OCR
Oxford Cambridge and RSA

GCE

Electronics

Unit **F614:** Electronic Control Systems

Advanced GCE

Mark Scheme for June 2016

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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.

Annotations, abbreviations and subject-specific conventions

1	BOD	31	BOD	Benefit of doubt
2		21	Cross	Cross
3	ECF	241	ECF	Error carried forward
4	NBOD	191	NBOD	Benefit of doubt not given
5		1841	Not Relevant	Expandable vertical wavy line
6	REP	271	REP	Repeat
7	TV	201	TV	Too vague
8		11	Tick	Tick
9	0	1741	ZERO	Zero (big)

Question	Expected Answer	Mark	Additional Guidance
1a	Potential divider from 9 V to 0 V with centre at X	1	or V_D to 0 V
	Top resistor 2.1 larger than bottom	1	top resistor 1.14 larger than bottom if V_D used
1b	Output connected to VD through capacitor	1	
	Input connected through capacitor	1	
	Input connected to gate	1	Accept connected to X
1ci	Correct shape	1	
	Transition at 2.8 V	1	
	Slope of 100 mA / 0.5 V	1	
1cii	Use of correct equation and 0.2 S including - sign	1	
	Use of 220 Ω resistor	1	-44
1di	So that the output can change up and down	1	
	Without clipping/large amplitude	1	
1dii	V= 9 – 5 = 4	1	
	4/220=18mA (no ecf)	1	
1e	Same shape as VGS=5V	1	
	Smaller max current and shallower gradient	1	
	Transistion at lower VDS (no ecf)	1	

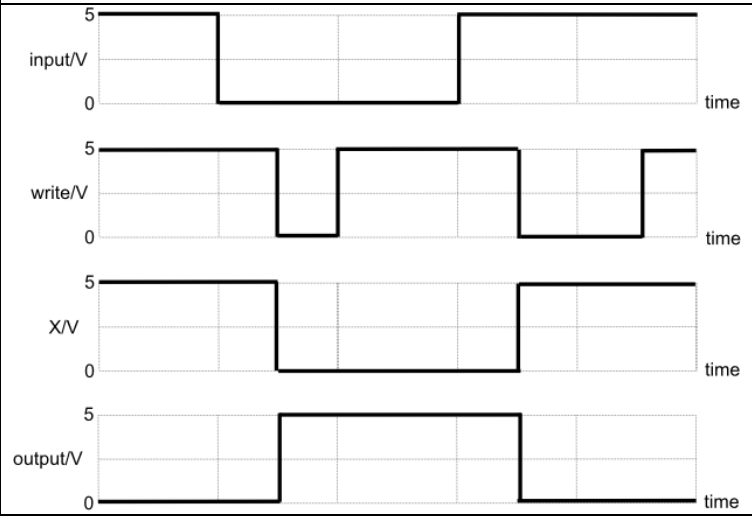
Question	Expected Answer	Mark	Additional Guidance
2a	Adjust/set the desired water temperature in the fish tank	1	
2b	When cold, voltage at T low	1	Allow same marks for argument about when hot
	So output of op amp high	1	
	Turns on MOSFET	1	
	Makes heater operate	1	
	Discussion of signals to turn heater off	1	
	Keeps turning on and off	1	
2c	I=4/4700=0.85mA	1	
	R=(12-4)/0.00085=9.4kΩ	1	
2d	T rises to 7 V	1	
	T hunts around 7 V	1	Curved lines only
	D digital 0V or 12 V	1	
	D initially low	1	
	D changes as T crosses 7 V	1	
2e	Proportional:		Allow other advantages with correct explanations
	No overshoot/reduced hunting	1	
	Reduces drive as gets close to desired value	1	
	On-off		
	Fast / simple circuit	1	
	Maximum drive to transducer / no need for difference amp (and ramp generator)	1	

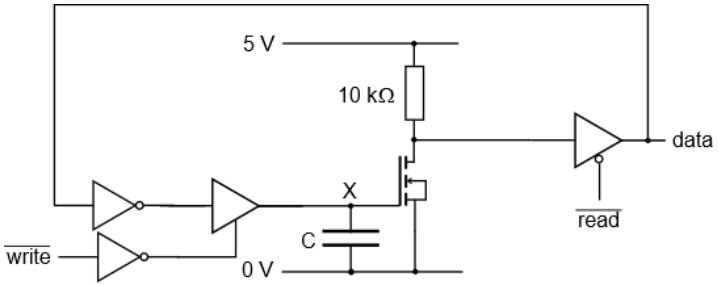
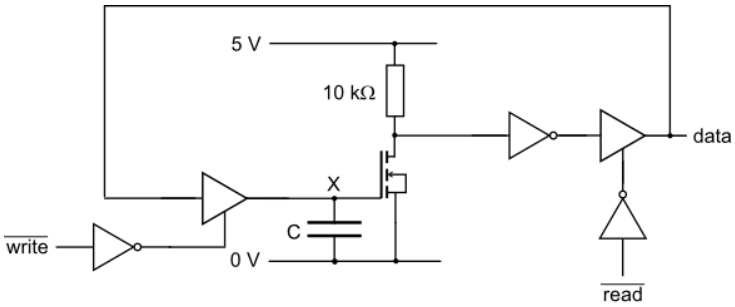
Question	Expected Answer	Mark	Additional Guidance
3a	Charges capacitor [through rectifier] increasing voltage [to above 5 V] Max 3 from: • Comparator changes state (wtte) • Opto-isolator turned on • Turns on oscillator • Produces an ac signal at output of transformer	1 3	Accept explanation of how current to smoother increases output voltage Answers to show understanding of on/off feedback
3bi	Correct shape Amplitude 6.3 V by eye Signal at 0 V when input < 0.7 V by eye	1 1 1	
3bii	T = 40 μs F= 25 kHz	1 1	
3ci	Ring around zener (and resistor)	1	
3cii	Valid method (same I in both resistors or by ratio) R2= 1.17 * R1	1 1	
3ciii	(V-1.7)/0.008=R Reasonable assumption about op amp high saturation voltage V	1 1	 e.g. output saturates high saturates at 5 V, saturates 2 V below supply so saturates at 3 V, or any other reasonable assumption [412Ω for 5V]

Question	Expected Answer	Mark	Additional Guidance
4ai	Proportional control system	1	
4aii	It contains a difference amp	1	Accept ramp generator not in other systems
4bi	-2V	1	
4bii	2V ecf from i	1	
4c	Use of [±]13 V, 2.5 V and 0.33 V/s in ramp generator formula R1C =7.6s R2=R3 R2, R3 in k	1 1 1 1	 Alternatively allow for gain≠-1 compensating for different ramp rate
4d	Positive Increasing Increasing Increasing Zero Unchanging Unchanging Unchanging	1 1 1 1 1 1 1 1	

Question	Expected Answer	Mark	Additional Guidance
5a	MOVI Sn, 7E OUT Q, Sn RET	2 1 1	1 mark for 7E
5b	MOVI Sm, 40 IN Sp, I AND Sm, Sp / AND Sp, Sm	2 1 1	1 mark for 40 p≠m Do not allow SUB
5c	Maximum 6 from: S7 set to zero initially S2 mask for sensor S4 mask for osciilator S3 holds input value S7 increases by one each time sensor goes high Returns to main program when relaxation oscillator low S7 returns number of pulses to main program	6	

5d	Turn on dp
	Without changing rest of display [need to use S0]
	Wait
	200ms
	Turn off dp (or toggle)
	Do it for 10s
		1
		1
		1
		1
		1
		1
			flash: MOVI S6, 01
			MOVI S4, 32
			repeat: EOR S0, S6
			OUT Q,S0
			MOVI S5, C8
			delay: RCALL wait1ms
			DEC S5
			JNZ delay
			DEC S4
			JNZ repeat
			RET

Question	Expected Answer	Mark	Additional Guidance
6a	Information retained when power switched off (wtte)	1	
6b	X Continues high until first write transition X Goes low at falling edge on write X Stays low until next falling edge on write Output inverse of X [digital]	1 1 1 1	

Question	Expected Answer	Mark	Additional Guidance
6c	Tristate connected to drain of MOSFET [through NOT gate] and read to control of tristate Tristate connected correct way around NOT gate to read tristate [or from output] Data needs to connect to input of write tristate and output of read tristate (ecf)	1 1 1 1	  Accept answers with one NOT gate producing active low read or inverting either input or output of memory

Question	Expected Answer	Mark	Additional Guidance
7a	General purpose register in CPU Store/memory For results/data needed for processing/calculations	1 1 1	
7b	Collection of wires For moving information <u>to and from</u> CPU to/from memory/ports	1 1 1 1	
7c	1. Address of next instruction/contents of PC stored on stack 2. Stack pointer incremented/decremented 3. PC loaded with called address 4. Subroutine executed 5. When return executed PC loaded from top of stack 6. Stack pointer decremented/incremented 7. Program continues with main program	1 1 1 1 1 1	Sequence should be in correct order but allow swapping order of 1 & 2 provided 5 & 6 swapped 6th mark for point 4 or 7 provided no incorrect elements added to sequence

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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