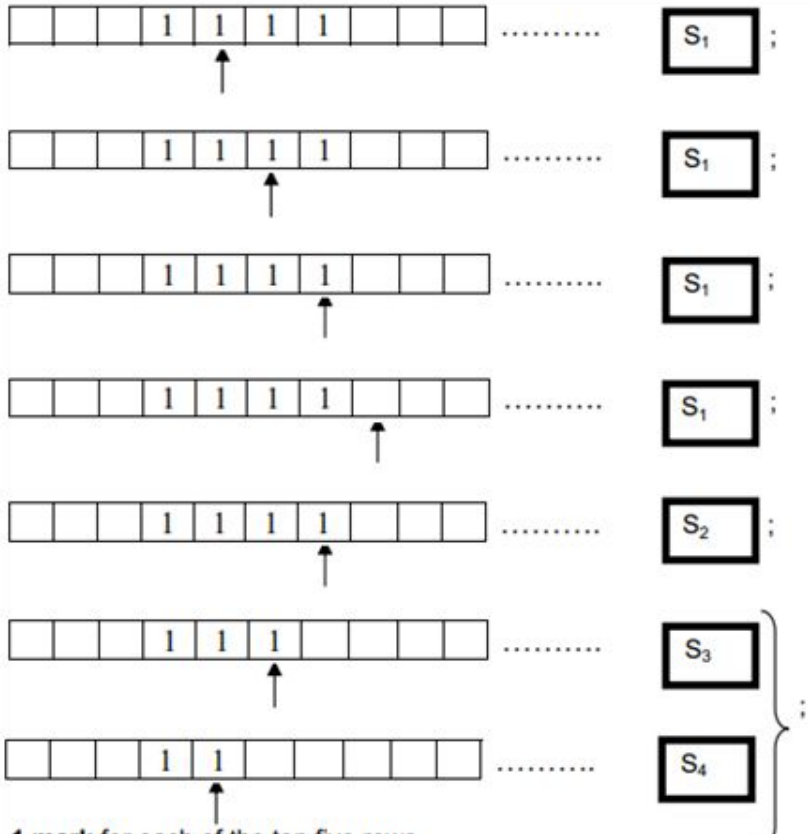
AQA Computer Science A-Level

4.4.5 A model of computation

Past Paper Questions

June 2011 Comp 3

11	(a)		 **1 mark** for each of the top five rows **1 mark** for sixth and seventh row together **Must have correct tape contents and state for each mark** **A** the blank cell symbol ☐ in blank cells **A** answers in which the initial situation of the TM is repeated **A** If the read/write head is not drawn on some rows, this should result in the loss of the mark on the first occasion that it is missing only. Marks should be awarded for subsequent rows, even if the read/write head is not drawn.	6

11	(b)		Deletes two ones from the (right hand) end of the string // Subtracts two from a (unary) number; **A** bits for ones **R** end of tape for end of string **NE** deletes two ones	1

11	(c)		A Turing machine that can execute/simulate the behaviour of any other Turing machine // can compute any computable sequence; Faithfully executes operations on the data precisely as the simulated TM does; (Note: Must have idea of same process) Description of/Instructions for TM (and the TM's input) are stored on the (Universal Turing machine's) tape // The UTM acts as an interpreter; **A** take any other TM and data as input *Alternative definition:* A UTM, U, is an interpreter that reads the description <M> of any arbitrary Turing machine M; and faithfully executes operations on data D precisely as M does.; The description <M> is written at the beginning of the tape, followed by D.;	**Max 2**

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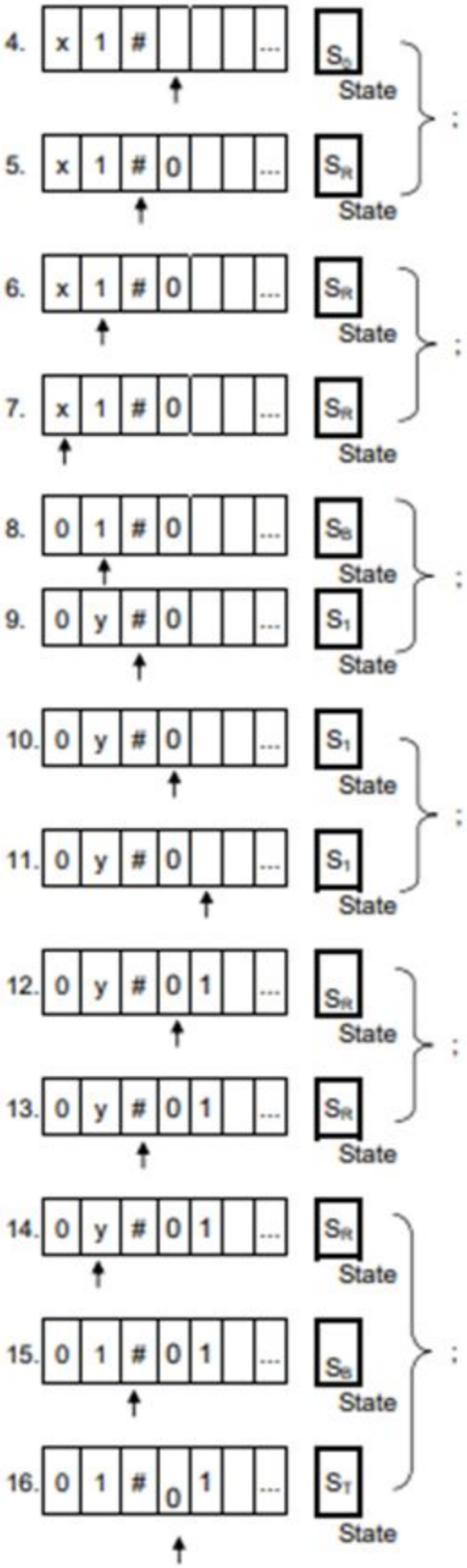
7	(a)	(i)	❷ S_1 **A.** 1, State 1 ❸ S_T **A.** T, State T Both answers correct to get mark;	**1**

7	(a)	(ii)	$\delta (S_B, 0) = (S_0, x, \rightarrow)$; **A.** 0, x, → or 0 | x | → **R** if additional rules listed **I** minor transcription errors e.g. missing , (δ	**1**

7	(a)	(iii)	$\delta (S_R, x) = (S_B, 0, \rightarrow)$ and $\delta (S_R, y) = (S_B, 1, \rightarrow)$; **A.** x, 0, → or x | 0 | → and y, 1, → or y | 1 | → **R** if additional rules listed **I** minor transcription errors e.g. missing , (δ	**1**

7	(b)		One mark per bracketed section.  	6

			Must have correct tape contents and state for each mark **A** blank symbols instead of empty cells **DPT** If the read/write head is not drawn on some rows, this should result in the loss of the mark on the first occasion that it is missing only. Marks should be awarded for subsequent rows, even if the read/write head is not drawn.	

7	**(c)**	**(i)**	Mark symbol currently being copied // to indicate how much of the string has been copied so far // to indicate where to return to (to copy next symbol); **A.** placeholders **NE.** x represents 0, y represents 1	**1**

7	**(c)**	**(ii)**	Copy a string//copy a binary number // copy a bit pattern; **A.** Repeat	**1**