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1. Berikan jawapan dalam perenambelasan bagi ungkapan perduaan berikut:

Give answer in hexadecimal for the following binary expression:

a) 11101 + 101011.
11101 + 101011.
(1 markah/*mark*)

b) 1110 x 110
1110 x 110
(1 markah/*mark*)

c) 110011.10 – 110.11
110011.10 – 110.11
(1 markah/*mark*)

a) $\begin{array}{r} 11101 \\ +\,101011 \\ \hline 1001000_2 \end{array}$

0100	1000
4	8

48_{16}

b) $\begin{array}{r} 1110 \\ \times\ \ 110 \\ \hline 0000 \\ 1110 \\ +\ 1110 \\ \hline 1010100_2 \end{array}$

101	0100
5	4

54_{16}

c) 110011.10 − 110.11

$\begin{array}{r} 110011.10 \\ -\ \ 110.11 \\ \hline 101100.11 \end{array}$

0010	1100	1100
2	C	C

$2CC_{16}$

A 1010
B 1011
C 1100

2. Ringkaskan ungkapan berikut dengan menggunakan algebra Boolean: (7 markah/marks)

Simplify the following expressions using Boolean algebra:

$$BCDE + BC\overline{(DE)} + \overline{(BC)}DE$$

(4 markah/marks)

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$BCDE + BC\overline{DE} + \overline{BC}DE$

$= BCDE + BC\bar{D} + BC\bar{E} + \bar{B}DE + \bar{C}DE$

$= DE(BC + \bar{C}) + BC\bar{D} + BC\bar{E} + \bar{B}DE$

$= DE(B + \bar{C}) + \ldots$

$= BDE + \bar{C}DE + BC\bar{D} + BC\bar{E} + \bar{B}DE$

$= DE(B + \bar{B} + \bar{C}) + BC(\bar{D} + \bar{E})$

$= DE + BC(\bar{D} + \bar{E})$

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3. Reka satu litar logik gabungan yang mempunyai lima input (namakan sebagai A,B,C,D,E) dan satu output (namakan sebagai Y). Output akan menghasilkan keluaran logik-1 apabila majoriti input adalah logik-1 dan menghasilkan keluaran logik-0 apabila mojoriti input adalah logik-0.

Design a combinational logic with five-inputs (named as A, B, C, D, E) and one-output (named as Y). The output will produce a logic-1 output when the majority of its inputs are logic-1 and produce a logic-0 output when the majority of its inputs are logic-0.

a) Tunjukkan jadual kebenaran untuk litar logik gabungan tersebut.

Show the truth table for the combinational logic circuit.

(4 markah/*marks*)

ABCDE → Y

majority ≥ 3

					A=0	A=1	
	B	C	D	E	Y	Y	
0	0	0	0	0	0	0	16
1	0	0	0	1	0	0	17
2	0	0	1	0	0	0	18
3	0	0	1	1	0	1	19
4	0	1	0	0	0	0	20
5	0	1	0	1	0	1	21
6	0	1	1	0	0	1	22
7	0	1	1	1	1	1	23
8	1	0	0	0	0	0	24
9	1	0	0	1	0	1	25
10	1	0	1	0	0	1	26
11	1	0	1	1	1	1	27
12	1	1	0	0	0	1	28
13	1	1	0	1	1	1	29
14	1	1	1	0	1	1	30
15	1	1	1	1	1	1	31

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b) Seterusnya, dapatkan *Sum of minterm (SOM)*

Then, get the Sum of Minterm (SOM)

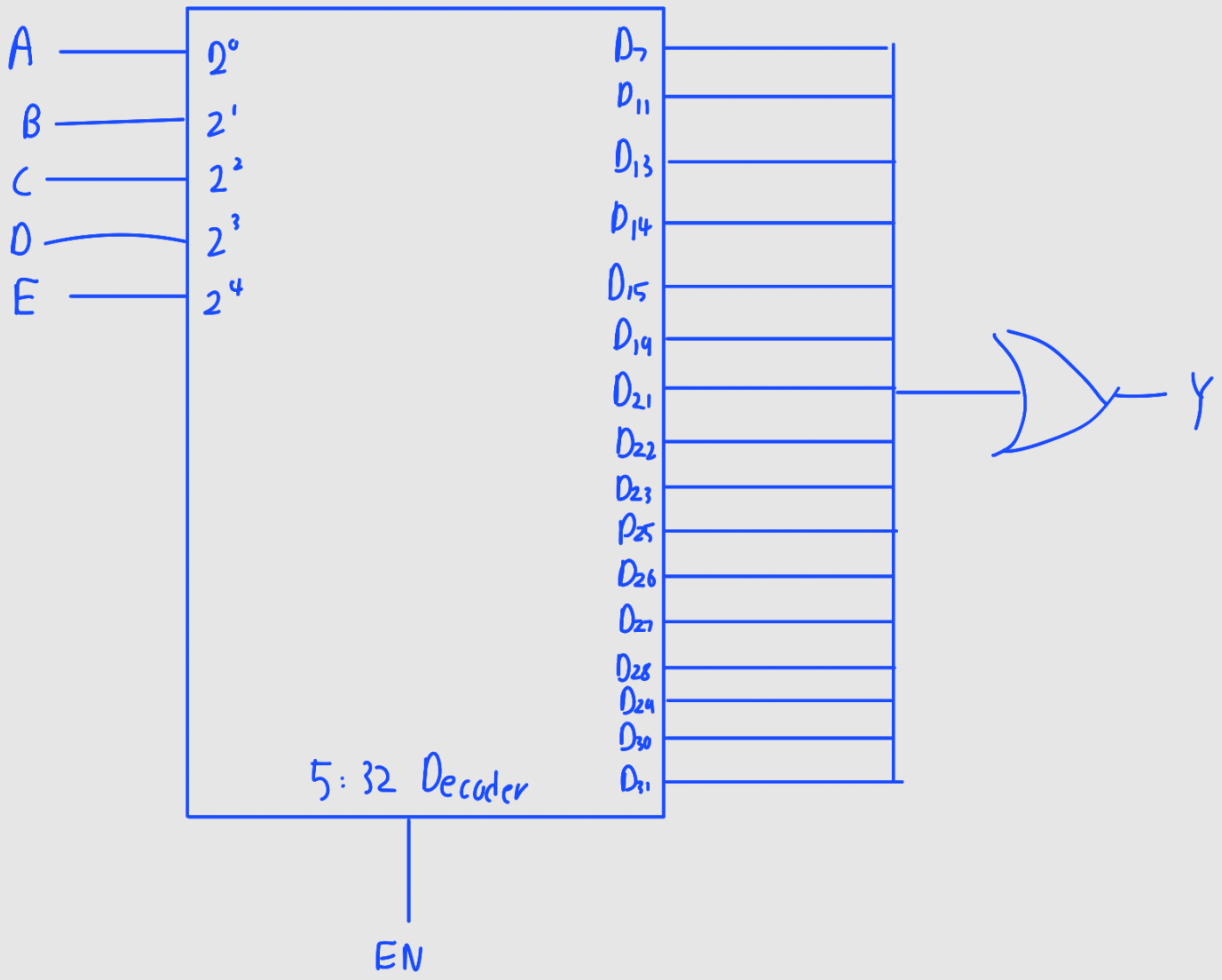
(2 markah/*marks*)

$$F(A,B,C,D,E) = \Sigma m(7, 11, 13, 14, 15, 19, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31)$$

c) Berdasarkan *SOM* pada soalan 3b, lukiskan penyahkod 5 x 32 bagi mewakili jadual kebenaran tersebut.

Based on the SOM in question 3b, draw a 5x32 decoder to represent the truth table.

(2 markah/*marks*)



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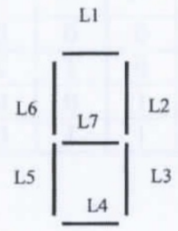
4) *A 4-bits Binary-coded Decimal (BCD) (A, B, C, D) is used to light up a 7-segment display as in Figure 1. A combinational logic circuit is used to supply logic-1 to light up each segment in the 7-segment display.*



Rajah 1: paparan 7-segmen
***Figure 1**: 7-segments display*

a) *Show the truth table for the combinational logic circuit with A, B, C and D as inputs and L1 to L7 as outputs. Assign the output as don't care if the input is not a BCD number.*

(5 markah/*marks*)

Binary coded decimal

Valid : 0-9

Invalid: 10-15

L1 - L7

L1 : top segment

L2 : top-right segment

L3 : bottom-right segment

L4 : bottom segment

L5 : bottom-left segment

L6 : top-left segment

L7 : middle segment

A	B	C	D	L1	L2	L3	L4	L5	L6	L7	
0	0	0	0	1	1	1	1	1	1	0	0
0	0	0	1	0	1	1	0	0	0	0	1
0	0	1	0	1	1	0	1	1	0	1	2
0	0	1	1	1	1	1	1	0	0	1	3
0	1	0	0	0	1	1	0	0	1	1	4
0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	0	1	1	1	1	1	6
0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	1	1	1	1	0	1	1	9
1	0	1	0	X	X	X	X	X	X	X	Invalid BCD
1	0	1	1	X	X	X	X	X	X	X	
1	1	0	0	X	X	X	X	X	X	X	
1	1	0	1	X	X	X	X	X	X	X	
1	1	1	0	X	X	X	X	X	X	X	
1	1	1	1	X	X	X	X	X	X	X	

Use Karnaugh map to get the simplified equation for each segments (L1-L7) in the 7-segment display.

(7 markah/*marks*)

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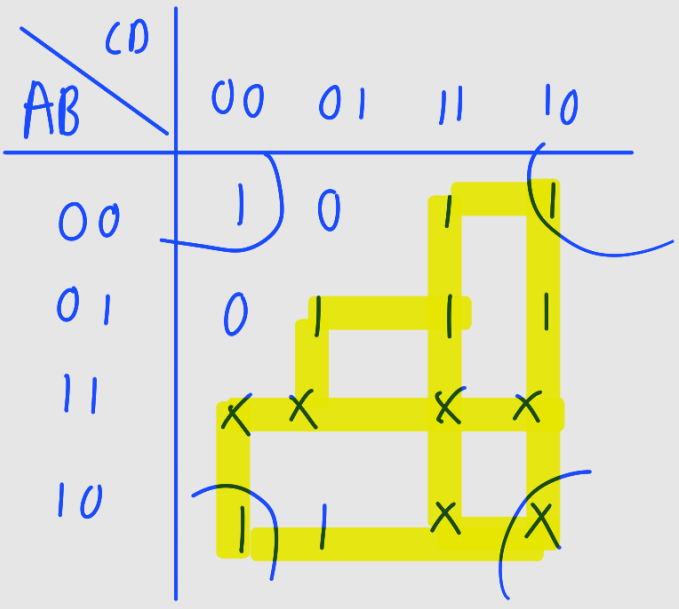
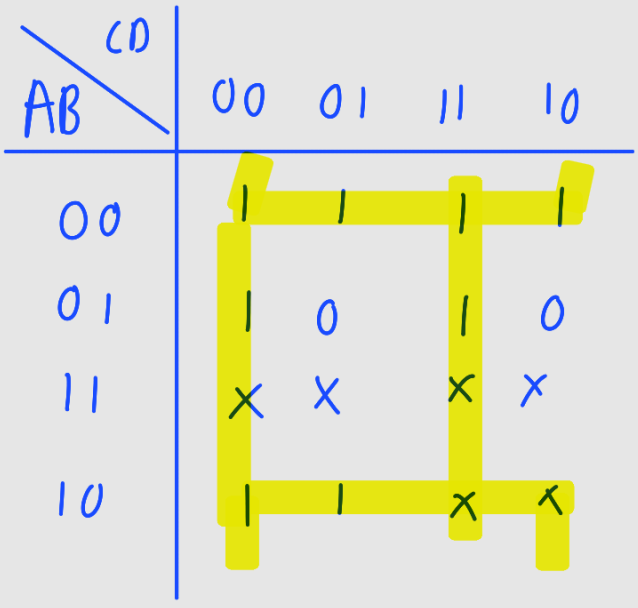
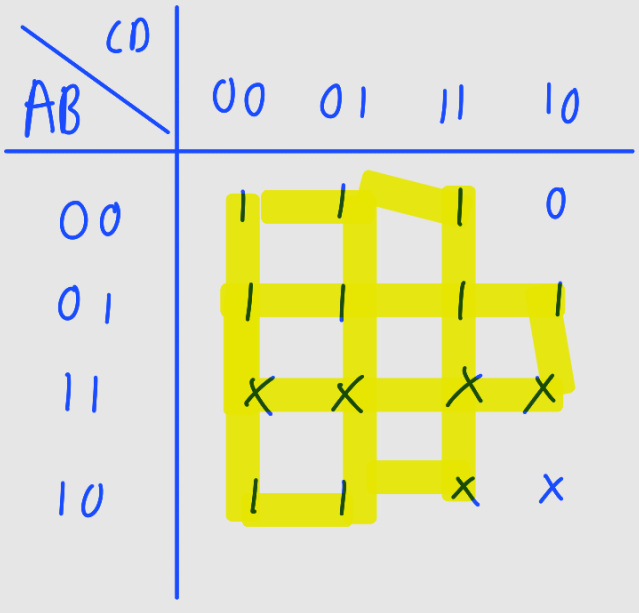


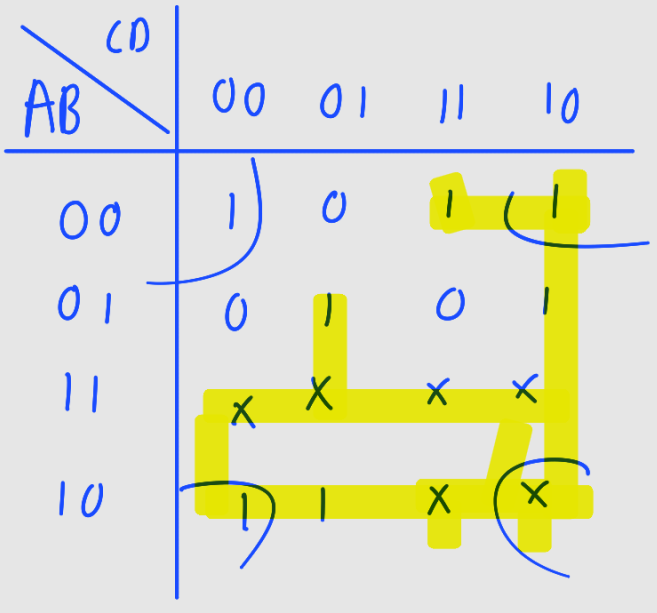
$L1 = B'D' + C + A + BD$



$L2 = B' + C'D' + CD$



$L3 = B + C' + D$



$L4: B'D' + B'C + BC'D + CD' + A$

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AB \ CD	00	01	11	10
00	1	0	0	1
01	0	0	0	1
11	X	X	X	X
10	1	0	X	X

L5: $AD' + A'B'D' + CD'$

AB \ CD	00	01	11	10
00	1	0	0	0
01	1	1	0	1
11	X	X	X	X
10	1	1	X	X

L6: $C'D' + BD' + BC' + A$

AB \ CD	00	01	11	10
00	0	0	1	1
01	1	1	0	1
11	X	X	X	X
10	1	1	X	X

L7: $A'B'C + A + BC' + BD'$

c) Given only **THREE** types of logic gates which are OR gate, NOT gate and Exclusive-OR gate, build the combinational logic circuit for segment L1, L2 and L3.

(3 markah/*marks*)

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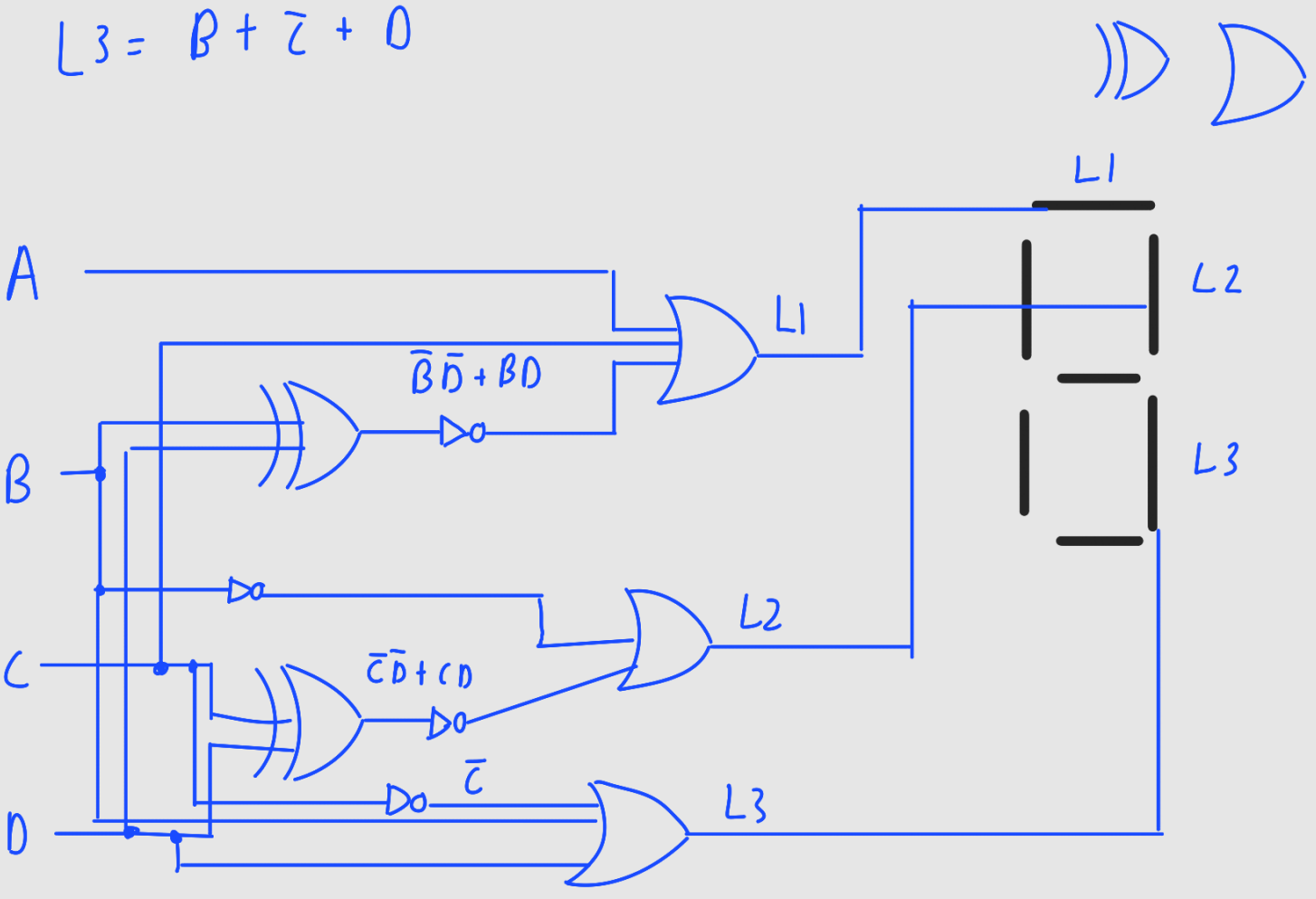
$L1 = \bar{B}\bar{D} + C + A + BD$

$L2 = \bar{B} + \bar{C}\bar{D} + CD$

$L3 = B + \bar{C} + D$

$XOR = x\bar{Y} + \bar{x}Y$

$XNOR = \bar{x}\bar{Y} + xY$ ← pattern match



5)

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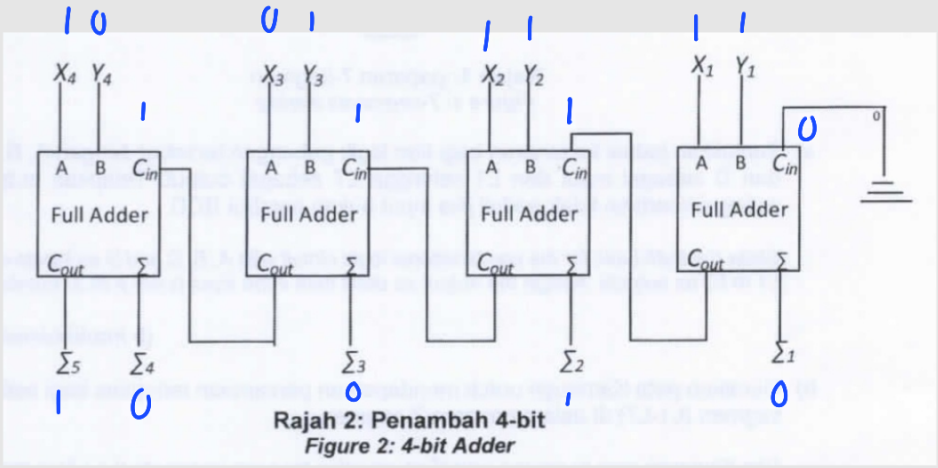
By using a 4-bit adder as shown in Figure 2, determine the output ∑ based on the given input as in the following table:

X_1	X_2	X_3	X_4	Y_1	Y_2	Y_3	Y_4	$\sum_1$	$\sum_2$	$\sum_3$	$\sum_4$	$\sum_5$
1	0	0	1	1	0	0	0	0	1	0	1	0
0	1	0	1	1	0	1	1	1	1	1	0	1
0	1	0	0	1	1	0	0	1	0	1	0	0
1	1	0	1	1	1	1	0	0	1	0	0	1



Rajah 2: Penambah 4-bit
Figure 2: 4-bit Adder

right to left

A	B	Cin	Sum (S)	Cout
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

6

Based on the state table as in Table 1, answer the following questions.

Keadaan Semasa *Current State*			Keadaan Berikut *Next State*		
A	B	C	A*	B*	C*
0	0	0	x	x	x
0	0	1	1	1	1
0	1	0	1	1	0
0	1	1	x	x	x
1	0	0	x	x	x
1	0	1	0	1	0
1	1	0	0	0	1
1	1	1	1	0	1

Jadual 1: Jadual keadaan
Table 1: State table

INPUT		OUTPUT	
Qn	Q(n+1)	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

a) *Show the maps for JK flip flops and get the JK flip-flop equation for J_A, K_A, J_B, K_B, J_C and K_C.*

(4 markah/*marks*)

A	B	C	A^+	B^+	C^+	J_A	K_A	J_B	K_B	J_C	K_C
0	0	0	x	x	x	x	x	x	x	x	x
0	0	1	1	1	1	1	x	1	x	x	0
0	1	0	1	1	0	1	x	x	0	0	x
0	1	1	x	x	x	x	x	x	x	x	x
1	0	0	x	x	x	x	x	x	x	x	x
1	0	1	0	1	0	x	1	x	0	x	1
1	1	0	0	0	1	x	1	x	1	1	x
1	1	1	1	0	1	x	0	x	1	x	0

A \ BC	00	01	11	10
0	X	1	X	1
1	X	X	X	X

$J_A = 1$

A \ BC	00	01	11	10
0	X	X	X	X
1	X	1	0	1

$K_A = B' + C'$

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A \ BC	00	01	11	10
0	X	1	X	X
1	X	X	X	X

$J_B = 1$

A \ BC	00	01	11	10
0	X	X	X	0
1	X	0	1	1

$K_B = AB$

A \ BC	00	01	11	10
0	X	X	X	0
1	X	X	X	1

$J_C = A$

A \ BC	00	01	11	10
0	X	0	X	X
1	X	1	0	X

$K_C = AB'$

b) *Based on the JK flip-flop equation from question 6a, get the next state for the states that are not in the cycle (i.e 000; 011; 100).*

Keadaan Semasa *Current State*			JK Flip Flop						Keadaan Berikut *Next State*		
A	B	C	J_A	K_A	J_B	K_B	J_C	K_C	A*	B*	C*
0	0	0	1	1	1	0	0	0	1	1	0
0	1	1	1	0	1	0	0	0	1	1	1
1	0	0	1	1	1	0	1	1	0	1	1

(4 markah/*marks*)

$J_A = 1$ $\quad K_A = \bar{B} + \bar{C}$

$J_B = 1$ $\quad K_B = AB$

$J_C = A$ $\quad K_C = A\bar{B}$

J	K	Qn+1
0	0	Qn
0	1	0
1	0	1
1	1	Qn'

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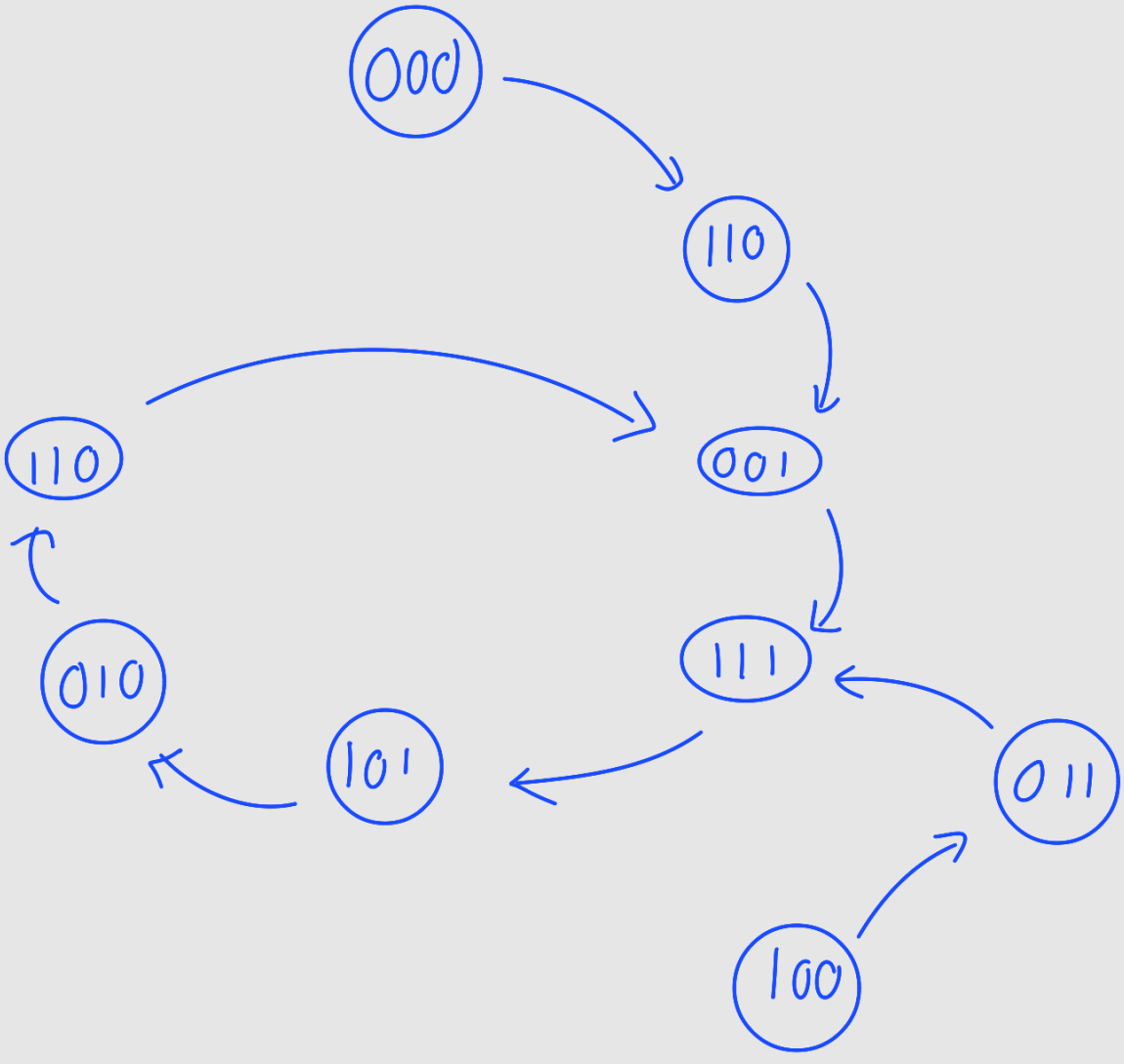
c)

Show the full state diagram.

(2 markah/*marks*)



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7) *If a register starts with 101001111000 state, what is their state after:*

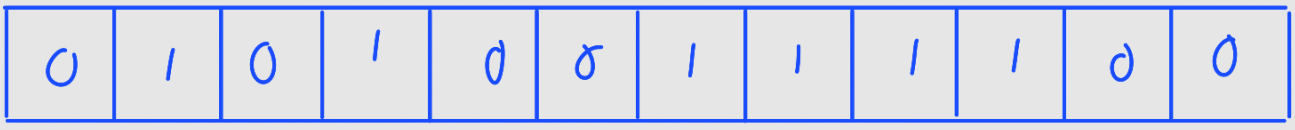
a) Putar-Kanan dengan 2 detik kitaran?

Rotate-Right with 2 clock pulse?

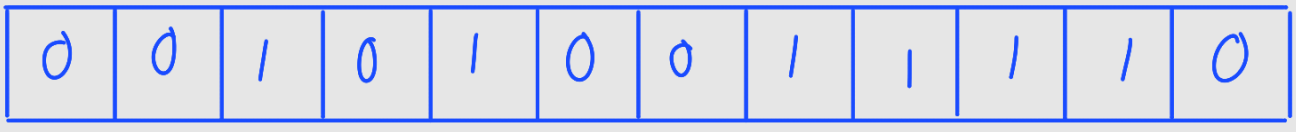
(2 markah/*marks*)

ori

①



②



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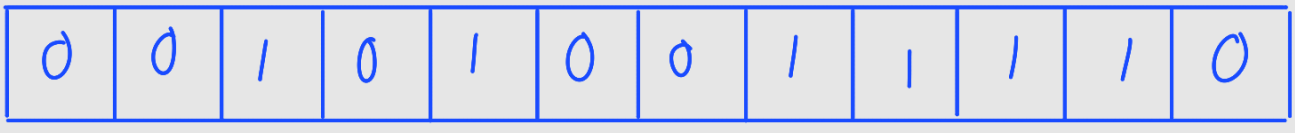
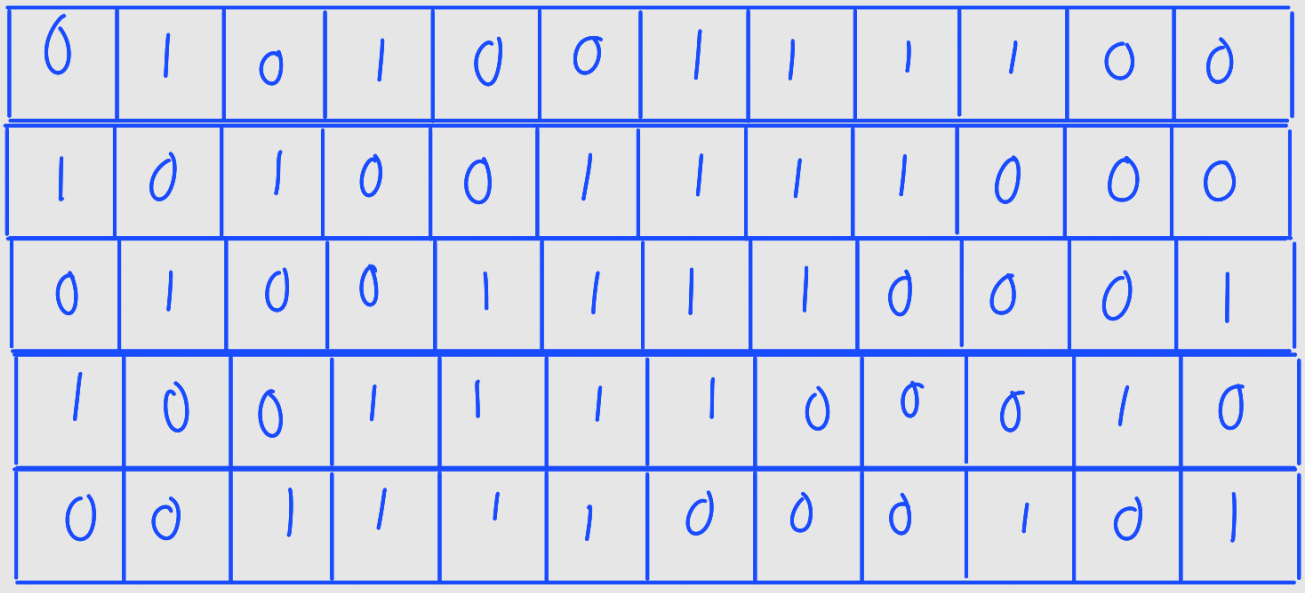
b) *By using the current state from question 7a,* Rotate-Left with 5 clock pulse.

(3 markah/*marks*)

ori:





free mark