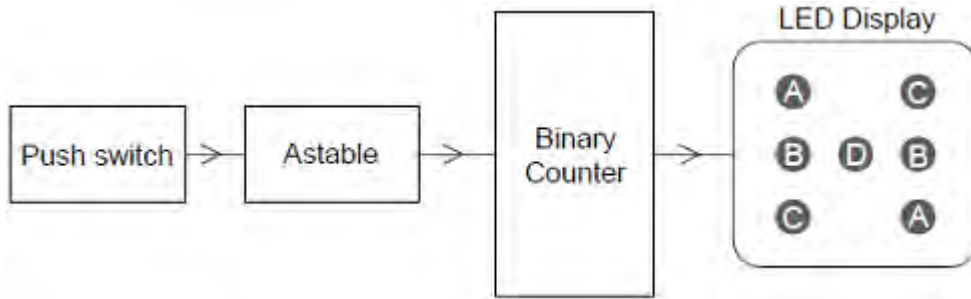
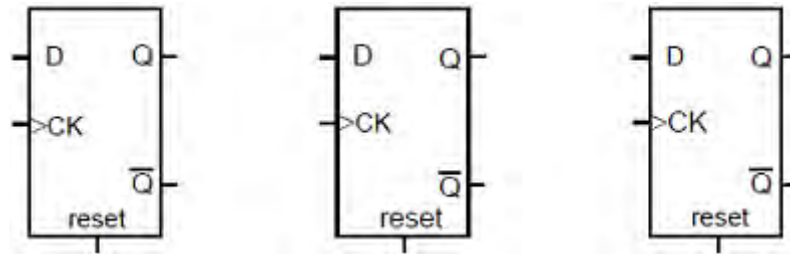


**Q1.** An electronic dice is to be constructed so that when a push switch is operated, the dice counts very quickly and continuously from 1 to 6. When the push switch is released, the number the dice has counted to, is displayed. The dice will consist of the following subsystems.



The binary counter consists of three rising edge triggered D-type flip-flops. The counter outputs are X, Y and Z. The most significant bit is Z.



(a) (i) On the diagram of the binary counter above, show how these flip-flops must be connected to form a 3-bit binary up-counter. Label the input from the astable and the three outputs X, Y and Z. (5)

(ii) Only six possible output states are required from the binary counter for the operation of the dice. Add to the diagram of the binary counter the additional connections and components needed to make the counter count from 0 to 5 and then reset on the sixth input pulse. (3)

(b) The outputs from the binary counter are to be decoded to operate the display to produce the dice numbers. Complete the table below to show how the dice output is related to the binary counter output.

Binary counter output		Dice output	
Denary	Binary Z Y X	Dice number	LED on
0	0 0 0	1	D
1	0 0 1	2	A
2	0 1 0	3	D, A
3		4	
4		5	A, C, D
5		6	

(5)  
(Total 13 marks)