

**GCE**

**Electronics**

Unit **F611**: Simple Systems

Advanced Subsidiary GCE

**Mark Scheme for June 2015**

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

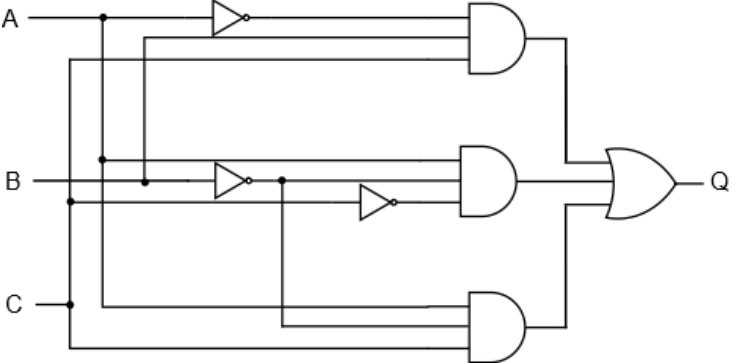
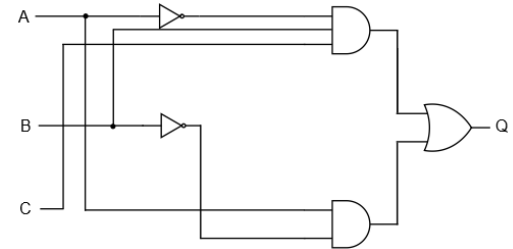
This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

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.

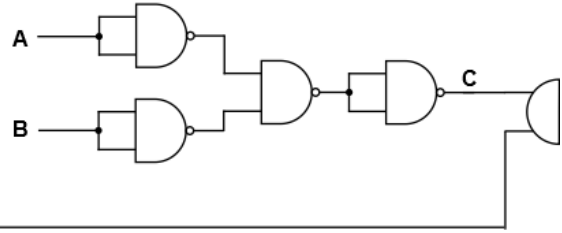
Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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

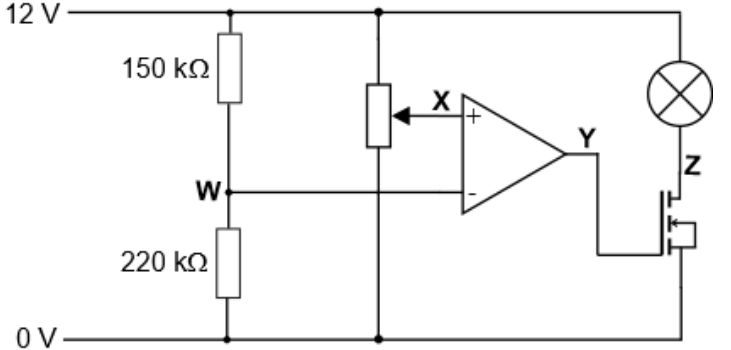
© OCR 2015

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

Question	Grade	Expected answer	Mark	Additional guidance															
2a	E	NOR gate	1																
2b		<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>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> </tbody> </table>	A	B	C	0	0	1	0	1	0	1	0	0	1	1	0		
A	B	C																	
0	0	1																	
0	1	0																	
1	0	0																	
1	1	0																	
	E	all combinations of A and B	1																
	E	C correct	1																
2c	C	$C = \overline{A + B}$	1	$C = \overline{A} \cdot \overline{B}$															
2d	E	Switch connecting A/B to 5 V or 0 V	1	Switch pulls A/B high or low															
	E	Resistor forming potential divider with switch across power supply	1																
	E	Identical working separate circuits for A and B (or inverted)	1																
2e	D	Answer consistent with 2b	1																
2f	B	To prevent input floating when <u>switch not pressed</u> /to make input low when <u>switch not pressed</u>	1																

Question	Grade	Expected answer	Mark	Additional guidance
2g	B E	Correct circuit Correct symbol for NAND	1 1	<p>5V _____</p>  <p>0V _____</p>

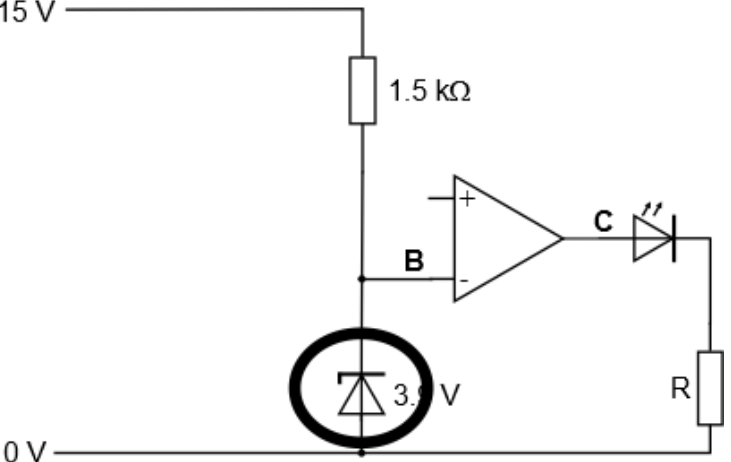
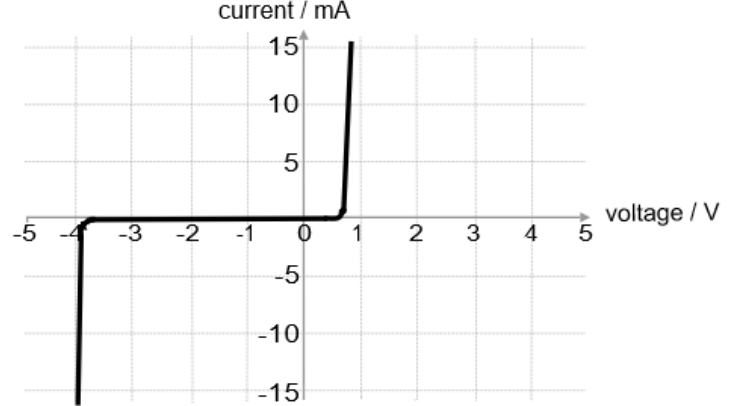
Question	Grade	Expected answer	Mark	Additional guidance
3a	D E	5-1.8=3.2 V (correct voltage across R) 3.2/470=0.0068 A (a voltage divided by 470 Ω)	1 1	0.0106 A or 0.0038 A for [1] 0.0068 A for [2]
3b	E E D	R at least 10 kΩ Use of 0.7 RC RC=28.5 s	1 1 1	±1.5 s
3c	B E D	LED stops glowing For 20s Then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

Question	Grade	Expected answer	Mark	Additional guidance
4a	E D E	Total $R=150k+220k=370k$ $I=12/370k=3.24 \times 10^{-5} \text{ A}$ $V=220 \times 3.24 \times 10^{-5} = 7.14 \text{ V}$	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	<p><b>While X is less than W (7.1 V)</b></p> <p>Lamp is off</p> <p>Y is -13 V / saturated low</p> <p>(VGS below threshold) MOSFET is not conducting</p> <p>Z is 12 V</p> <p><b>When X is greater than W</b></p> <p>Lamp is on</p> <p>One from:</p> <ul style="list-style-type: none"> <li>• Y is +13 V / saturated high</li> <li>• MOSFET conducting</li> <li>• Z is 0V</li> </ul>	1 1 1 1 1 1	ecf from part (a)      If candidate gives more detail for $X > W$ accept reverse argument

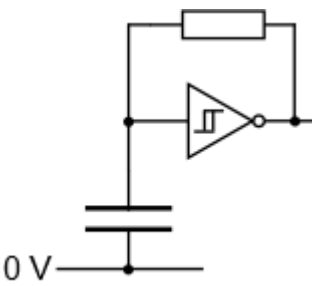
Question	Grade	Expected answer	Mark	Additional guidance
4d	E	3 A	1	
4e	A	<ul style="list-style-type: none"><li>• STP36NF06L</li><li>• It can handle the current and is the cheapest</li></ul>	1	Not power



Question	Grade	Expected answer	Mark	Additional guidance
5a	A	2 <sup>nd</sup> expression	1	
5b	A	3 <sup>rd</sup> expression	1	
5c	A	1 <sup>st</sup> expression	1	
5d	A	1 <sup>st</sup> 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, <u>steep</u> 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	Resistance varies with temperature	1	
	E	Resistance decreases with increasing temperature (or vice versa)	1	
6dii	E	Correct thermistor symbol	1	
	E	Thermistor and resistor forming potential divider from power supply, centre connected to non-inverting input	1	
	D	Thermistor from 0 V to non-inverting input	1	
6diii	A	$I = 3.9/3700 = 1.05 \times 10^{-3} \text{ A}$	1	ecf if 6dii the wrong way around:
	A	V across resistor = $15 - 3.9 = 11.1 \text{ V}$	1	V across thermistor = $15 - 3.9 = 11.1 \text{ V}$
	A	$R = 11.1/1.05 \times 10^{-3} = 10530 \ \Omega = 10.5 \text{ k}\Omega$	1	$I = 11.1/3700 = 3.00 \times 10^{-3} \text{ A}$
				$R = 3.9/3 \times 10^{-3} = 1300 \ \Omega = 1.3 \text{ k}\Omega$
6e	C	$V = 13 - 2.1 = 10.9 \text{ V}$	1	Award this mark for voltage/current if voltage includes reasonable output voltage from comparator. No credit for 2.1 V/8 mA
	E	$R = 10.9/8 \times 10^{-3} = 1360 \ \Omega = 1.4 \text{ k}\Omega$	1	

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	To provide enough current for the lamp	1	Allow boost/amplify <u>current</u>
	D	Because the logic gate cannot provide sufficient current	1	
7ci	E	$F=1/0.4=2.5$ Hz	1	
7cii	D	Use of Schmitt trigger NOT with correct symbol	1	 <p>0 V</p> <p>If 7ci is 5 Hz <math>RC=0.4</math> s</p>
	C	With capacitor and resistor	1	
	B	Correct circuit	1	
	E	R at least 10k	1	
	E	Use of $0.5RC$	1	
	C	$RC=0.8$ s (ecf from 7ci)	1	
7d	B	Operation of NAND gate e.g output can only charge when one input is high (wtte)	1	Only award second mark if first mark awarded
	B	Therefore light sensor gives out a 1 in the dark (no ecf)	1	

Question	Grade	Expected answer	Mark	Additional guidance																																				
8a	E	$E = \bar{B}$	1	F = $\bar{A} \cdot B$ or suitable alternative ecf from E G = $\bar{B} \oplus C$ or suitable alternative ecf from E H = $\bar{A} \cdot B \cdot C$ or suitable alternative ecf from F and G																																				
	D	$F = \overline{\bar{B} + A}$	1																																					
	C	$G = B \cdot C + \bar{B} \cdot \bar{C}$	1																																					
	D	$H = (\overline{A + \bar{B}}) \cdot (B \cdot C + \bar{B} \cdot \bar{C})$	1																																					
8b	E	<table border="1" style="margin-left: auto; margin-right: auto;"> <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>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> </tbody> </table>	E	F	G	H	1	0	1	0	1	0	0	0	0	1	0	0	0	1	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	4	No ecf from 8a
	E		F	G	H																																			
	1		0	1	0																																			
	1		0	0	0																																			
	0		1	0	0																																			
	0		1	1	1																																			
	1		0	1	0																																			
	1		0	0	0																																			
	0		0	0	0																																			
	0		0	1	0																																			
E																																								
E																																								
E																																								
E																																								
E																																								
E																																								
E																																								
E																																								
E																																								
		1 mark for each correct column (ecf H from F & G)																																						
		Total	87																																					
		QWC	3	Overleaf																																				
		=	90																																					

**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.

**OCR (Oxford Cambridge and RSA Examinations)**  
1 Hills Road  
Cambridge  
CB1 2EU

**OCR Customer Contact Centre**

**Education and Learning**  
Telephone: 01223 553998  
Facsimile: 01223 552627  
Email: [general.qualifications@ocr.org.uk](mailto:general.qualifications@ocr.org.uk)

[www.ocr.org.uk](http://www.ocr.org.uk)

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

**Oxford Cambridge and RSA Examinations**  
is a Company Limited by Guarantee  
Registered in England  
Registered Office; 1 Hills Road, Cambridge, CB1 2EU  
Registered Company Number: 3484466  
OCR is an exempt Charity

**OCR (Oxford Cambridge and RSA Examinations)**  
Head office  
Telephone: 01223 552552  
Facsimile: 01223 552553

© OCR 2015

