

Electronics

Advanced Subsidiary GCE

Unit **F611**: Simple Systems

Mark Scheme for June 2011

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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.


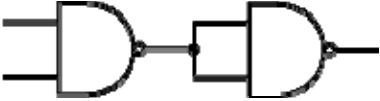
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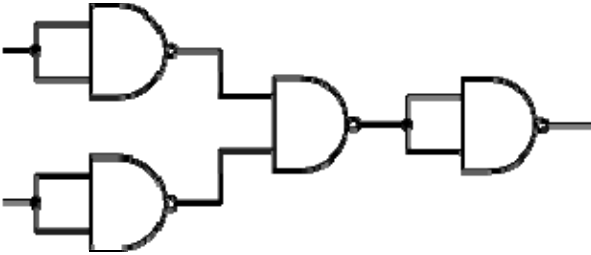
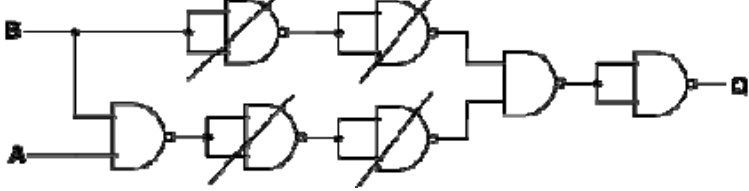
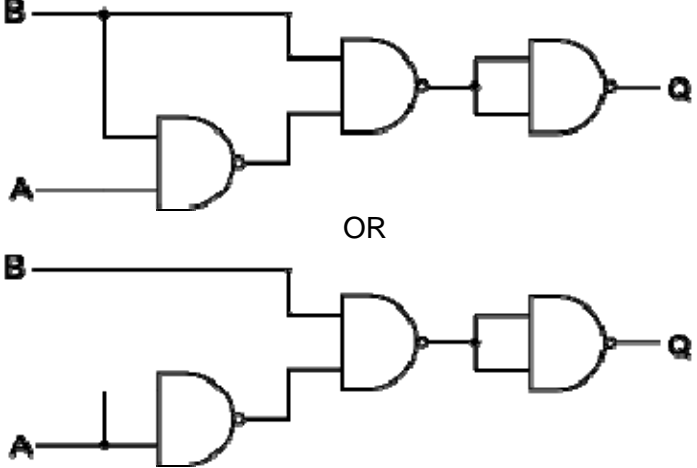
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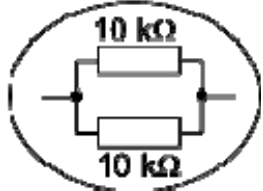
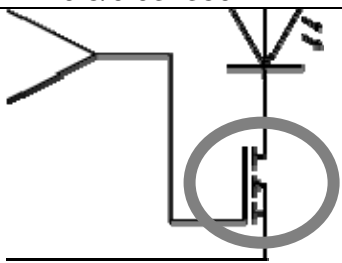
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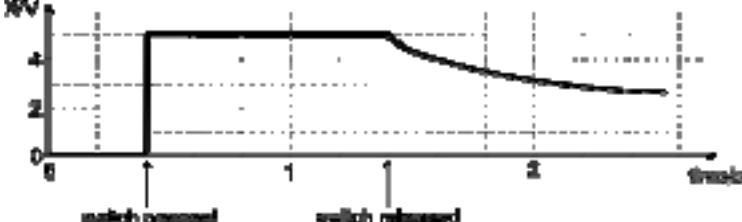
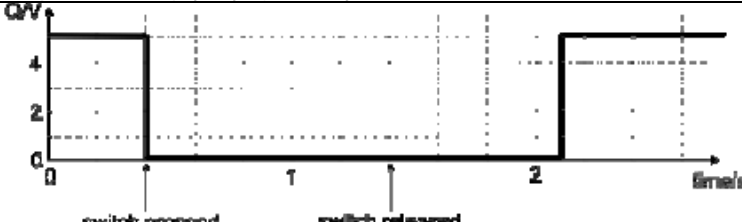
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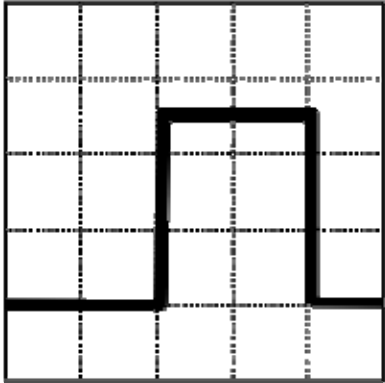
Question	Grade	Expected answer	Mark	Additional Guidance																									
1 (a)	E E E	<table border="1" data-bbox="551 240 1117 520"> <thead> <tr> <th>B</th> <th>A</th> <th>C</th> <th>D</th> <th>Q</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> </tbody> </table> <p data-bbox="459 595 689 624">Column C correct</p> <p data-bbox="459 647 685 676">Column D correct</p> <p data-bbox="459 700 952 729">Column Q correct (ecf from C AND D)</p>	B	A	C	D	Q	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	1	1	0	1	0	[1] [1] [1]	
B	A	C	D	Q																									
0	0	1	0	0																									
0	1	1	0	0																									
1	0	0	0	1																									
1	1	0	1	0																									
1 (b)	D	$Q = \bar{A} \cdot B$ (ecf)	[1]	Do not accept answers in terms of C and D																									
1 (c)	E		[1]																										
1 (d)	E		[1]																										

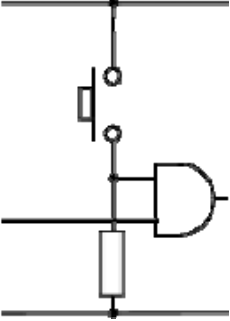
Question	Grade	Expected answer	Mark	Additional Guidance
1	(e)	<p>C</p> 	[1]	
1	(f)	<p>C</p> <p>Correct diagram (ecf from c,d & e)</p>  <p>E</p> <p>Labels correct on correct diagram</p>	[1]	 <p>OR</p>
1	(g)	<p>B</p> <p>Any one of: often need fewer integrated circuits takes up less space on the board making more of one i.c. makes it cheaper (owtte)</p>	[1]	

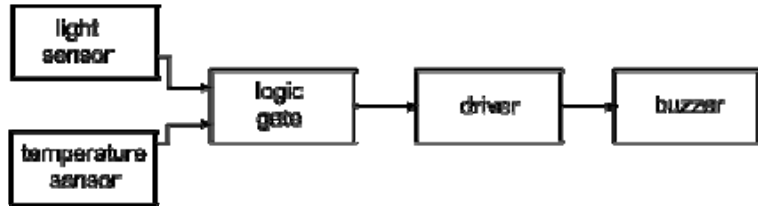
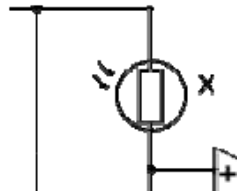
Question			Grade	Expected answer	Mark	Additional Guidance
2	(a)	(i)	E E	2.2k Ω and 4.7k Ω resistors resistors in series	[1] [1]	
2	(a)	(ii)	A		[1]	
2	(b)		C D C	$I = \frac{15}{(2.2 \times 10^3 + 5 \times 10^3)} = 2.08 \text{mA}$ $V = 2.08 \times 10^{-3} \times 5 \times 10^3$ ecf $= 10.42 \text{V}$	[1] [1] [1]	(Calculation of current by) dividing by sum of 2.2k and 5k Multiply (current) by 5k (ecf) Correct answer full marks by any method
2	(c)		A	No current flow into or out of the inputs of an op-amp (wtte)	[1]	Op-amp has high input impedance/resistance
2	(d)		A E	$V = 15 - 4.5 = 10.5 \text{V}$ $R = 10.5 / 0.03 = 350 \Omega$	[1] [1]	1 mark for dividing a voltage by 30mA correctly accept 340 Ω – 360 Ω
2	(e)		E		[1]	
2	(f)		B D	The op-amp can only provide 10mA at its output (wtte) The MOSFET can conduct enough current for the LED (wtte)	[1] [1]	Must state that current from op-amp is small (<30mA) Any statement about higher current from MOSFET or using the term “buffer” or “driver”

Question		Grade	Expected answer	Mark	Additional Guidance
2	(g)	E		[1]	Must have correct symbol and both connections
2	(h)	E D C B	no current through LED because MOSFET off C saturated negative voltage at B > A when cold thermistor has high resistance voltage at B is large/high any of above to max of 4	[max 4]	Allow C=-13V
2	(i)	C A B	the LED will come on (suddenly) as temp rises thermistor resistance falls and V_B falls as soon as $B < A$ (suddenly) C = +13V MOSFET conducting as $V_{GS} > V_{th}$ any of above to max 3	[max 3]	Do not allow slowly/gradually LED comes on at particular temp Allow C goes high

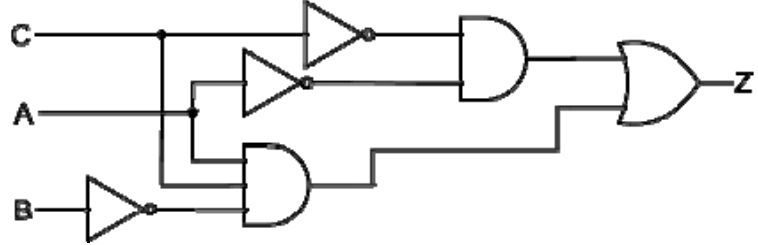
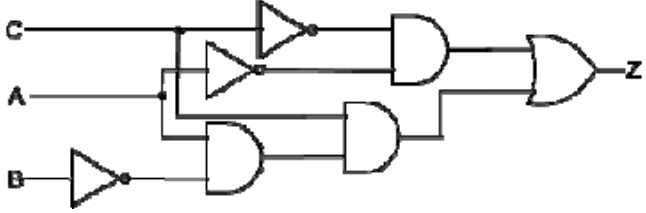
Question			Grade	Expected Answer	Mark	Additional Guidance
3	(a)	(i)	E D	$22 \times 10^3 \times 47 \times 10^{-6} = 1.03s$ correct unit conversions multiply R by C	[1] [1]	7.3×10^n for 1 mark
3	(a)	(ii)	C	$0.7\tau = 0.7s$ (ecf)	[1]	
3	(b)		E D E C	 <p>Sudden change at switch pressed 5V between switch pressed and switch released voltage steady Exponential (by eye) decay from switch released</p>	[1] [1] [1] [1]	
3	(c)		E E A	 <p>Starts high, goes low then returns high Changes state when switch pressed Changes state at $t=2.1s$ (by eye) ecf from 3a(ii)</p>	[1] [1] [1]	
3	(d)		E D C B A A	<p>1 mark for each point (max 6 marks): when switch pressed capacitor (instantly) charges to 5V (A=5V makes) Q go to 0V 0V at Q (makes 5V across buzzer) so sound produced buzzer continues to sound whilst switch pressed when switch released C discharges (through R) when X reaches 2.5V Q= 5V buzzer sounds (for 0.7s) after switch released</p>	[6]	Do not allow slowly/gradually

Question		Grade	Expected Answer	Mark	Additional Guidance
4	(a)	E	$T = \frac{1}{f} = \frac{1}{440} = 2.3 \times 10^{-3} \text{ s} = 2.3 \text{ ms}$	[1]	
4	(b)	E D C	$R \geq 10 \text{ k}\Omega$ $RC = \frac{2.3 \times 10^{-3}}{0.5}$ (correct equations) $= 4.6 \times 10^{-3} \text{ s}$ e.g. $R = 10 \text{ k}\Omega$ $C = 4.5 \times 10^{-7} \text{ F}$	[1] [1] [1]	mark for large resistor value $RC = 4.5 \times 10^n$ for 1 mark Allow calculation using $T=2\text{ms}$
4	(c)	E	connection of some symbol for CRO between A and 0V	[1]	
4	(d)	E D C	 <p>square wave 2.5 divisions high period 4 division</p>	[1] [1] [1]	position of trace on screen unimportant

Question		Grade	Expected Answer	Mark	Additional Guidance	
4	(e)					
		E	switch pulls AND gate input high	[1]		
		D	resistor in series with switch between supply rails	[1]		
4	(f)		$I = \frac{V}{R} = \frac{5}{8} = 0.625A$	[1]		
4	(g)	(i)	E	ZVN4306A	[1]	
4	(g)	(ii)	E	EITHER can conduct sufficient current OR low $R_{DS\ on}$	[1]	

Question	Grade	Expected Answer	Mark	Additional Guidance
5 (a)	E	1 mark for each correct box 	[4]	
5 (b)	A	The flow of <u>information</u>	[1]	
5 (c) (i)	E		[1]	Allow any clear identification of LDR
5 (c) (ii)	E D	Resistance depends on light intensity Resistance falls with increased light intensity	[1] [1]	
5 (c) (iii)	D C C	current 0 for negative V current 0 then rises sharply at about 0.7V (by eye)	[1] [1] [1]	Not more than 2V for rise
5 (c) (iv)	A A A	$I = \frac{5}{22 \times 10^3} = 2.27 \times 10^{-4} \text{ A}$ $V_R = 13 - 0.7 - 5 = 7.3 \text{ V}$ $R = \frac{7.3}{2.27 \times 10^{-4}} = 3.2 \times 10^4 \Omega = 32 \text{ k}\Omega$	[1] [1] [1]	Beware of missing 0.7V (lose 1 mark for wrong V) ecf
5 (c) (v)	D	Potentiometer	[1]	Not variable resistor
5 (c) (vi)	A B	allows the voltage at the inverting input to be altered to adjust the turn on/turn off (light level)	[1] [1]	

Question		Grade	Expected Answer	Mark	Additional Guidance									
6	(a)	C	$W = \bar{C} \cdot \bar{B} \cdot A + \bar{C} \cdot B \cdot A + C \cdot B \cdot \bar{A} + C \cdot B \cdot A$	[1]										
6	(b)	(i)	<p>B $W = \overline{(A \cdot \bar{C}) \cdot (B \cdot C)}$ from circuit</p> <p>B $W = \bar{C} \cdot \bar{B} \cdot A + \bar{C} \cdot B \cdot A + C \cdot B \cdot \bar{A} + C \cdot B \cdot A$</p> <p>A $W = \bar{C} \cdot (B + \bar{B}) \cdot A + C \cdot B \cdot (A + \bar{A})$ factorizing</p> <p>A $W = \bar{C} \cdot A + C \cdot B$ [A + \bar{A}]</p> <p>$W = \overline{(A \cdot \bar{C}) \cdot (B \cdot C)}$ D.M.T.</p>	[1] [1] [1] [1]	1 mark for getting correct expression of diag 1 mark for any correct Boolean manipulation 1 mark for any other type of Boolean manipulation									
6	(b)	(ii)	B to improve clarity of circuit diagram (owtte)	[1]	Do not accept 'unnecessary'									
6	(c)		<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="text-align: center;">Z</td></tr> <tr><td style="text-align: center;">1</td></tr> <tr><td style="text-align: center;">0</td></tr> <tr><td style="text-align: center;">1</td></tr> <tr><td style="text-align: center;">0</td></tr> <tr><td style="text-align: center;">0</td></tr> <tr><td style="text-align: center;">1</td></tr> <tr><td style="text-align: center;">0</td></tr> <tr><td style="text-align: center;">0</td></tr> </table> <p>B first four lines correct</p> <p>A second four lines correct</p>	Z	1	0	1	0	0	1	0	0	[1] [1]	
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Question	Grade	Expected Answer	Mark	Additional Guidance
6	(d)	 <p data-bbox="427 491 1234 624"> C correct inversion of each line B use of 2 input AND for A&C and 3 input AND for others E use of OR gate for Z </p>	<p data-bbox="1339 491 1384 624"> [1] [1] [1] </p>	 <p data-bbox="1429 539 2063 624"> alternatively use two 2-input AND gates to make 3-input AND gate </p>

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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