

GCE

Electronics

Unit **F611**: Simple Systems

Advanced Subsidiary GCE

Mark Scheme for June 2014

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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.

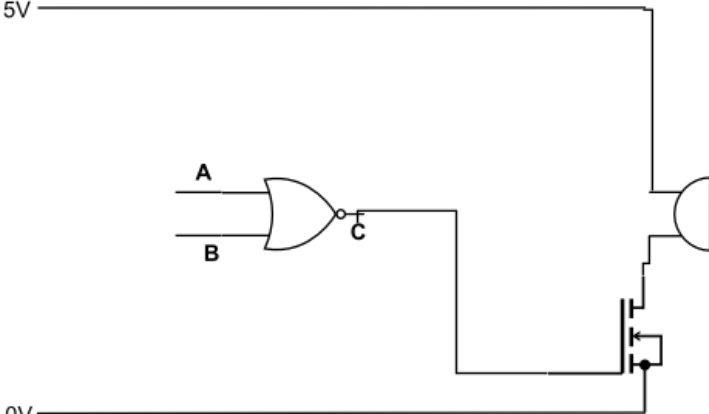
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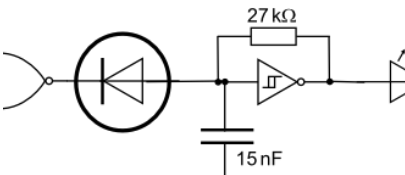
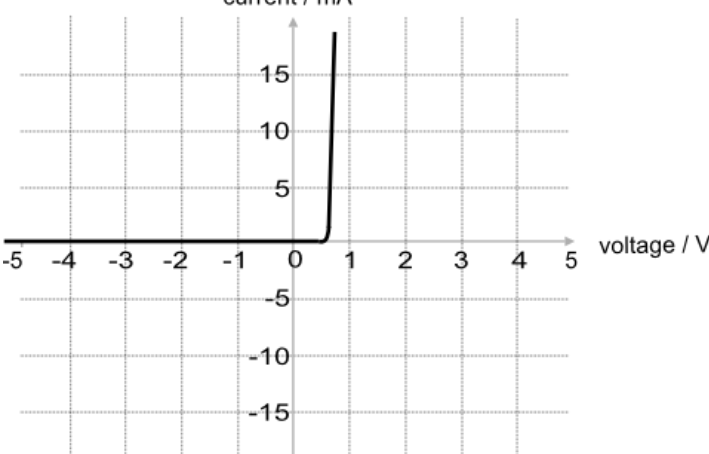
These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning of annotation
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.

question	grade	expected answer	mark	additional guidance															
1a	E	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>1</td> </tr> </tbody> </table>	A	B	C	0	0	0	0	1	1	1	0	1	1	1	1		
A	B	C																	
0	0	0																	
0	1	1																	
1	0	1																	
1	1	1																	
	E	all combinations of A and B	1																
	E	C correct	1																
1c	C	$C = A + B$	1	$C = A \cdot B + \bar{A} \cdot B + A \cdot \bar{B}$															
1d	C	Logic gates can only supply a few millamps at output (wtte)	1																
	C	MOSFET can <u>switch</u> large current (with virtually no current at gate) (wtte)	1	Allow MOSFETs <u>amplify</u> current for [1]															

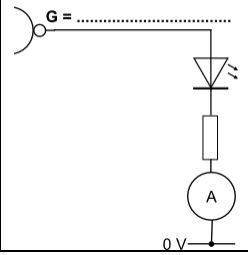
question	grade	expected answer	mark	additional guidance
1e	B D B D	Correct MOSFET symbol MOSFET and buzzer in series with power Source to 0 V Drain to buzzer Gate to output of OR gate	1 1 1 1	 <p>5V</p> <p>0V</p> <p>Ignore anything connected to A or B unless connected to output</p>

question	grade	expected answer	mark	additional guidance
2a	E	$47k+68k=115k$ (adding resistors)	1	correct unit conversion throughout calculation
	D	115000Ω (units conversion)	1	
	C	$I = 15/115000 = 0.00013 \text{ A} = 0.13 \text{ mA}$ (calculation of current using 15V)	1	
	C	$V = 68000 \times 0.00013 = 8.87 \text{ V} \approx 9 \text{ V}$	1	
2b	C	It only conducts in one direction wtte	1	Diode behaviour
	D	It conducts when there is a pd of about 2V across it wtte	1	1.7 V – 4.5 V
2c	C	$X = 8.87 \text{ V}$ (9 V)	1	Allow other valid methods e.g. ratios
	B	$I = 8.87/7500=0.00118\text{A}$ ($9/7500=0.0012\text{A}$)	1	
	A	V across LDR = $15-8.87=6.13\text{V}$ ($15-9=6\text{V}$)	1	
	A	R of LDR = $6.13/0.00118=5194\Omega$ or 5183Ω ($6/0.0012=5000\Omega$)	1	
2d	C	$X < W$	1	
	D	LDR high resistance	1	
	B	Y saturated low OR $Y = -13\text{V}$	1	
	A	LED reverse biased OR no current in LED	1	

question	grade	expected answer	mark	additional guidance
3a	E	ring around diode	1	
3b	D B	0 mA for negative voltages steep rise at about 0.7 V by eye [$>0.5V <1V$]	1 1	
3c	A E D	Voltage across R is $5-1.8=3.2V$ $R=3.2/0.006$ $R=533\Omega$	1 1 1	Evidence of subtracting 1.8v from output Correct use of Ohm's law Correct answer 0.53Ω for [2] 5/0.006 for [2] 1.8/0.006 for [2] 5/6 for [1]

question	grade	expected answer	mark	additional guidance
3d	B	P is low, Q is high	1	
	C	S is low	1	
	D	<u>Diode conducting</u> so T is low	1	
	E	so output of Schmitt NOT U is high so LED glow	1	
3e	A	SW1 open, SW2 closed	1	
3f	E	use of $27k\Omega$ and $15\mu F$	1	calculation of period frequency from period
	B	correct conversion of units	1	
	E	$T=0.5 \times 27000 \times 15 \times 10^{-6} = 0.203s$ (0.203s)	1	
	C	$1/0.2=5Hz$ (4.938Hz) (ecf)	1	
3g	E	<u>correct symbol</u> to output and 0V	1	(sawtooth) waveform in a circle
3h	E	square wave	1	
	B	2.5 squares high	1	
	A	<u>2 periods</u> on screen	1	

question	grade	expected answer	mark	additional guidance
4a	E	2 nd table	1	
4b	B	1 st table	1	
4c	A	4 th table	1	
4d	A	1 st table	1	
4e	AAAA	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>$\bar{v} \cdot y$</p> <hr/> <p>$\overline{v + x + y}$</p> <hr/> <p>$v \cdot \bar{x} + \bar{v} \cdot \bar{y} + \bar{x} \cdot \bar{y}$</p> <hr/> <p>$(\bar{+x} \cdot \bar{y} + v \cdot \bar{x} \cdot y)$</p> </div> <div style="width: 45%;"> <p>$\bar{v} \cdot \bar{x} + \overline{\bar{v} + y}$</p> <hr/> <p>$\overline{v \cdot x \cdot y}$</p> <hr/> <p>$\bar{v} \cdot \bar{x} \cdot \bar{y}$</p> <hr/> <p>$v \cdot \bar{x} \cdot y$</p> <hr/> <p>$v \cdot \bar{x} \cdot y + \bar{v} \cdot \bar{x} \cdot y$</p> <hr/> <p>$\bar{v} \cdot x \cdot y$</p> <hr/> <p>$\bar{v} \cdot y + \bar{v} \cdot x \cdot y$</p> </div> </div> <p>One mark for each correct line</p>	4	[0] if more than one line from a statement in LH column

question	grade	expected answer	mark	additional guidance
5a	E	$D = \bar{B}$	1	allow ecf from D allow ecf from E and F
	D	$E = A \oplus \bar{B} = A \cdot B + \bar{A} \cdot \bar{B}$	1	
	E	$F = \overline{B + C}$	1	
	E	$G = \overline{B + C} \cdot \overline{A \oplus B}$	1	
5b	E	not needed, assumed to be there (wtte)	1	
	C	keeps the diagram uncluttered (wtte)	1	
5c	E	LED forward biased from G to 0V (through resistor and ammeter)	1	
	E	resistor in series with LED	1	
	E	ammeter in series with LED	1	

question	grade	expected answer	mark	additional guidance
6a	E	0V	1	
6b	E	0.47s	1	
6c	E A B A A	X inverse of W Y changes instantaneously from 0V to -5V at 1.5s Y changes instantaneously from 0V to 5V at 4.5s (ecf) Y decays exponentially (by eye) through half value between 0.2s and 0.4s after transition	1 1 1 1 1	<p>The additional guidance for question 6c contains three graphs on a grid with time/s on the x-axis (0 to 6) and voltage/V on the y-axis (0 to 4). 1. The top graph, labeled W/V, shows a pulse that starts at 1.5s and ends at 4.5s, with a constant value of 5V. 2. The middle graph, labeled X/V, shows a square wave that is 5V from 0s to 1.5s, drops to 0V from 1.5s to 4.5s, and returns to 5V from 4.5s to 6s. 3. The bottom graph, labeled Y/V, shows a pulse that starts at 1.5s and ends at 4.5s, with a constant value of -5V. The pulse is inverted relative to W/V.</p>
6di	A A A	Negative pulse much reduced./ clamps negative pulse (to -0.7V) logic gate contains clamping diodes/clamping diode from input to 0V positive pulse unchanged	1 1 1	

question	grade	expected answer	mark	additional guidance
6dii	E	LED lights	1	Allow flashes for 1 mark
	D	for a short time	1	Implied if < 1 s
	C	of 0.3s (0.3s-0.4s)	1	
6diii	C	voltage across resistor = $5-2=3V$	1	
	D	$I = V/R = 3/680 = 0.0044 A$	1	
	E	$0.0044 A = 4.4 mA$	1	Conversion to mA

question	grade	expected answer	mark	additional guidance
7a	E	AND gate	1	
	E	Only turns the buzzer/output high on when both the inputs are high wtte	1	
7b	E	switches connected to 0 V	1	
	E	output from other end of switch	1	
	D	switch in series with resistor across power supply	1	
7c	E	easier to analyse operation of system (wtte)	1	
7d	E	flow of information	1	
7e	E	$55/12 = 4.58 \text{ A}$	1	correct use of power equation
	E	$4.58 \times 2 = 9.17 \text{ A}$	1	correct dealing with two headlights
7f	E	SB683	1	
	E	the only switch that has a current rating above calculated value (wtte)	1	

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