類組：電機類　科目：數位邏輯(300H)　　共 9 頁 第 1 頁

※請在答案卷內作答

考生請注意：

- 本試卷共有 20 題試題。 每題 5 分。
- 你的答案必須如下圖所示由上而下依序寫在答案卷的做答區。
- 只要填寫考題所要求的答案，**請勿附加計算過程**。

從此處開始寫起
1. (a), (b).
2. (c), (d).
3. 15
4. (1) 1 ,(2) 0
5. Z = B+AC'
、、、

注意：背面有試題

類組：電機類　科目：數位邏輯(300H)　　共 9 頁 第 2 頁

※請在答案卷內作答

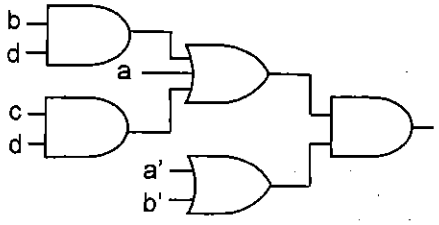
Question 1 [5pt]. Determine the radix r for the following equation:
$(13)_r \times (21)_r - (24)_r = (244)_r$.

Question 2 [5pt]. Let $(N)_R$ denote the number N under radix R, and omit specifying the radix when $R = 10$. What should be the number in radix 10 corresponding to $(11)_{(11)_{(11)_{(11)_2}}}$?

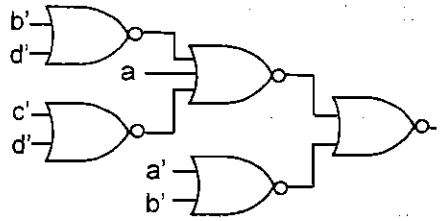
Question 3 [5pt]. If we already know that $A \oplus B \oplus C \oplus D = 1$, then $ABC + ABD + ACD + BCD = 1$. True or False?

Question 4 [5pt]. Consider circuit (a), which of the four circuits (b)~(e) are equivalent to (a)?

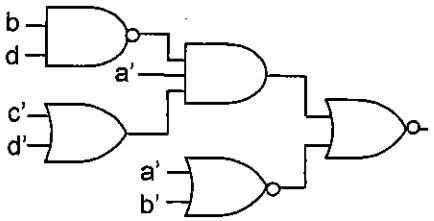
(a)



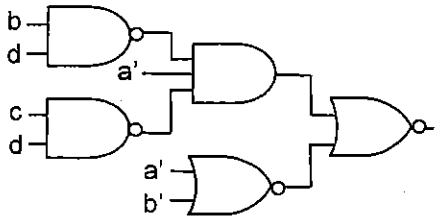
(b)



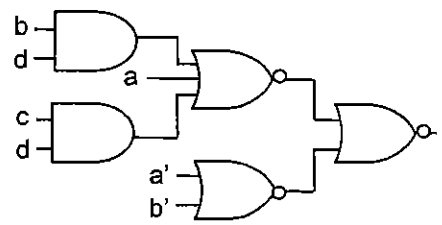
(c)



(d)



(e)



Question 5 [5pt]. Consider a logic operation: $X \otimes Y = XY + X'$. Is the operation "$\otimes$" functionally complete?

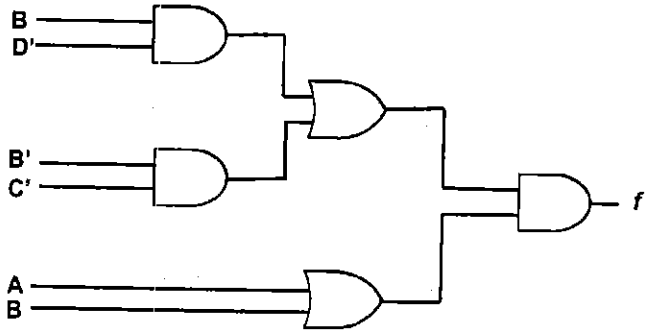
Question 6 [5pt]. Given the maxterm expansion of a 3-input function $F = M_0 \bullet M_3 \bullet M_6$. Represent F' (complement of F) and F^D (duality of F) by minterm expansion.

Question 7 [5pt]. The maxterm expansion of the complement of F is given by
$F'(a, b, c, d) = \Pi M(1, 3, 4, 8, 10, 11, 12, 15) \bullet \Pi D(0, 14)$.
Please write down the **minimum** sum of products for function F.

注意：背面有試題

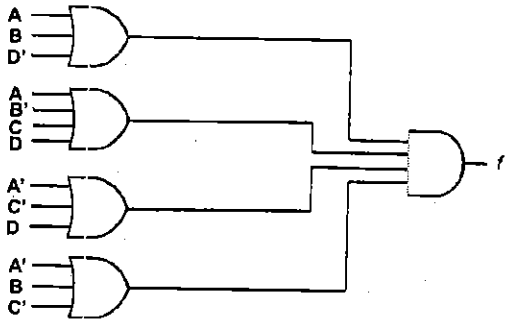
Question 8 [5pt].

Consider the following three-level circuit. How many possible static hazards are in this circuit?



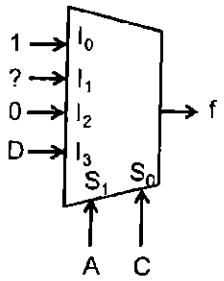
Question 9 [5pt].

Please identify the input transition that could cause static 0-hazard to the following circuit.



Question 10 [5pt].

The following 4-to-1 MUX implements the function: f(A,B,C,D) = A'C' + A'B'D' + ACD + A'BD. Please identify the missing input signal I_1.



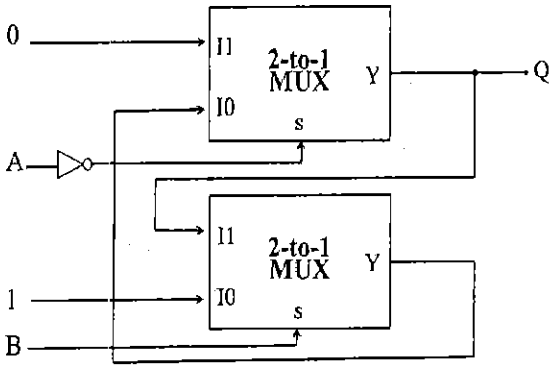
Question 11 [5pt].

Please derive the Boolean algebra equation for the next value of the output Q in terms of Q, A, and B.

Q^+ = ____ + ____

類組：電機類　科目：數位邏輯(300H)　　共 9 頁 第 4 頁

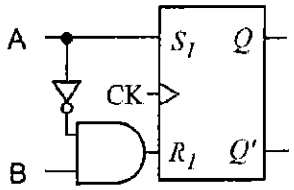
※請在答案卷內作答



Question 12 [5pt].

The following circuit uses a S-R Flip-Flop to implement a special type of Flip-Flop. Please derive the next-state equation of the output Q.

$Q^+ =$ ____ + ____



Question 13 [5pt].

A U-V flip-flop operates as follows. If UV = 00, the flip-flop does not change state. If UV = 10, the flip-flop is set to Q = 0. If UV = 11, the flip-flop changes state. The input combination UV = 01 is not allowed. Please derive the next-state equation of this flip-flop.

$Q^+ =$ ____ + ____

Question 14 [5pt].

A decade counter counts in the sequence: 0000, 0001, 0010, 0011, 0100, 0101, 0110, 0111, 1000, 1001, (repeat) 0000, ……

Design this counter using J-K flip-flop. What is the next state if the counter is started in state 1101?

Question 15 [5pt]. Figure-1 illustrates a Mealy machine with two JK flip-flops (A and B) and some logic circuits with the logic expressions denoted as L-a, L-b and L-c. Figure-2 shows the state transition graph of this mealy machine, where S0, S1 ,S2 and S3 represent (A,B)= (0,0) ,(0,1), (1,0) and (1,1), respectively.

注意:背面有試題

參考用

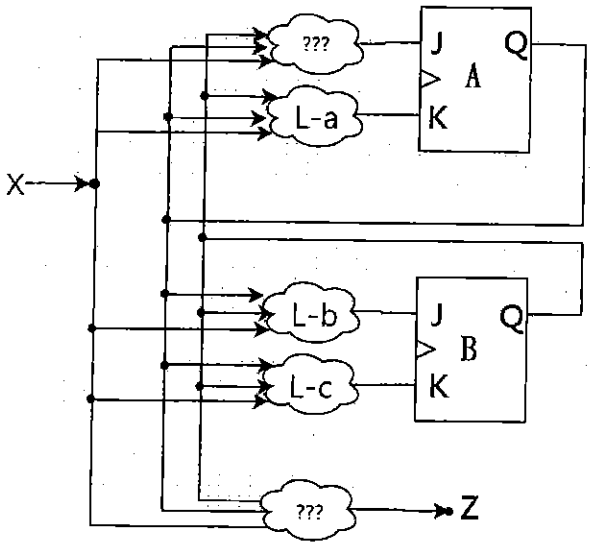


Figure-1

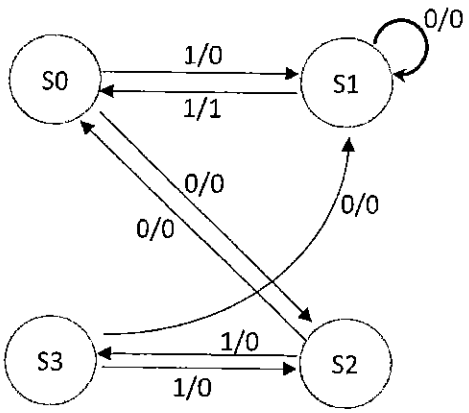


Figure-2

Which of the following ten logic expressions can meet the specification of the mealy machine defined above?

(1) L-a = B'X　(2) L-a = BX'+B'X　(3) L-a = BX+B'X'　(4) L-a = A BX'+AB'X

(5) L-b = X　(6) L-b = AX　(7) L-b = A'X　(8) L-c = X

(9) L-c = X'　(10) L-c = A'X

Question 16 [5pt]. Table-1 shows the state table of a Moore machine with one input (X), two outputs (Z0 and Z1) and three flop-flops. Output (Z0,Z1) represents the binary number of the sum of the last three inputs, where (Z0,Z1)=(0,0),(0,1),(1,0),(1,1) denotes 0, 1, 2, and 3. Eight states, denoted by S0, S1, S2, … and S7, represents 000, 001, 010 … and 111 of the last three inputs, respectively. There are five missing slots (from a to e) in the state table. Table-2 shows an exemplary input sequence and its corresponding output sequence.

state	Next state		Z0 Z1
	X=0	X=1	
S0	S0	S1	00
S1	a	S3	01
S2	S4	b	01
S3	S6	S7	d
S4	S0	c	01
S5	S2	S3	e
S6	S4	S5	10
S7	S6	S7	11

Table-1

X	0	1	1	0	1	1	1	0	0	0
Z0 Z1	00	01	10	10	10	10	11	10	01	00

Table-2

Which of the following statements about the missing slots are true for the given Moore machine?

(1) a=S1　(2) a=S2　(3) b=S0　(4) c=S1　(5) c=S5

(6) d=01　(7) d=10　(8) e=01　(9) e=10

Question 17 [5pt]. Table-3 shows the state assignment for two flip-flops (denoted as A and B) of a mealy machine with one input X and one output Z, where Z=1 whenever input sequence 010 occurs at X. Table-4 shows an exemplary input sequence and its corresponding output sequence.

AB	Continuous sequence in
00	none
01	0
10	01

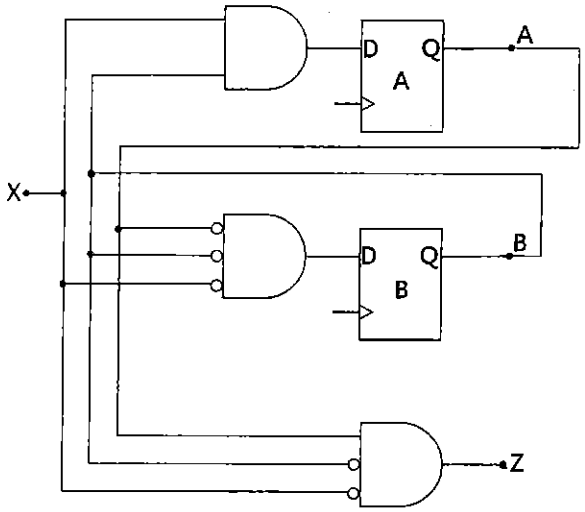
Table-3

X	0	0	1	0	1	0	1	1
Z	0	0	0	1	0	1	0	0

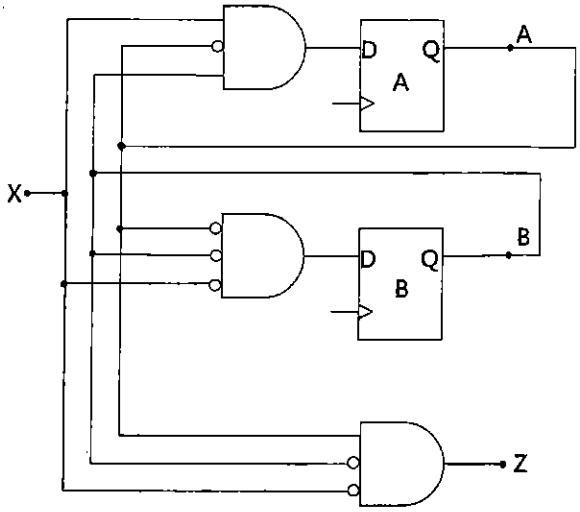
Table-4

Which of the following five circuits can realize the Mealy machine defined above?

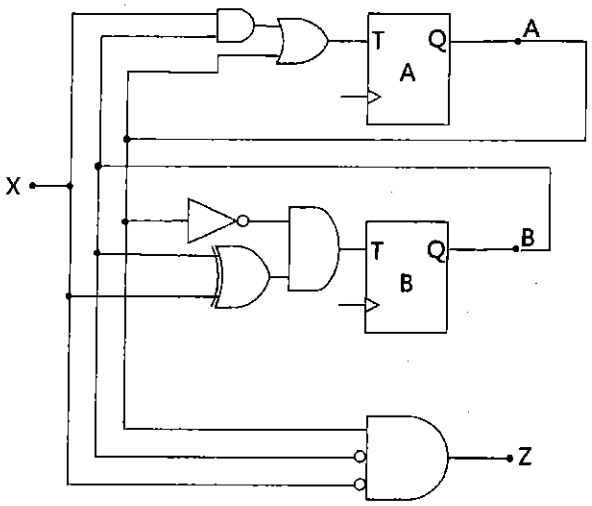
(a)



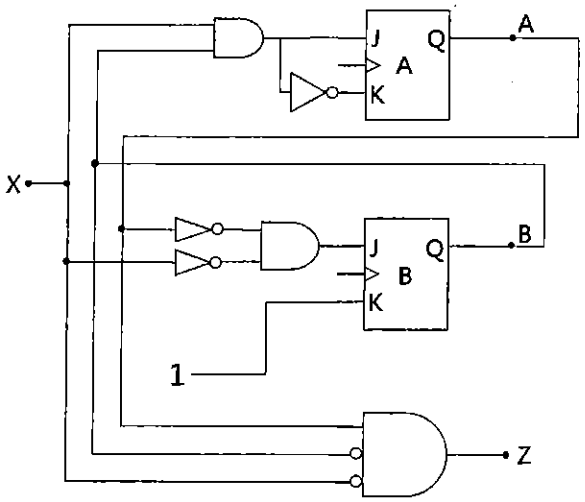
(b)



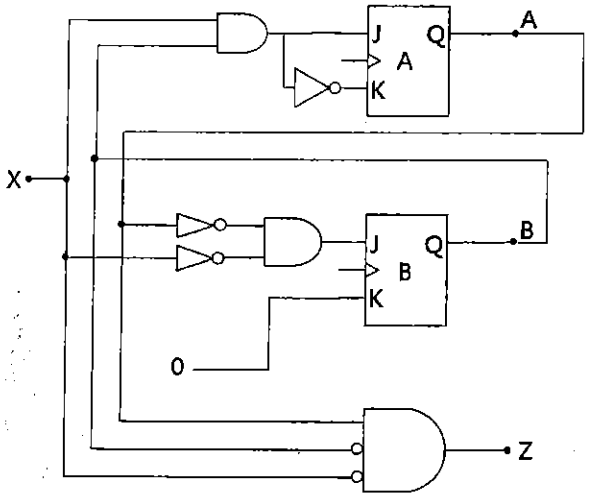
(c)



(d)



(e)



注意：背面有試題

參考用

Question 18 [5pt]. Reduce the following state table (Table-5) to the minimum number of states. Please list all the equivalent states in the original state table. (For example, i=j=k, l=m.)

Present State	Next State		Present Output	
	X=0	X=1	X=0	X=1
a	h	c	1	0
b	c	d	0	1
c	h	b	0	0
d	f	h	0	0
e	c	f	0	1
f	f	g	0	0
g	g	c	1	0
h	a	c	1	0

Table-5

Question 19 [5pt]. Figure-3 shows the state graph representing a sequential circuit that controls a binary multiplier. The circuit contains three inputs (St, M, and K) and four outputs (Load, Ad, Sh, and Done). A one-hot state assignment with four flip-flops (denoted as Q_0, Q_1, Q_2 and Q_3) is used to represent each of the four states. The one-hot assignment for each state is also listed in Figure-3.

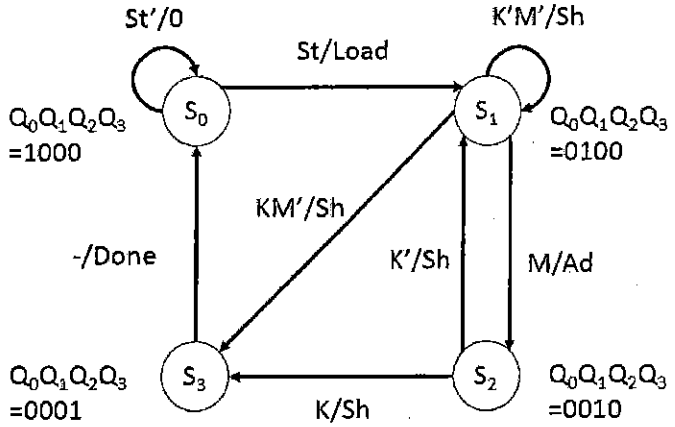


Figure-3

Represent **the next state of Q_1** (denoted as **Q_1^+**) and the **output Sh** with a logic expression of the present states of the four flop-flops and the inputs. The reported logic expression must be reduced to the **minimum sum of product**.

注意：背面有試題

Question 20 [5pt]. Figure-4 shows a counter using three T flip-flops, *A*, *B*, and *C*. The counter will generate the following repeated sequence: *ABC* = 000 -> 111 -> 110 -> 001 -> 011 -> 000 -> 111 … (repeat).

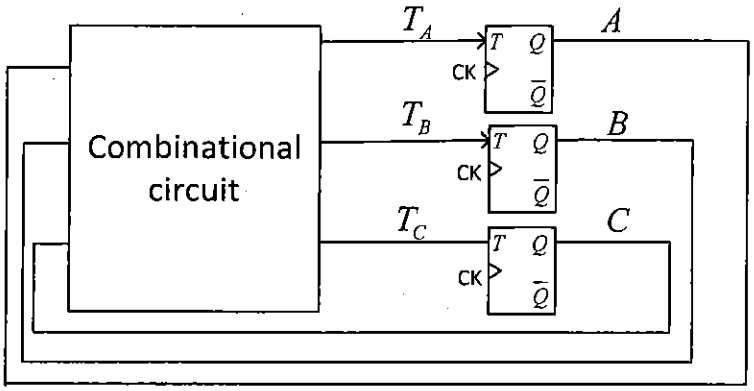


Figure-4

What is the **minimum sum of product** for each input equation of the three T flop-flops, T_A, T_B, and T_C?