OCR
RECOGNISING ACHIEVEMENT

GCE

Electronics

Advanced Subsidiary GCE

Unit **F611:** Simple Systems

Mark Scheme for June 2012

Oxford Cambridge and RSA Examinations

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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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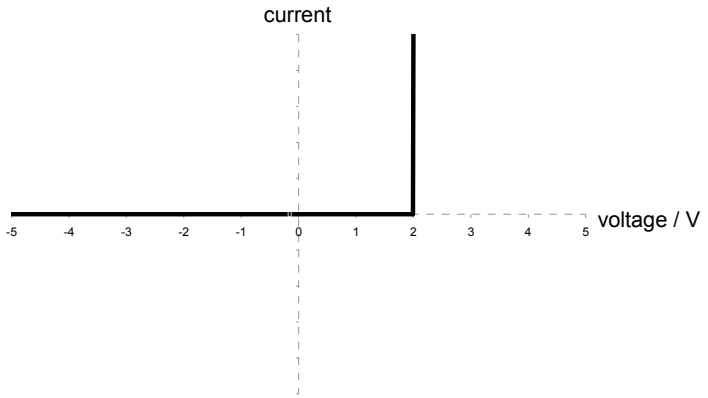
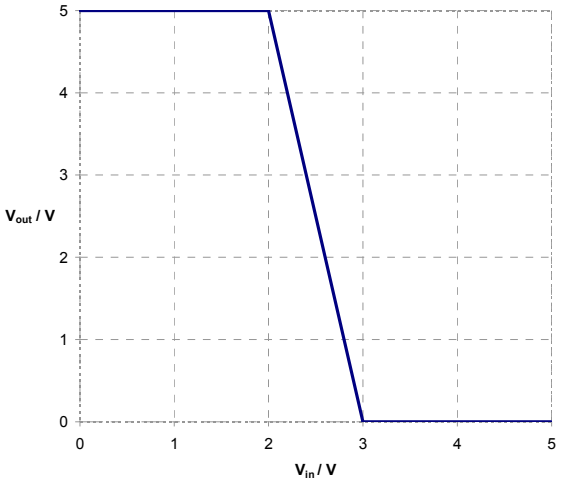
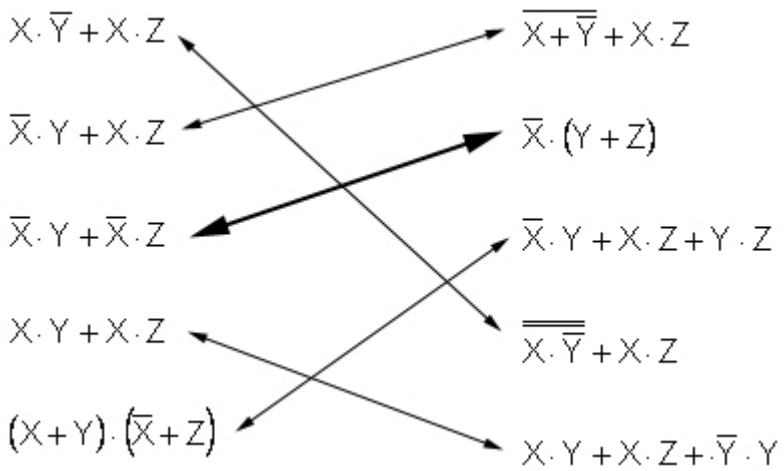
Question				Answer	Marks	Guidance
1	(a)		B	flow of information through the system	1	accept information or signals
	(b)	(i)	C D	limits current/power in LED so that the LED does not overheat	1 1	reduces voltage across LED/5 V is too high for the LED prevents damage by too much current/power Not blown
		(ii)	C A D E B	Vout=5V Voltage across R is 5-2=3V I=1.5mA=0.0015A R=3/0.0015 (ecf) R=2000Ω	1 1 1 1 1	Evidence of output voltage of gate used Evidence of subtracting 2v from output Correct conversion from milli or use of kΩ in answer Correct use of Ohm's law Correct answer
		(iii)	D E	line at zero current for negative voltages line rises steeply from x-axis at ~2V 		Accept graph which shows v. small current below threshold and then curve and steep gradient. Positive line within region 1.5 V – 2.5 V must touch 2V

Question				Answer	Marks	Guidance
	(c)	(i)	D D B	5V When Vin 0V – 1V 5V at start 0V at other end of scale Transition in region 2V - 3V (any gradient including step)  	1 1 1	
		(ii)	E A	When input is low output needs to be high The voltages from the paper sensor are above and below the thresholds of the gate (wtte)	1 1	function of NOT gate behaviour thresholds

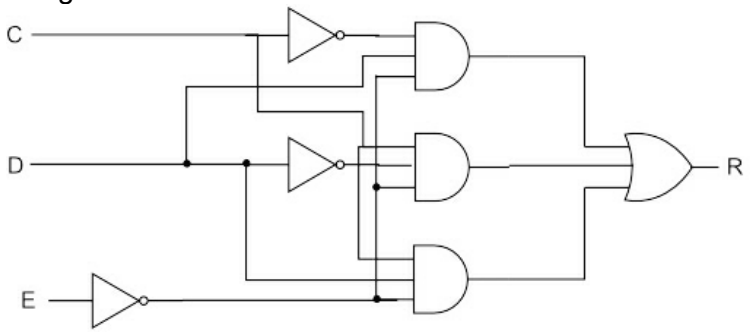
Question				Answer	Marks	Guidance
2	(a)		E	Ring around thermistor	1	
	(b)		E E	**Resistance** depends on **temperature** Resistance decreases as temperature increases	1 1	Or any statement that implies this or resistance increases as temperature decreases
	(c)		D C C	total resistance: 33k+39k=72k current: 15/72000=2.08x10^{-4} A voltage: IR = 39x10^{3} x 2.08x10^{-4} so V=8.1(25) V (at least 2 s.f. needed)	1 1 1	evidence of adding two resistor (33k + 39k) ecf multiply current by 39k
	(d)		E A A A	conversion from kΩ to Ω: R = 2100Ω V across thermistor: 15 – 6 = 9V Calculation of current: I = 9/2100 = 0.00429A R = 6/0.00429 = 1400Ω (ecf)	1 1 1 1	Any other valid method for [4] Conversion can come anywhere in the calculation. No ecf ecf for current
	(e)		D C B	LED is off Plus up to 2 of: • Because (voltage at) inverting input > non-inverting input • so output of op amp saturated negative (-13 V) / goes negative • so LED reverse biased	1 1 1	 comparing voltages at inputs or reference to saturation/comparator action for [1]
	(f)		C D A	LDR in voltage divider in circuit Fixed reference voltage circuit which turns on LED when dark	1 1 1	

Question				Answer	Marks	Guidance
3	(a)		E C D B	$L = \overline{G}$ $N = \overline{H + \overline{G}}$ ecf $M = J \cdot K$ $P = J \cdot K + \overline{H + \overline{G}}$ ecf	1 1 1 1	
	(b)		E D	switch between H and 5V switch and resistor in series with power supply	1 1	

Question	Answer	Marks	Guidance
4	**Column 1** / **Column 2**  	3	E One correct [1] C Two correct [2] A All correct [3] 4 1 (2) 5 3

Question				Answer	Marks	Guidance
5	(a)		C E E C	Correct MOSFET symbol MOSFET in series with speaker across power supply MOSFET gate to output of oscillator speaker to connected to drain, source to 0V	1 1 1 1	
	(b)		E E D D	680pF and 820kΩ values in equation correct conversion from kΩ correct conversion from pF calculation of T= 278×10^{-6}s	1 1 1 1	
	(c)		E E	Conversion from μs to s (or MHz to Hz): 278μs or 300μs Correct calculation using 1/T: f=3597±50 Hz (f =3571 Hz or 3333±50 Hz) (ecf)	1 1	
	(d)	(i)	E	1V/div	1	
		(ii)	E	50μs	1	
		(iii)	E	Recognisable oscilloscope symbol connected across capacitor	1	
		(iv)	B A A	• (curved) triangular wave in phase with square wave • wave in step with square wave of amplitude less than 5 V • rising when square wave high	1 1 1	Not a square wave or a sine wave
	(e)		 C B A	Up to 3 of: • output of NOT gate high; • diode reverse biased; • capacitor can charge and discharge; • MOSFET turns on and off operating speaker;	3	Allow reverse argument for when switch pressed

Question				Answer	Marks	Guidance
6	(a)		E E C	R at least 10kΩ Use of 30s = 0.7 RC Calculation of C to make RC = 42.8 s to 43 s	1 1 1	
	(b)		E E	LED turns on for 30s (but does not comes on again without pressing switch)	1 1	
	(c)	(i)	E E	correct voltmeter symbol connected across switch	1 1	
		(ii)	D	0V	1	
	(d)		A A B	5 – 1.2 = 3.8V; $I = {}^{3.8}/_{220}$ = 0.017A (ecf from V); P = 3.8 x 0.017 = 0.066W;	1 1 1	 must use 220Ω or V^2/R
	(e)	(i)	D	B	1	
		(ii)	E E	Correct resistance maximum power above power needed (wtte)	1 1	Allow if ei answer is D

Question				Answer	Marks	Guidance
7	(a)		D D D	Exactly 3 terms ORed together 1 term for R=1 in a sum of products correct All terms for R=1 and no others correct in sum of products	1 1 1	Any correct expression for 3 marks, e.g. $R = C \cdot \overline{E} + D \cdot \overline{E}$ $R = (C + D) \cdot \overline{E}$ $R = \overline{\overline{(C + D)} + E}$ If correct 3 terms not ORed together [1]
	(b)		E E C B	E NOTted Use of AND to combine signals from all three inputs Correct NOTs for all three terms OR gate to combine all terms  	1 1 1 1	or any other working circuit No ecf from a

<table>
<tr><th colspan="4">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>8</td><td>(a)</td><td></td><td>E</td><td>EOR or XOR or EXOR or exclusive OR</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>E
C</td><td>All combinations of A & B (any order)
Correct Q
<table><tr><th>A</th><th>B</th><th>Q</th></tr><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></table></td><td>1
1</td><td>No ecf</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>B</td><td>LED on</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>A
A
A</td><td>When switch 1 is open A is low
When switch 2 is open B is high
(When A is high and B is low) Q is high making LED glow/LED is forward biased/current flows through LED</td><td>1
1
1</td><td></td></tr>
</table>

APPENDIX 1

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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