C \vee E)$
$\wedge (\bar{B} \vee \bar{E} \vee G) \wedge (B \vee \bar{G}) \wedge (E \vee \bar{G}) \wedge (\bar{D} \vee \bar{G} \vee F)$
$\wedge (D \vee \bar{F}) \wedge (G \vee \bar{F}) \wedge (\bar{E} \vee \bar{H}) \wedge (E \vee H) \wedge (F \vee \bar{I})$
$\wedge (\bar{F} \vee I) \wedge (\bar{G} \vee \bar{H} \vee \bar{J}) \wedge (G \vee H \vee \bar{J}) \wedge (G \vee \bar{H} \vee J)$
$\wedge (\bar{G} \vee H \vee J) \wedge (I \vee J \vee \bar{Y}) \wedge (\bar{I} \vee Y) \wedge (\bar{J} \vee Y)$

$\wedge Y \wedge \bar{J} \wedge \bar{F}$

Since the F is stuck at 1, we put $\bar{F}$
as and to the SAT formula, also using path
sensitization J has to be made 0 $\therefore$ $\bar{J}$ is
anded to the SAT formula.

A	B	C	D	E	F	G	H	I	J	Y
1	2	3	4	5	6	7	8	9	10	11

$\bar{A} \vee \bar{D}$	$-1\ -4\ 0$	$F \vee I$	$6\ 9\ 0$
$A \vee D$	$1\ 4\ 0$	$\bar{G} \vee \bar{H} \vee \bar{J}$	$-7\ -8\ -10\ 0$
$\bar{B} \vee \bar{C} \vee \bar{E}$	$-2\ -3\ -5\ 0$	$G \vee H \vee \bar{J}$	$7\ 8\ -10\ 0$
$B \vee E$	$+2\ +5\ 0$	$G \vee \bar{H} \vee J$	$7\ -8\ 10\ 0$
$C \vee E$	$3\ 5\ 0$	$\bar{G} \vee H \vee J$	$-7\ 8\ 10\ 0$
$\bar{B} \vee \bar{E} \vee G$	$-2\ -5\ 7\ 0$	$I \vee J \vee \bar{Y}$	$9\ 10\ -11\ 0$
$B \vee \bar{G}$	$2\ -7\ 0$	$\bar{I} \vee Y$	$-9\ 11\ 0$
$E \vee \bar{G}$	$5\ -7\ 0$	$\bar{J} \vee Y$	$-10\ 11\ 0$
$\bar{D} \vee \bar{G} \vee F$	$-4\ -7\ 6\ 0$	Y	$11\ 0$
$D \vee \bar{F}$	$4\ -6\ 0$	$\bar{J}$	$-10\ 0$
$G \vee \bar{F}$	$7\ -6\ 0$	$\bar{F}$	$-6\ 0$
$\bar{E} \vee \bar{H}$	$-5\ -8\ 0$		
$E \vee H$	$5\ 8\ 0$	$ABC = 000$	
$\bar{F} \vee I$	$-6\ -9\ 0$	put $A = 1$	
		$ABC = 100$	
		if we force $B = 1 \Rightarrow$ unsat	
		if we force $C = 1$	

ABC = 001

if we force A = 1, C = 1

    ABC = 101   Ans