



GCE

Electronics

Unit **F611**: Simple Systems

Advanced Subsidiary GCE

Mark Scheme for June 2017

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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.

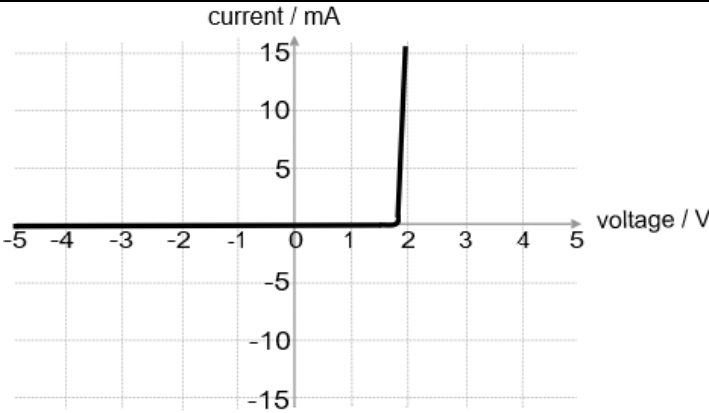
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Annotations

1		31	BOD	Benefit of doubt
2		21	Cross	Cross
3		241	ECF	Error carried forward
4		191	NBOD	Benefit of doubt not given
5		1841	Not Relevant	Expandable vertical wavy line
6		271	REP	Repeat
7		201	TV	Too vague
8		11	Tick	Tick
9		1741	ZERO	Zero (big)
10				
11				
12				
13				
14				

question	grade	expected answer	mark	additional guidance															
1a	E	XOR gate/EOR gate/ Exclusive-OR gate	1																
1b		<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</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> </tbody> </table>	A	B	C	0	0	0	0	1	1	1	0	1	1	1	0		
A	B	C																	
0	0	0																	
0	1	1																	
1	0	1																	
1	1	0																	
	E	all combinations of A and B	1																
	E	C correct	1																
1c	C	$C = A \oplus B$	1	$C = \bar{A} \cdot B + A \cdot \bar{B}$															
1d	C	Press both switches (owtte)	1																
	C	Leave both switches unpressed (owtte)	1																

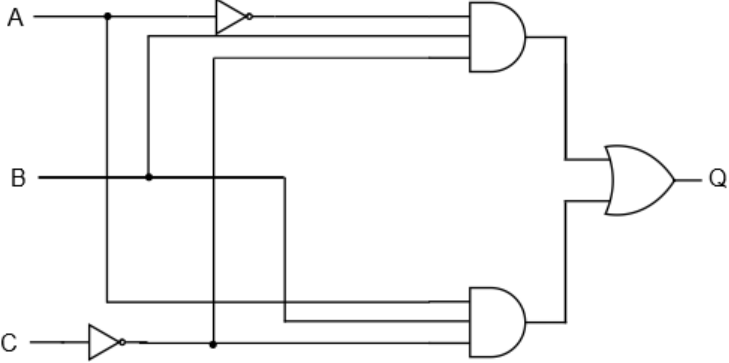
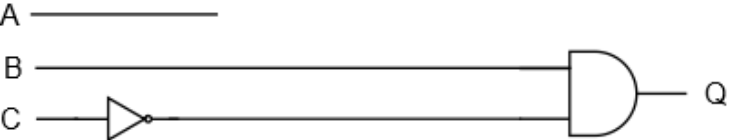
<p>1e</p>	<p>E B D</p>	<p>0 mA for negative voltages For positive voltages: 0 mA then sharp transition with near vertical +ve line after transition (<0.4 V wide by eye) no horizontal line afterwards Transition at 1.9 V</p>	<p>1 1 1</p>	
<p>1f</p>	<p>E D D</p>	<p>V from logic gate is 5 V $R = (5 - 1.9) / 180$ 17mA</p>	<p>1 1 1</p>	<p>Subtraction</p>

question	grade	expected answer	mark	additional guidance
2a	E	$5 \times 0.009 = 0.045 \text{ W}$	1	
2b	E	Lamp glows when switch is pressed	1	
	E	Because W is 0 V when switch pressed	1	
	D	Output of NAND gate is high when one input low	1	
2c	B	$T = 0.5 RC$	1	Evidence of choosing correct equation
	E	$C = \frac{0.5}{0.5 \times 22 \times 10^3} = 4.545 \times 10^{-5}$	1	Correct calculation using 22 k Ω
	D	C=45 μF	1	Conversion to μF

<p>2d</p>	<p>E E B A C B C A A</p>	<p>W make digital with one transition at 1 s W = 0 V between 0 s and 1 s X shows charging discharging with bottom > 0V top < 5V X rising when Y high, X falling when Y low Y square wave (period ≤ 1s) Y has period of 0.5 s Z = 5 V between 0 s and 1 s Z is square wave between 1 s and 2.5 s Z is inverse of Y between 1 s and 2.5 s</p>	<p>1 1 1 1 1 1 1 1 1</p>	<p>The figure contains four vertically stacked graphs sharing a common x-axis labeled 'time/s' from 0 to 2.5 with major ticks every 0.5 units. Vertical dashed lines are drawn at 0.5s intervals. The top graph shows 'W/V' on the y-axis (0 to 5). It is 0V until t=1s, where it jumps to 5V. Arrows labeled 'switch pressed' and 'switch released' point to t=0 and t=1 respectively. The second graph shows 'X/V' on the y-axis (0 to 5). It is a sawtooth wave starting at 5V at t=0, decreasing linearly to a minimum of approximately 2.5V at t=0.25s, then increasing linearly to 5V at t=0.5s, and repeating this cycle. The third graph shows 'Y/V' on the y-axis (0 to 5). It is a square wave that is 0V for the first half of each 0.5s interval and 5V for the second half. The fourth graph shows 'Z/V' on the y-axis (0 to 5). It is 5V from t=0 to t=1s. From t=1s to t=2.5s, it is an inverted square wave, being 0V for the first half and 5V for the second half of each 0.5s interval.</p>

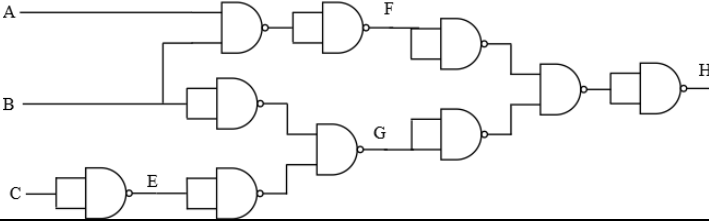
question	grade	expected answer	mark	additional guidance
3a	E	Resistance depends on temperature	1	
	D	Resistance goes down as temperature increases	1	
3b	E	Correct thermistor symbol	1	No BOD
	D	Forming potential divider with resistor across power supply and connected to one of comparator inputs	1	Must use correct symbols
	D	Potential divider or other voltage reference circuit	1	
	B	Buzzer sounds when thermistor is hot	1	
3c	B	One of: So that the buzzer does not sound when output low To protect buzzer from reversed power connection	1	Allow to protect comparator from reverse current from (back emf) coil in buzzer. Answer must be associated with this application and without error
3d	B	13V used as saturated V_{out}	1	
	A	Subtract 0.7 V to find pd across resistor e.g. (13-0.7)	1	
	C	$0.08/(13-0.7) = 0.0065$ A No ecf	1	
3e	E	TB319 ecf from (d)	1	

question	grade	expected answer	mark	additional guidance	
4a	A	3 rd expression	1		
4b	A	4 th expression	1		
4c	A	4 th expression	1		
4d	A	3 rd expression	1		

question	grade	expected answer	mark	additional guidance
5a	B	$Q = \bar{A} \cdot B \cdot \bar{C} + A \cdot B \cdot \bar{C}$	1	Or any equivalent expression e.g. $Q = B \cdot \bar{C}$
5b	A A A	OR gate at end Correct logic for first term Correct logic for second term	1 1 1	 <p>Or any other logically equivalent circuit e.g.</p> 

question	grade	expected answer	mark	additional guidance
6a	C	Diode in reverse bias	1	Allow D pulled low by R_2
	B	No current flows through diode	1	
	A	No current in R_2 so 0 V across R_2	1	
6b	C	Evidence of assuming I same through both resistors	1	7.3:5 So that current ≤ 10 mA
	A	Ratio $R_1:R_2 = 1.46:1$	1	
	E	Provides 5V at D i.e. correct ratio and $R_1+R_2 > 1$ k Ω	1	
6c	E	Use of 4.2 V	1	Evidence of calculating current in 3.3 k Ω resistor (or ratios) Evidence of using voltage across LDR Mark for correct answer, no ecf
	E	$I = 4.2/3300 = 1.27$ mA ecf	1	
	C	V across LDR = $15 - 4.2 = 10.8$ V ecf	1	
	C	$R = 10.8 / 0.00127 = 8.5$ k Ω	1	
6d	E	LDR resistance goes high	1	
	E	A goes lower than B	1	
	C	So C saturates low (-13 V)	1	
	A	Not gate inverts D to make E high	1	
	A	LED forward bias so LED glows	1	

question	grade	expected answer	mark	additional guidance
7a	C	To show the flow of <u>information</u>	1	
7b	E	Because the logic gate cannot provide sufficient <u>current</u> for the lamp (wtte)	1	
7ci	E	Correct MOSFET symbol	1	No errors in symbol
	E	MOSFET in series with lamp, gate connected to OR gate	1	
	E	MOSFET D connect to lamp, S connected to 0 V	1	
	E	Correct labels	1	
7cii	D	$0.7 \times 120k \times 150\mu$	1	Correct calculation
	C	12.6 s	1	Correct conversion to s
7ciii	E	Lamp shines when switch pressed and	1	Award this mark if total time on >30s No ecf if function incorrect (e.g. flashing)
	B	Continues to shine when released	1	
	A	For a total 42.6 s ecf from 7cii for time	1	
7civ	B	To stop the inputs to the logic gate from floating	1	
	D	When switch not pressed	1	

question	grade	expected answer	mark	additional guidance																																				
8a	E D D C	$E = \bar{C}$ $F = A \cdot B$ $G = B + \bar{C}$ $H = \overline{(A \cdot B) + (B + \bar{C})}$	1 1 1 1	Accept logically equivalent expressions ecf from E ecf from F and G																																				
8b	EEEE	1 mark for each correct NAND gate equivalent	4																																					
8c	E E E E	<table border="1"> <thead> <tr> <th>E</th> <th>F</th> <th>G</th> <th>H</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>	E	F	G	H	1	0	1	0	0	0	0	1	1	0	1	0	0	0	1	0	1	0	1	0	0	0	0	1	1	1	1	0	0	1	1	0	4	1 mark for each correct column (ecf H from F & G)
E	F	G	H																																					
1	0	1	0																																					
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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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