OCR
Oxford Cambridge and RSA

GCE

Electronics

Unit **F611:** Simple Systems

Advanced Subsidiary GCE

Mark Scheme for June 2015

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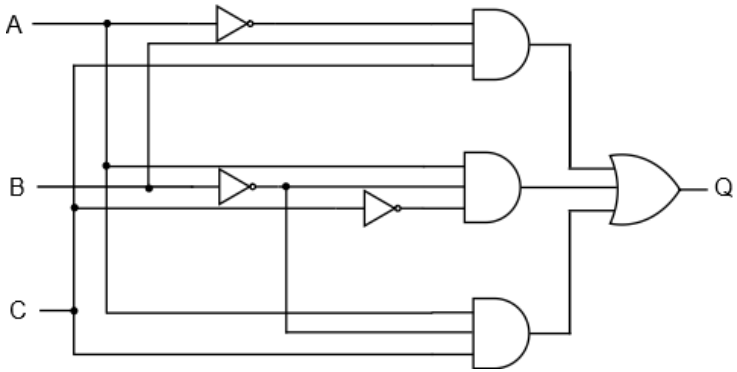
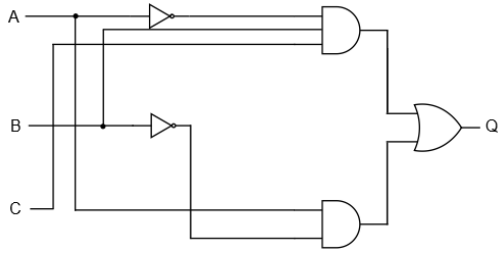
This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

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.

Question	Grade	Expected answer	Mark	Additional guidance
1a	B	$Q = \overline{A} \cdot B \cdot C + A \cdot \overline{B} \cdot \overline{C} + A \cdot \overline{B} \cdot C$	1	Or any equivalent Boolean expression e.g. $Q = \overline{A} \cdot B \cdot C + A \cdot \overline{B}$
1b	B A	OR gate at end rest as TT	1 1	 Or any other logic circuit whch operates as the truth table e.g.  No ecf

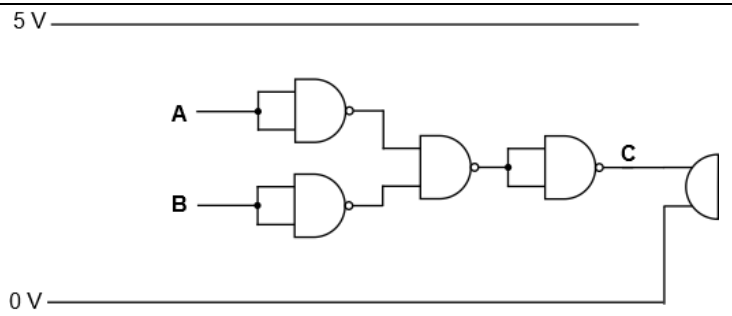
<table>
<tr><th>Question</th><th>Grade</th><th>Expected answer</th><th>Mark</th><th>Additional guidance</th></tr>
<tr><td>2a</td><td>E</td><td>NOR gate</td><td>1</td><td></td></tr>
<tr><td>2b</td><td>

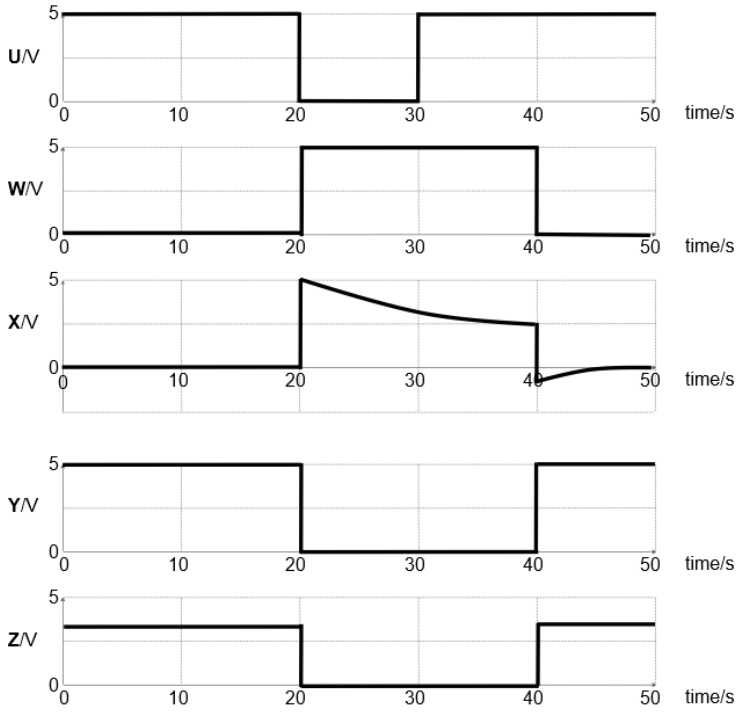
E
E</td><td><table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table>
all combinations of A and B
C correct</td><td>

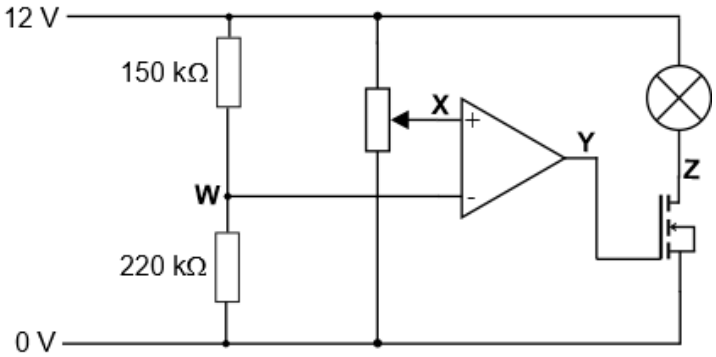
1
1</td><td></td></tr>
<tr><td>2c</td><td>C</td><td>$C = \overline{A + B}$</td><td>1</td><td>$C = \overline{A} \cdot \overline{B}$</td></tr>
<tr><td>2d</td><td>E
E

E</td><td>Switch connecting A/B to 5 V or 0 V
Resistor forming potential divider with switch across power supply
Identical working separate circuits for A and B (or inverted)</td><td>1

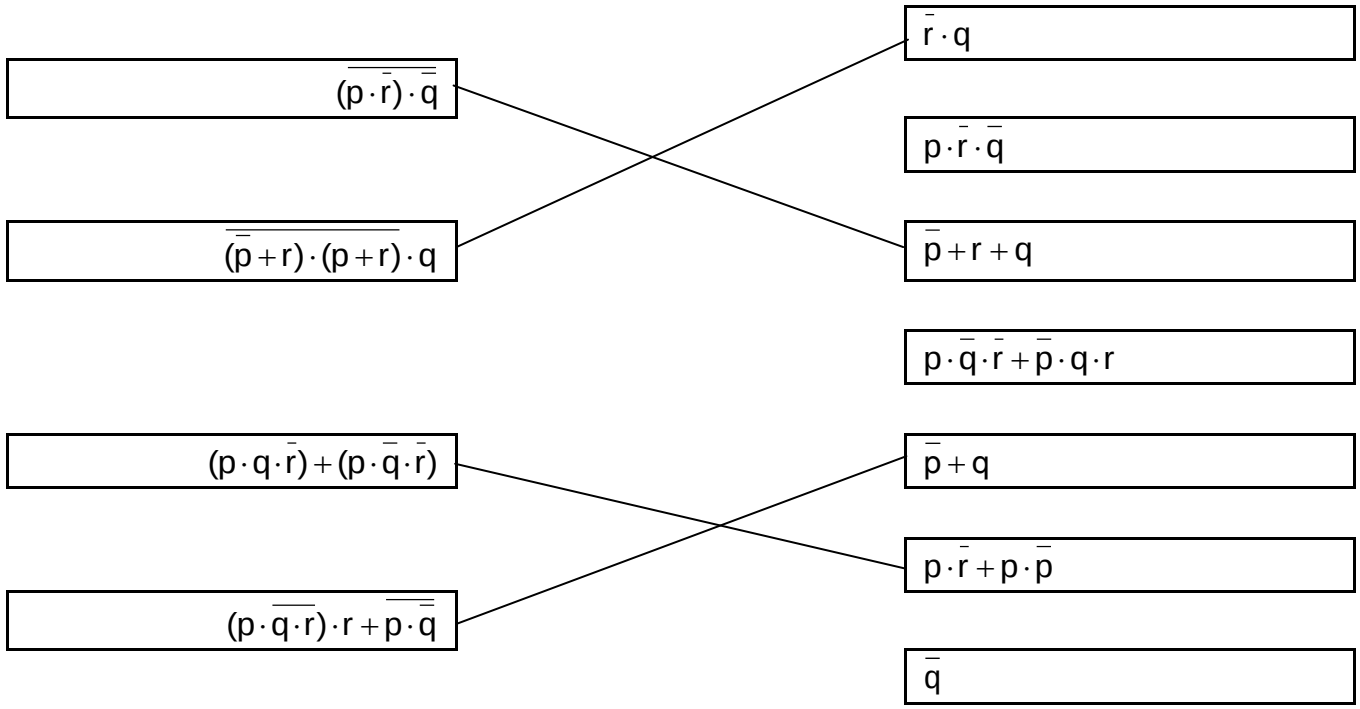
1
1</td><td>Switch pulls A/B high or low</td></tr>
<tr><td>2e</td><td>D</td><td>Answer consistent with 2b</td><td>1</td><td></td></tr>
<tr><td>2f</td><td>B</td><td>To prevent input floating when switch not pressed/to make input low when switch not pressed</td><td>1</td><td></td></tr>
</table>

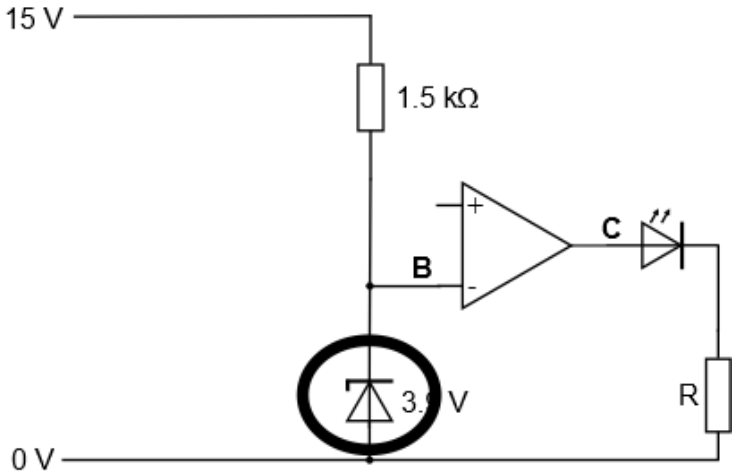
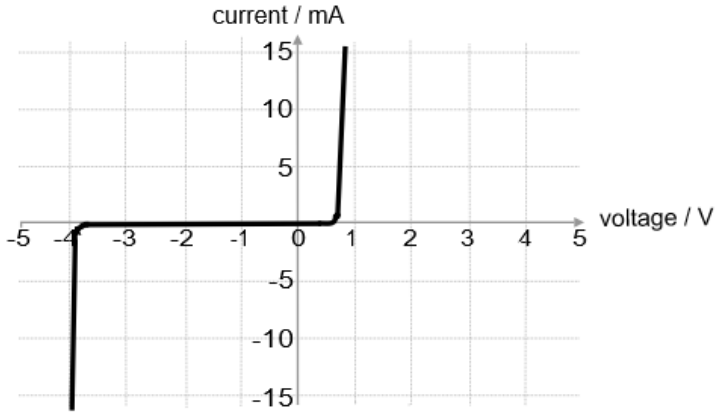
Question	Grade	Expected answer	Mark	Additional guidance
2g	B E	Correct circuit Correct symbol for NAND	1 1	

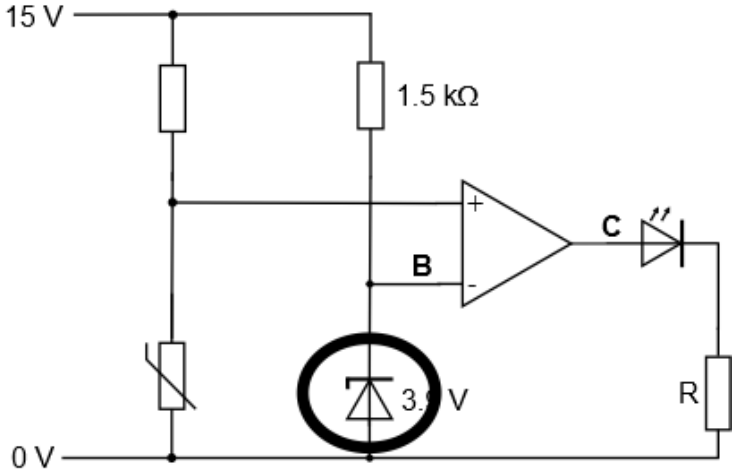
Question	Grade	Expected answer	Mark	Additional guidance
3a	D	5-1.8=3.2 V (correct voltage across R)	1	0.0106 A or 0.0038 A for [1]
	E	3.2/470=0.0068 A (a voltage divided by 470 Ω)	1	0.0068 A for [2]
3b	E	R at least 10 kΩ	1	
	E	Use of 0.7 RC	1	
	D	RC=28.5 s	1	±1.5 s
3c	B	LED stops glowing	1	
	E	For 20s	1	Monostable action
	D	Then turns on again (ecf from first mark)	1	No mark if answer indicates slow charging
3d	E	$W = \overline{U \cdot Y}$	1	
	C	W goes high at 20 s	1	
	C	X goes to 5V at 20s then decay exponentially	1	
	B	To 2.5 V at 40 s then goes low suddenly	1	
	A	To -0.7 V approx and then exponential to 0V	1	
	E	Y starts high	1	
	B	Goes low between 20s and 40s	1	
	A	Z same shape as Y but only at 0 V and 3.2 V (by eye)	1	

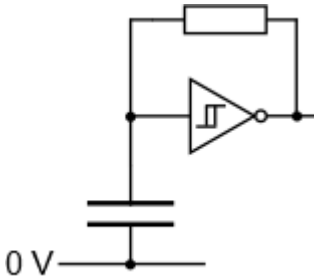
Question	Grade	Expected answer	Mark	Additional guidance
4a	E D E	Total R=150k+220k=370k I=12/370k=3.24x10^{-5} A V=220x3.24x10^{-5} = 7.14 V	1 1 1	 4.8 V [2] 7.14 V [3]
4b	E E	Correct symbol Wiper to X, ends to 12 V and 0 V	1 1	
4c	 D C C C D C	**While X is less than W (7.1 V)** Lamp is off Y is -13 V / saturated low (VGS below threshold) MOSFET is not conducting Z is 12 V **When X is greater than W** Lamp is on One from: • Y is +13 V / saturated high • MOSFET conducting • Z is 0V	 1 1 1 1 1 1	 ecf from part (a) If candidate gives more detail for X>W accept reverse argument

Question	Grade	Expected answer	Mark	Additional guidance
4d	E	3 A	1	
4e	A	• STP36NF06L • It can handle the current and is the cheapest	1	Not power

Question	Grade	Expected answer	Mark	Additional guidance
5a	A	2nd expression	1	
5b	A	3rd expression	1	
5c	A	1st expression	1	
5d	A	1st expression	1	
5e		1 mark per correct connection 		

Question	Grade	Expected answer	Mark	Additional guidance
6a	E	Ring around zener	1	
6b	B E C	Correct shape (0 mA around origin, steep transitions in positive and negative quadrant < 0.3 V wide) Transition at 0.7 V Transition at -3.9 V	1 1 1	
6c	D D	Max 2 from: To provide a fixed voltage at B To compare with a varying voltage Voltage independent of supply	1 1	Regulate or stabilise

Question	Grade	Expected answer	Mark	Additional guidance
6di	E E	Resistance varies with temperature Resistance decreases with increasing temperature (or vice versa)	1 1	
6dii	E E D	Correct thermistor symbol Thermistor and resistor forming potential divider from power supply, centre connected to non-inverting input Thermistor from 0 V to non-inverting input	1 1 1	
6diii	 A A A	 I = 3.9/3700=1.05x10^{-3} A V across resistor = 15-3.9 = 11.1V R = 11.1/1.05x10^{-3} = 10530 Ω = 10.5 kΩ	 1 1 1	ecf if 6dii the wrong way around: V across thermistor = 15-3.9 = 11.1V I = 11.1/3700=3.00x10^{-3} A R = 3.9/3x10^{-3} = 1300 Ω = 1.3 kΩ
6e	C E	V=13-2.1=10.9 V R=10.9/8x10^{-3} =1360 Ω = 1.4 kΩ	1 1	 Award this mark for voltage/current if voltage includes reasonable output voltage from comparator. No credit for 2.1 V/8 mA

Question	Grade	Expected answer	Mark	Additional guidance
7a	B	To turn on off the signal from the relaxation oscillator	1	Notion that it allows the light sensor to gate the oscillator
7b	E D	To provide enough current for the lamp Because the logic gate cannot provide sufficient current	1 1	Allow boost/amplify <u>current</u>
7ci	E	F=1/0.4=2.5 Hz	1	
7cii	D C B E E C	Use of Schmitt trigger NOT with correct symbol With capacitor and resistor Correct circuit R at least 10k Use of 0.5RC RC=0.8s (ecf from 7ci)	1 1 1 1 1 1	 If 7ci is 5 Hz RC=0.4 s
7d	B B	Operation of NAND gate e.g output can only charge when one input is high (wtte) Therefore light sensor gives out a 1 in the dark (no ecf)	1 1	 Only award second mark if first mark awarded

<table>
<tr><th>Question</th><th>Grade</th><th>Expected answer</th><th>Mark</th><th>Additional guidance</th></tr>
<tr><td>8a</td><td>E
D
C
D</td><td>$E = \overline{B}$
$F = \overline{\overline{B} + A}$
$G = B \cdot C + \overline{B} \cdot \overline{C}$
$H = (\overline{A + \overline{B}}) \cdot (B \cdot C + \overline{B} \cdot \overline{C})$</td><td>1
1
1
1</td><td>
$F = \overline{A} \cdot B$ or suitable alternative ecf from E
$G = \overline{B} \oplus C$ or suitable alternative ecf from E
$H = \overline{A} \cdot B \cdot C$ or suitable alternative ecf from F and G</td></tr>
<tr><td>8b</td><td>E
E
E
E</td><td><table><tr><th>E</th><th>F</th><th>G</th><th>H</th></tr><tr><td>1</td><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td></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></table>1 mark for each correct column (ecf H from F & G)</td><td>4</td><td>No ecf from 8a</td></tr>
<tr><td></td><td></td><td>Total</td><td>87</td><td></td></tr>
<tr><td></td><td></td><td>QWC</td><td>3</td><td>Overleaf</td></tr>
<tr><td></td><td></td><td>=</td><td>90</td><td></td></tr>
</table>

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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