OCR
Oxford Cambridge and RSA

GCE

Electronics

Unit **F611:** Simple Systems

Advanced Subsidiary GCE

Mark Scheme for June 2016

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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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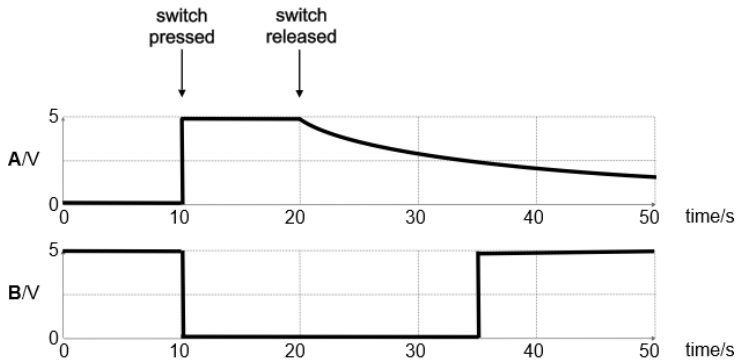
Question	Expected answer	Mark	Additional guidance
1a	EOR gate/XOR gate/ExOR-gate/Exclusive-OR gate	1	
1b	**A B C** 0 0 0 0 1 1 1 0 1 1 1 0 all combinations of A and B C correct	 1 1	
1c	$C = \overline{A} \cdot B + A \cdot \overline{B}$	1	
1d	To turn LED off make switch by bed same as state of switch by door (wtte) To turn LED on make switch by bed opposite to state of switch by door (wtte)	1 1	Full statement of how to turn LED off Full statement of how to turn LED on If one condition for off and one condition for on [1]

Question	Expected answer	Mark	Additional guidance
2a	5-2.2=2.8 V (Correct voltage across R) 2.8/0.015=187 Ω correct use of Ohm's law and conversion from mA	1 1	 2.2/0.015= 147 Ω for [1] 190 Ω [2]
2b	Zero current for all voltages < 0V Line goes through 15 mA , 2.2 V Line at zero current from 0 V to around 2 V (1.5 – 2.2V) then rises from zero in current (∆V<0.5 V)	1 1 1	 Do not award mark if saturates at 15 mA (i.e. there should be no horizontal line at 15 mA)
2c	LED glows (and stays glowing) Max 3 from: Capacitor charges instantly Input A to NOT gate high Output B from NOT gate low LED forward biased	1 3	No mark if answer indicates LED goes off No mark if answer indicates slow charging
2d	0.7 RC used (EOR) Correct answer	1 1	 14.7 s [2]

Question	Expected answer	Mark	Additional guidance
2e	A goes to 5 V at 10 s A stays 5 V between 10 s and 20 s A exponential decay from 20 s to 50s (by eye) A goes through 2.5 V, 35 s (±5 s) B 5V at start goes low from 10s to when A is at 2.5 V and then goes high	1 1 1 1 1	

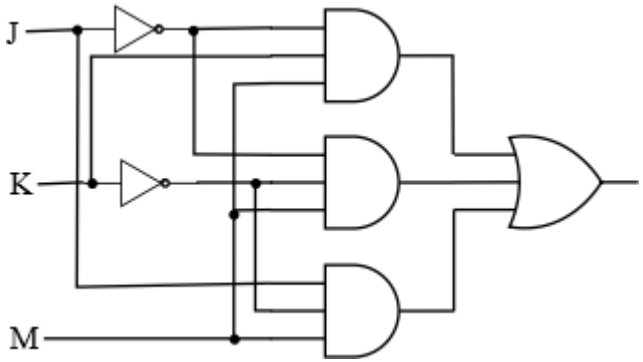
Question	Expected answer	Mark	Additional guidance
3a	Correct MOSFET symbol Connected in series with speaker across power supply Drain to speaker, Source to 0 V. Gate to H All names of terminals correct	1 1 1 1 1	
3b	To provide enough current for the speaker Because the logic gate cannot provide enough current	1 1	Allow to amplify the current [1]
3c	$T=1/3000=3.33\times10^{-4}$s Evidence of correct rule T=0.5RC $R=2T/C=2\times3.33\times10^{-4}/4.7\times10^{-9}=1.42\times10^{5}=140$ kΩ	1 1 1	140 kΩ [3]
3d	Thermistor symbol drawn correctly	1	

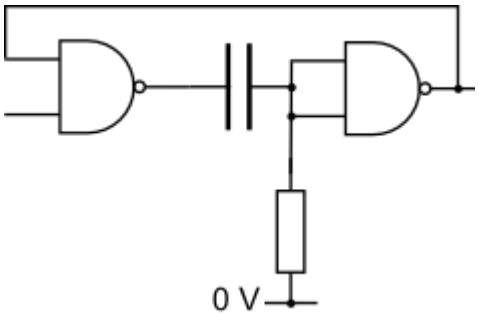
Question	Expected answer	Mark	Additional guidance
3e	When hot: F=0.7V G = 5V H =0V so speaker off When cold: G oscillates so speaker makes a sound Diode in reverse bias	5	

Question	Expected answer	Mark	Additional guidance
4a	1st expression $R = \overline{E} + F$	1	
4b	2nd expression $Q = B \cdot \left(\overline{A} + \overline{B}\right)$	1	
4c	3rd expression $P = (\overline{D} + D) \cdot \overline{C}$	1	
4d	3rd expression $Q = \overline{\overline{A} \cdot \overline{B} + A}$	1	

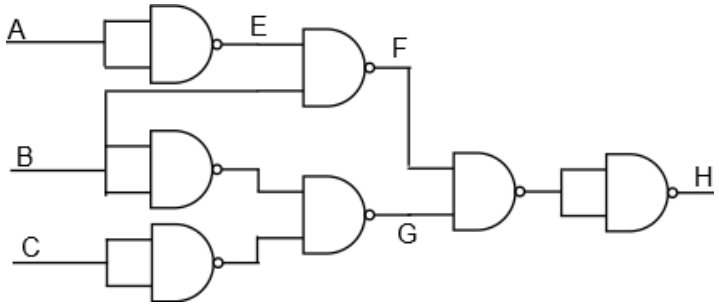
Question	Expected answer	Mark	Additional guidance
5a	Reverse bias zener When the voltage across the zener reaches 2.7 V a current flows (wtte) The rest of the voltage is dropped across the 2.2kΩ resistor / sources current from 15 V rail	1 1 1	 Allow acts as pull up resistor OR limits current (wtte)
5b	Voltage across resistor = 15 – 2.7 = 12.3 V 12.3/2200=0.0056 A (no ecf)	1 1	Accept 5.6 mA [2]
5c	Resistance depends on light intensity Resistance falls as light intensity increases	1 1	
5d	R_T=27+7=34 kΩ I=15/34000=4.41x10^{-4} A V=4.41x10^{-4}x7000=3.1 V	1 1 1	
5e	[Inverting terminal at 2.7 V and non-inverting at 3.1 V so] non-inverting A > inverting B So output of op amp 13 V Diode forward biased	1 1 1	
5f	I = 12.3/27000=4.56x10^{-4} A (ecf from 5b with evidence of subtraction) R = 2.7/4.56x10^{-4} = 5900 Ω = 5.9 kΩ	1 1	5.9 kΩ [2]

Question	Expected answer	Mark	Additional guidance
5g	Max 4 from: Bulbs glow regardless of polarity. When the output of the op amp is -13V [light intensity is high] bulb does not glow no current flows because diode is reverse biased	4	
5h	Voltage across bulb = 13-0.7 = 12.3 V 2/12.3=0.16 A (ecf)	1 1	0.16 A [2]
5i	BAT43 (ecf from h)	1	

Question	Expected answer	Mark	Additional guidance
6a	$Q = M \cdot (\overline{J} + \overline{K})$ $Q = \overline{J} \cdot \overline{K} \cdot M + J \cdot \overline{K} \cdot M + \overline{J} \cdot K \cdot M$	1	
6b	One term correct Circuit functions as TT	1 1	
6c	Switch from K to 5 V Resistor from K to 0 V	1 1	Allow pull up resistor with push to break switch

Question	Expected answer	Mark	Additional guidance
7a	Make it <u>easier/simpler</u>(wtte) to analyse the operation of the system	1	
7b	Two NAND gates with feedback from output to 1 input Capacitor connects first NAND to second NAND (or NOT) Resistor at least 1 kΩ from second NAND input to 0 V Use of 0.7RC used to give correct R & C (21 s)	1 1 1 1	

Question	Expected answer	Mark	Additional guidance
8a	$E = \overline{A}$ $F = \overline{\overline{A} \cdot B}$ $G = B + C$ $H = (\overline{\overline{A} \cdot B}) \cdot (B + C)$	1 1 1 1	ECF for 2nd and 4th marks Insist on parentheses around OR function (answer should be unambiguous)
8b	**E F G H** 1 1 0 0 1 1 1 1 1 0 1 0 1 0 1 0 0 1 0 0 0 1 1 1 0 1 1 1 0 1 1 1 1 mark for each correct column (ecf H from F & G)	4	

Question	Expected answer	Mark	Additional guidance
8c	NOT gate equivalent between A and E OR gate equivalent between B, C and G AND gate equivalent between F, G and H NAND gate between E, B and F and circuit correctly arranged (ecf)	1 1 1 1	 No ecf from a
8d	One from: Fewer chips needed because multiple gates per chip Cheaper to mass produce one gate type	1	Allow saves space

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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