GCE

Electronics

Advanced Subsidiary GCE

Unit **F611:** Simple Systems

Mark Scheme for June 2013

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 2013

Annotations

Annotation	Meaning

Subject-specific Marking Instructions

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.

ADDITIONAL OBJECTS: You **must** annotate the additional objects for each script you mark. If no credit is to be awarded for the additional object, please use annotation as agreed at the SSU, likely to be 'seen' or the highlighting tool.

CROSSED OUT, RUBRIC ERROR (OPTIONAL QUESTIONS) AND MULTIPLE RESPONSES

Crossed-out Responses: Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions: Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses: When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.
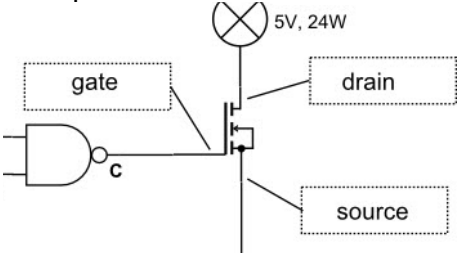
Contradictory Responses: When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.
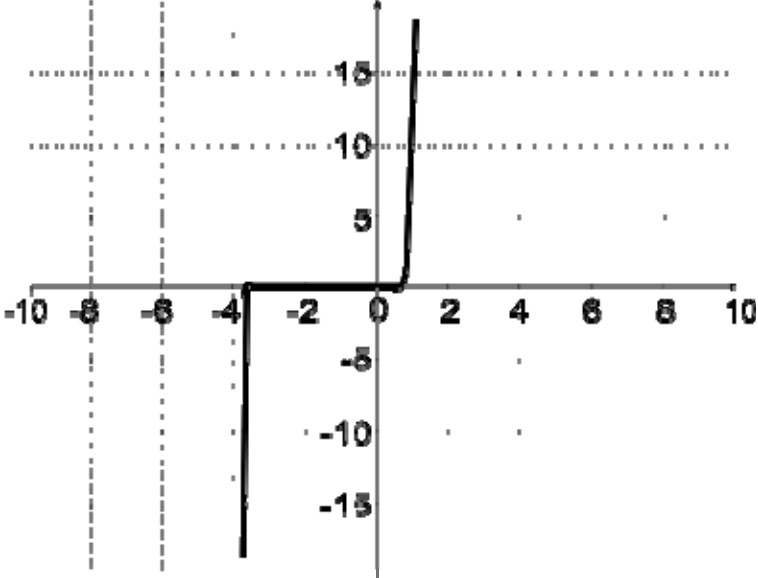
Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**): Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*
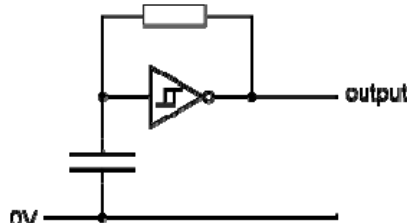
Short Answer Questions (requiring a more developed response, worth **two or more marks**): If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)
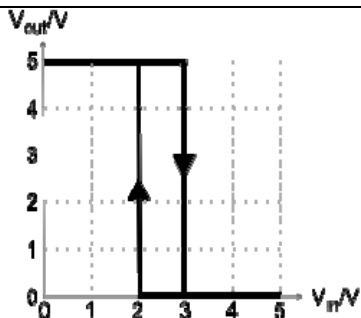
Longer Answer Questions (requiring a developed response): Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

Question			Answer	Marks	Guidance
1	**(a)**		NAND	1	
	(b)		All combinations of A and B C correct | A	B	C
---	---	---
0	0	1
0	1	1
1	0	1
1	1	0		2	No ecf
	(c)		Either $C = \overline{A \cdot B}$ or $C = \overline{A} \cdot \overline{B} + A \cdot \overline{B} + \overline{A} \cdot B \qquad C = \overline{A} + \overline{B}$	1	No ecf
	(d)		switch connects **A** to 0V when closed resistor and switch in series with power supply and connected to circuit	2	

Question		Answer	Marks	Guidance
(e)		Two names correct All three names correct (drain, gate, source) 2 names in the correct places 	3	Mark for correct names, not placing labels
(f)		The output of the logic gate can only operate **low** power devices. The MOSFETS acts as driver sinking a **high** current from the lamp. The lamp is off when the output of the logic gate is **low** which makes gate-source voltage **low** and so the drain-source resistance is **infinite/high**. The lamp is on when the output of the logic gate is **high** which makes gate-source voltage **high** and so the drain-source resistance is **low**.	8	Allow either "infinite" or "high"
(g)		0.6/5=0.12 A	1	120 mA
(h)		2N7000	1	
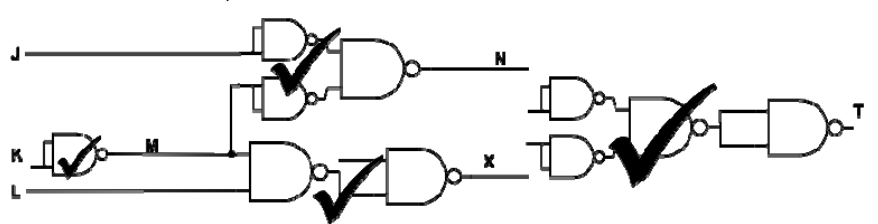
Question			Answer	Marks	Guidance
2	**(a)**		Ring around zener	1	
	(b)		correct shape ignoring slope - Horizontal line through 0,0 (at least 1V wide) rising from axis in positive quadrant, falling from axis in negative quadrant) rises from 0mA about 0.7V not exceeding 1V falls from 0mA about - 3.6V not exceeding -4V 	3	Must be at 0mA through origin
	(c)		Find total resistance 8300+3300=11600Ω Find current 9/11600=0.000776A ecf Find voltage 0.000776x3300=2.56V ecf	3	divide supply by resistance 2.56 V [3]
	(d)		[diode reverse biased] no current through diode no pd across 22kΩ resistor/22kΩ resistor pulls down to 0V	2	
	(e)		Find current 5/22000=0.000227A pd across R1=13 - 0.7 – 5 = 7.3V R1 = 7.3/0.000227 = 32000Ω ecf	3	Missing 0.7 V drop so 35200 Ω [2]

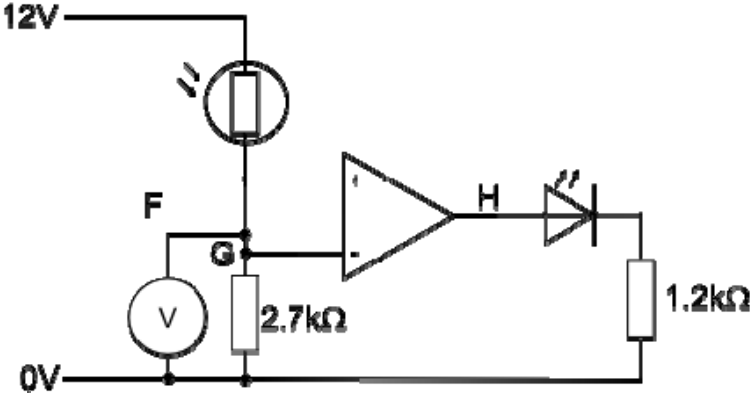| Question			Answer	Marks	Guidance
3	**(a)**		pd across R2 = 5 − 2.1 = 2.9 V convert to A 4 mA = 0.004 A R2 = 2.9/0.004 = 725 Ω	3	1 mark for 525 Ω correct unit conversion
	(b)		period = 0.5s	1	
	(c)		[Sudden] behaviour change at 180 ºC At low temperature LED flashes (at 2 Hz) At high temperature LED always on Maximum 2 from: when L=1, M=1/output M always high as at least one input high when L=0, M=K 0, 1, 0 ,1 at K / LED on for ¼ s, off for ¼ s	5	Do not accept gradually/slowly
	(d)		Resistor and capacitor used Resistor and capacitor in correct position "output" marked at output of Schmitt trigger R at least 1kΩ RC = 1s	5	mark awarded regardless of position of C and R

Question			Answer	Marks	Guidance
	(e)		 NOT behaviour hysteresis with switching at 2V and 3V	2	Arrows not needed on graph

Question			Answer	Marks	Guidance
4	(a)		$Q = \overline{A} + B$	1	
	(b)		$P = (C + D) \cdot \overline{C}$	1	
	(c)		$R = (\overline{E} \cdot F) + (E \cdot \overline{F})$	1	
	(d)		$S = G + \overline{\overline{G} + H}$	1	

Question			Answer	Marks	Guidance
5	(a)		$M = \overline{K}$ $N = J + \overline{K}$ $X = \overline{K} \cdot L$ ecf for each equation $T = \overline{(J + \overline{K}) + (\overline{K} \cdot L)}$ $T = K \cdot \overline{J}$	4	

7

Question			Answer	Marks	Guidance
	(b)			4	1 mark for each correct column
	(c)		NOT between K and M AND between L,M and X OR between J, M and N NOR between N, X and T	4	

The answer for (b) contains the following table:

M	N	X	T
1	1	0	0
1	1	1	0
0	0	0	1
0	0	0	1
1	1	0	0
1	1	1	0
0	1	0	0
0	1	0	0

Question			Answer	Marks	Guidance
6	**(a)**		switch, monostable, driver, heater	1	
	(b)		<u>Easier</u> to design a system./ <u>Simpler/easier</u> to understand.	1	Not shows flow of information
	(c)	**(i)**	T=300s R between 1kΩ and 10MΩ RC=429s correct conversion to μF	4	
		(ii)	Y changes to high at 100 s Y decays exponentially by eye Y falls to approx 2.5 V then goes suddenly low 0 V (or more accurately -0.7 V and then charges to 0 V) Z high at 0s Z shows 300s pulse Z digital with change of state at 100s 	6	Not a straight line

Question			Answer	Marks	Guidance
7	(a)		Correct potentiometer symbol Connected to power supply and F	2	
	(b)		Resistance changes with light level resistance high when in dark	2	or resistance low when in bright light (owtte)
	(c)		correct symbol and connections 	1	
	(d)	(i)	LED glows then max 3 of: • LDR resistance is <u>very</u> high/infinite [so voltage at G is <u>very</u> low/0V] • voltage at G less than voltage at F • output of op amp, H, saturates high. • LED forward biased	4	

Question			Answer	Marks	Guidance
	(e)	**(ii)**	Maximum 2 from: As brightness increases voltage at G rises when voltage at G>F output H saturates low LED reverse biased Need to say for final mark: and so LED turns off [suddenly].	3	Do not accept gradually/slowly