OCR
RECOGNISING ACHIEVEMENT

GCE

Electronics

Advanced GCE **F611**

Simple Systems

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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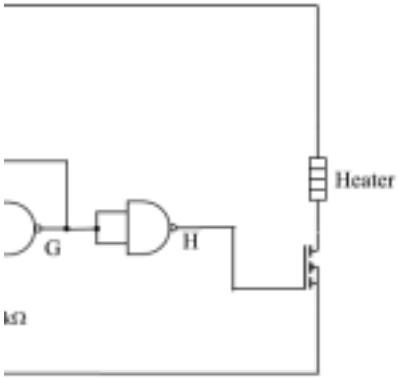
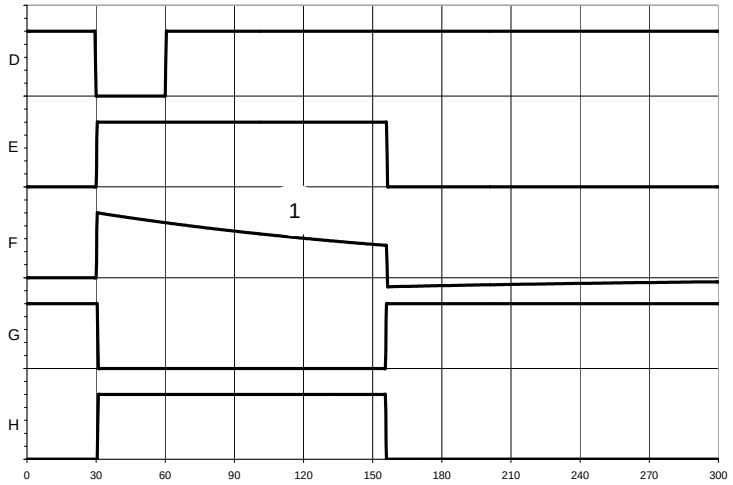
Question	Grade	Expected answer	Mark	Additional guidance
1a	E E	$P = I \times V = 8 \times 12 = 96W$ Units: Watts or W	1 1	Correct numerical answer Correct units
1b	D D	NAND gates can only supply about 10mA Driver amplifies current / switches large current	1 1	Accept answers indicating limited current from gates [1]
1ci	D	IRF630	1	
1cii	D D	Can switch 8A (wtte) Not too expensive (wtte)	1 1	
1di	C E D	Correct n-MOSFET symbol with correct DS polarity Heater and MOSFET/transistor in series with power supply MOSFET gate connected to output of monostable 	1 1 1	Symbol needs to be correct with arrow pointing in

Question	Grade	Expected answer	Mark	Additional guidance
1dii	E D	Switch between input and 0v Switch and resistor in series across supply	1 1	
1diii	C	To make input high when switch not pressed (wtte)	1	Accept sentence with "pull up" Accept "input would float without resistor" wtte Accept sensible answer about function of switch/resistor circuit e.g. "to allow the user to trigger the monostable"
1e	E D D	$t = 0.7RC \quad (eor)$ $t = 0.7 \times 180 \times 10^{3} \times 1000 \times 10^{-6} \quad (correct\ \ conversion)$ $t = 126s \quad (calculation\ accurate)$	1 1 1	ecf incorrect units conversion for <u>one</u> of R or C

1f	C D C B C A	Three or more changes of state at 30s $H = \overline{G}$ Pulse length of H 120s – 140s by eye F suddenly rises to 5v then falls slowly F goes low when it falls to ~2.5V F falls suddenly to -0.7v when voltage gets to ~2.5v and $E = \overline{D \cdot G}$  	1 1 1 1 1 1	Look for pulse going just below line at end of T

<table>
<tr><th>Question</th><th>Grade</th><th>Expected answer</th><th>Mark</th><th>Additional guidance</th></tr>
<tr><td>2ai</td><td>E</td><td>OR</td><td>1</td><td></td></tr>
<tr><td>2aii</td><td>E</td><td>  </td><td>1</td><td>Back should be curved, front should be pointed</td></tr>
<tr><td>2aiii</td><td>D</td><td>A + B</td><td>1</td><td>or any correct expression</td></tr>
<tr><td>2bi</td><td>E</td><td>NAND</td><td>1</td><td></td></tr>
<tr><td>2bii</td><td>E</td><td><table><tr><th>C</th><th>D</th><th>R</th></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table></td><td>1</td><td>All need to be correct for the mark</td></tr>
<tr><td>2biii</td><td>D</td><td>$\overline{C \bullet D}$ or $\overline{C} \bullet \overline{D} + \overline{C} \bullet D + C \bullet \overline{D}$ or $\overline{C} + \overline{D}$</td><td>1</td><td>No credit for $\overline{A \cdot B}$ or other expressions with symbols other than C & D</td></tr>
</table>

Question	Grade	Expected answer	Mark	Additional guidance
2c	C	$X = \overline{\overline{(N \cdot M)} \cdot (N + M)}$	1	Valid expression from circuit
	A	$X = \overline{\overline{(N \cdot M)} + \overline{(N + M)}}$ (D.M.T.)	1	1 mark for each of lines 2,3 & 4 to maximum of 2 marks
	A	$X = (N \cdot M) + \left(\overline{N + M}\right)$ ($2 \times$ double negative)	1	
		$X = (N \cdot M) + \overline{\overline{N} \cdot \overline{M}}$ (D.M.T.)		ACCEPT attempt at reverse argument
		$X = N \cdot M + \overline{N} \cdot \overline{M}$ (double negative)		Use of valid rule eg DMT, cancelled, Pair of inversions, reversal/inversion of brackets [1]

Question	Grade	Expected answer	Mark	Additional guidance
3a	E	Vout=13v	1	Evidence of correct output voltage used
	E	Voltage across R is 13-4.2=8.8 V ecf 15-4.2=10.8V	1	Evidence of subtracting 4.2v from output
	E	I=15mA=0.015A	1	Correct converstion from milli
	E	R=8.8/0.015	1	Correct use of Ohm's law
	E	R=590Ω	1	Correct answer (1) allow ecf at each stage 590Ω allow more sig figs [5] 720Ω [4] 4.2/0.015 = 280Ω [2]
3b	E	Analogue: any value (between minimum and maximum)	1	
	E	Digital: one of only two values	1	
	E	Analogue: voltage at B	1	Accept voltage from LDR. Not just LDR
	E	Digital: Voltage at output of comparator	1	Accept voltage across LED. Not just LED
3ci	E	Ring around zener	1	
3cii	D	(sharp) rise from zero current in +ve quadrant (sharp) fall from zero current in –ve quadrant	1 1	Max 2 if rises not sharp
	C	departs from 0V axis at 0.7V	1	
	C	departs from 0V axis at -3.6V		
3ciii	E	3.6V	1	Do not accept -3.6V
3d	E	Resistance falls with increasing light intensity	1	
	E	Line curves to be asymptotic to axes	1	
3e	C	Total resistance is 2.4k + 6.8k = 9.2k	1	
	C	Current through LDR is 15/9.2k=0.0016A	1	
	C	Voltage across 2.4k is 0.0016x2.4k=3.9V	1	
3f	B	LED reverse biased	1	
	D	Output is -13V	1	Accept "saturated negative"
	C	because voltage at inverting input (B) > voltage at non-inverting input (A)	1	comparison of voltages at op-amp inputs
3g	C	Voltage at inverting input (B) = 3.6v at 30 Lux	1	Any evidence of using 3.6V in calculations ecf from 3cii
	C	Current through 2.4k is 3.6/2.4k=0.0015A	1	
	B	Voltage across LDR is 15-3.6=11.4v	1	Use of potential divider rule with 2.4kΩ
	B	Resistance of LDR is 11.4/0.0015=7600Ω	1	Accept 7.6kΩ for 4 marks

<table>
<tr><th>Question</th><th>Grade</th><th>Expected answer</th><th>Mark</th><th>Additional guidance</th></tr>
<tr><td>4a</td><td>E
B</td><td>All possible combinations of Q, R and S
P correct
<table>
<tr><th>Q</th><th>R</th><th>S</th><th>P</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
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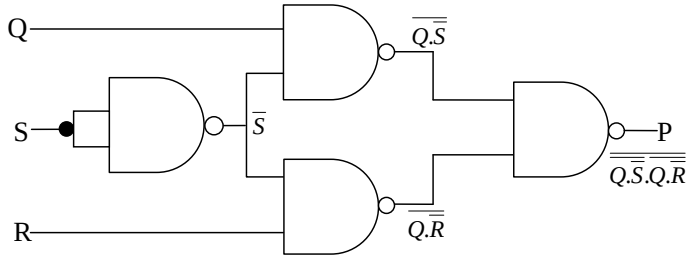
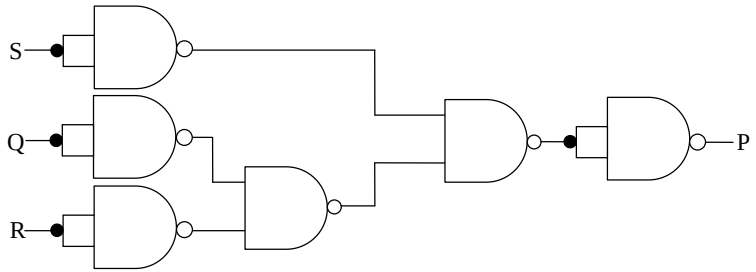
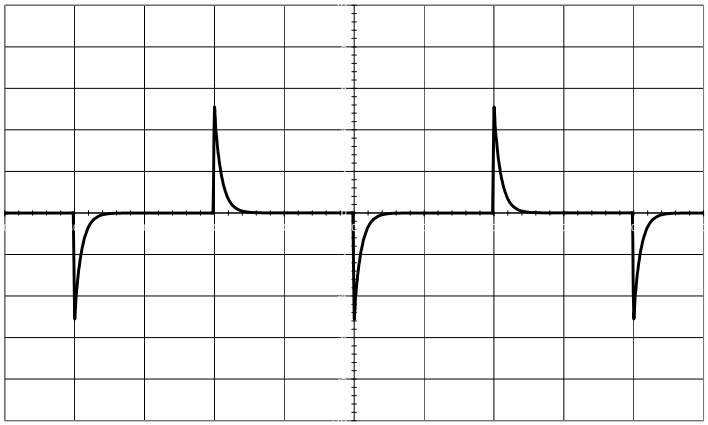
<tr><td>1</td><td>1</td><td>1</td><td>0</td></tr>
</table></td><td>1
1</td><td>Order unimportant</td></tr>
</table>

Question	Grade	Expected answer	Mark	Additional guidance
4b	A A A	$P = Q \cdot \overline{S} + \overline{Q} \cdot R \cdot \overline{S}$ $P = \left(Q + \overline{Q} \cdot R\right) \cdot \overline{S}$ $P = \left(\overline{\overline{Q} \cdot \overline{R}}\right) \cdot \overline{S}$ $P = (Q + R) \cdot \overline{S}$ $P = Q \cdot \overline{S} + R \cdot \overline{S}$ OR $P = (Q + \overline{Q}) \cdot R \cdot \overline{S} + Q \cdot \overline{S}$ $P = R \cdot \overline{S} + Q \cdot \overline{S}$ OR $P = Q \cdot \overline{S} + \overline{Q} \cdot R \cdot \overline{S}$ $P = \left(Q + \overline{Q} \cdot R\right) \cdot \overline{S}$ $P = (Q \cdot (R + \overline{R}) + \overline{Q} \cdot R) \cdot S$ $P = \left(\overline{Q} \cdot R + Q \cdot R + Q \cdot R + Q \cdot \overline{R}\right) \cdot \overline{S}$ $P = \left((\overline{Q} + Q) \cdot R + Q \cdot (R + \overline{R})\right) \cdot \overline{S}$ $P = (Q + R) \cdot \overline{S}$ $P = Q \cdot \overline{S} + R \cdot \overline{S}$	1 1 1	Any valid Boolean manipulation 1 mark + Any valid result with fewer terms than original 1 mark Allow reverse argument for answer

Question	Grade	Expected answer	Mark	Additional guidance
4c	B A A	 Correct implementation of $\overline{S}$ Correct implementation of OR function Correct circuit with labels P, Q, R, S OR  	1 1 1	

Question	Grade	Expected answer	Mark	Additional guidance
5ai	E E	Correct identification of period (4 divisions) Correct conversion from divisions to ms (x200) 800ms	1 1	400ms worth 1 mark
5aii	E E	1/0.8 ecf 1.25Hz	1 1	Reciprocal of time from 5ai Correct conversion of units to get answer in Hz
5aiii	E E	Correct identification of height (2.5 divisions) Correct conversion from divisions to V (x2)=5V	1 1	
5bi	E E	Identifiable oscilloscope symbol connected to 0V Connection to junction of capacitor and resistor	1 1	
5bii	E E D	correct conversion of 10kΩ to 10000Ω correct conversion of 22μF to 0.0000022F correct answer in ms ecf	1 1 1	22ms [3]
5biii	B B A A	Spikes – Sharp rise, slow fall signal goes up/down 2.5 squares +ve and –ve in time with correct period Completely decaying in ~half a division 	1 1 1 1	

Question	Grade	Expected answer	Mark	Additional guidance
5ci	B B A A	Positive spikes remain Negative spikes reduced (disappear) to amplitude of -0.7V because of clamping diodes in NOT gate	1 1 1 1	ecf if signal in 5bi all in region 0V to 5V – no change [1] ecf if signal in 5bi outside 0V to 5V – describe clamping with values and explanation to max of [4] if all points covered.
5cii	C A A	Lamp flashes with period of 800ms Off for about 15ms (0.7RC) In opposite state for about 785ms	1 1 1	Allow if period implied from on time + off time Allow 10ms – 20ms Allow 780ms – 790ms On and off periods reversed [2]

Quality of Written Communication

3 The candidate expresses complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are consistently relevant and well structured. There will be few, if any, errors of grammar, punctuation and spelling.

2 The candidate expresses straightforward ideas clearly, if not always fluently. Sentences and paragraphs may not always be well connected. Arguments may sometimes stray from the point or be weakly presented. There may be some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.

1 The candidate expresses simple ideas clearly, but may be imprecise and awkward in dealing with complex or subtle concepts. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling may be noticeable and intrusive, suggesting weaknesses in these areas.

0 The language has no rewardable features.

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