RECOGNISING ACHIEVEMENT

GCE

Electronics

Advanced GCE

Unit **F614:** Control Systems

Mark Scheme for June 2013

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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.

Subject-specific Marking Instructions

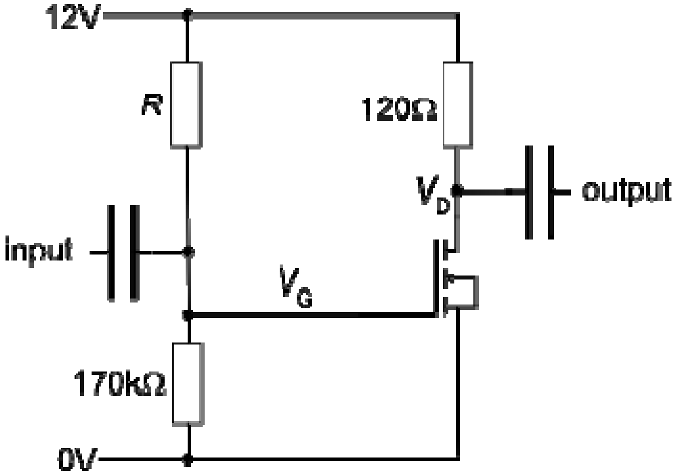
Quality of Written Communication

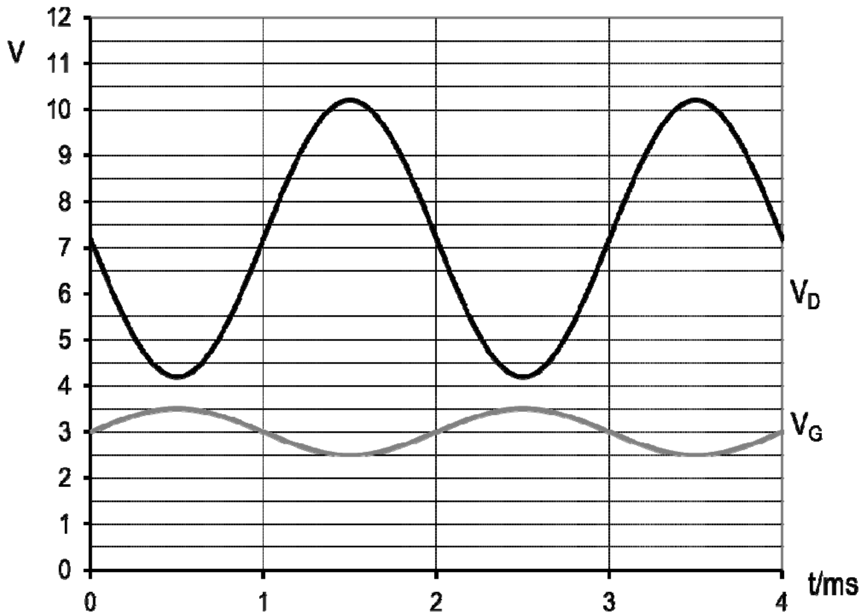
3 The candidate expresses complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are consistently relevant and well structured. There will be few, if any, errors of grammar, punctuation and spelling.

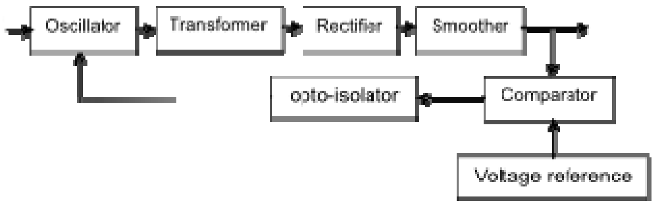
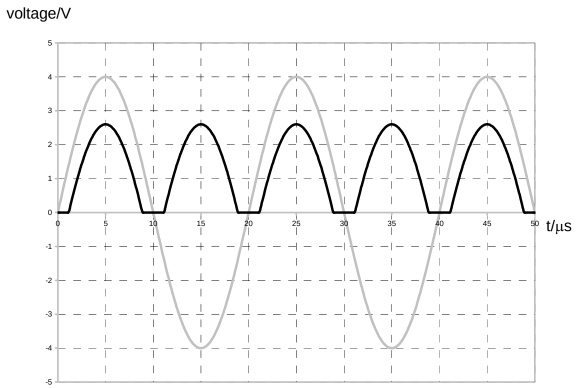
2 The candidate expresses straightforward ideas clearly, if not always fluently. Sentences and paragraphs may not always be well connected. Arguments may sometimes stray from the point or be weakly presented. There may be some errors of grammar, punctuation and spelling, but not such as to suggest a 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.

Question			Answer	Marks	Guidance
1	(a)		Capacitors x 2 output to D, input to G  	2	
	(b)		calculate current $I = 3/170\text{x}10^3 = 1.76\text{x}10^{-5}$ calculate voltage across R $V = 12 - 3 = 9$ V calculate $R = 9/1.76\text{x}10^{-5} = 5.1\text{x}10^5 = 510$ kΩ	3	Could solve by ratios: If incorrect allow 1 mark for correct ratio.
	(c)	(i)	2.2 V	1	
		(ii)	current from graph 40 mA voltage across 120Ω resistor 4.8 V $V_D = 12 – 4.8 = 7.2$ V	3	
		(iii)	correct units conversion find ΔV divide change in current by voltage to calculate $g_m = 0.05$ S (ecf)	3	
		(iv)	$-g_m$ from 1ciii x 120Ω	2	

Question			Answer	Marks	Guidance
	(d)	(i)	recognisable symbol between D and 0 V	1	
		(ii)	sinewave amplitude 3.0 V centred around 7.2 V inverse of input 	3	
		(iii)	1/0.002 = 500 Hz	1	

Question			Answer	Marks	Guidance
2	(a)		one mark to point to max of 6: • opto-isolator correct • oscillator correct • transformer correct • rectifier correct • smoother correct • voltage correct • comparator correct. 	6	
	(b)		all positive correct shape peak at ~2.6 V by eye 0V flat around transistion 	4	
	(c)		LED emits light when <u>input high</u> owtte phototransistor <u>conducts</u> when light incident owtte	2	BOD low impedance when light incident
	(d)		reduces voltage increases current/energy efficient/power efficient	2	

Question			Answer	Marks	Guidance
3	**(a)**		data bus connects cpu, memory, input port and output port arrows show data going to cpu, memory and output port (optionally data to input port) control bus connects cpu, memory, input port and output port arrows show control going to memory, output port and input port (optionally cpu) address bus connects cpu and memory (and optionally both input port and output port – not just one) arrows show data going to memory (and to input port and output port if connected) <u>not cpu</u>	6	
	(b)		fetch instruction from memory EITHER pointed at by program counter OR store instruction in instruction register increment program counter execute instruction (in instruction register) correct order	5	 Allow PC to address bus

Question			Answer	Marks	Guidance

4	(a)		`MOVI Sn, 04`
			`IN   Sm, I`
			`AND  Sm, Sn` or `AND  Sn, Sm`
				2
				1
				1
					1 mark for 04
					
					n and m different numbers 0-7

	(b)		`showf:  MOVI S2,` **`E2`** **`OUT Q, S2`** **`RET`**	3	
	(c)		`MOVI S5,C8`	2	1 mark for C8
	(d)		bell sounds turn bell off after 200ms sounds 3 times display does not change	4	

	(e)		`soundb:  INC S2`
			`OUT Q, S2`
			`RCALL wait200ms`
			`RCALL wait200ms`
			`RCALL wait200ms`
			`DEC S2`
			`OUT Q, S2`
			`RET`
				8	Turn on bell
					Without affecting display
					Wait attempt
					Long time (>200ms)
					Exactly 600ms
					Turn off bell
					Without affecting display
					return

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5</td><td>(a)</td><td></td><td>F correct
S correct
<table>
<tr><th>C</th><th>B</th><th>A</th><th>F</th><th>S</th></tr>
<tr><td>0</td><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><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
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<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table></td><td>2</td><td>Not all combinations of CBA [0]</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>all clocks connected together to store
outputs from Qs
Inputs to Ds</td><td>3</td><td>Qs not connected to anything else
Ds not connected to anything else</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>first four sum digits correct
last four sum digits correct
carry correct
<table>
<tr><td></td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td></td></tr>
</table></td><td>3</td><td>Must be 0 or 1 in each box</td></tr>
<tr><td></td><td>(c)</td><td></td><td>42 in binary 00101010
all bits correctly inverted 11010101 ecf
1 added correctly 11010110</td><td>3</td><td>Allow other explained method (eg bit 7 = -128)</td></tr>
</table>

Question			Answer	Marks	Guidance
6	(a)		reference, difference amp, power amp, motor, position sensor	1	
	(b)		30/47 +1	2	1.64
	(c)		potentiometer	1	
	(d)	(i)	2 – 5 = -3 V	2	subtraction
		(ii)	-3 x 1.6 = -4.8 V ecf from di	1	
		(iii)	to start with D = -4.8 V and <u>motor turns</u> (quickly) One from: • the voltage at P gets smaller as dish turns • as P gets small P – R = E gets smaller • When P=R, E = 0 V and D = 0 V so D gets smaller and <u>motor slows</u> when P = R motor stops.	4	None zero D causes motor to turn Some explanations about calculation of voltages Motor slows as correct position approached Motor stops at correct position
	(e)		on-off feedback drives at full power until ref so hunts/never settles at one position proportional feedback slows as it approaches ref so gently moves to required position	4	sensible comment distinguishing on-off from proportional

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>7</td><td>(a)</td><td></td><td>information lost when power removed</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>
<table>
<tr><th>$\overline{\text{CE}}$</th><th>$\overline{\text{Read}}$</th><th>$\overline{\text{Write}}$</th><th>CK</th><th>E</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
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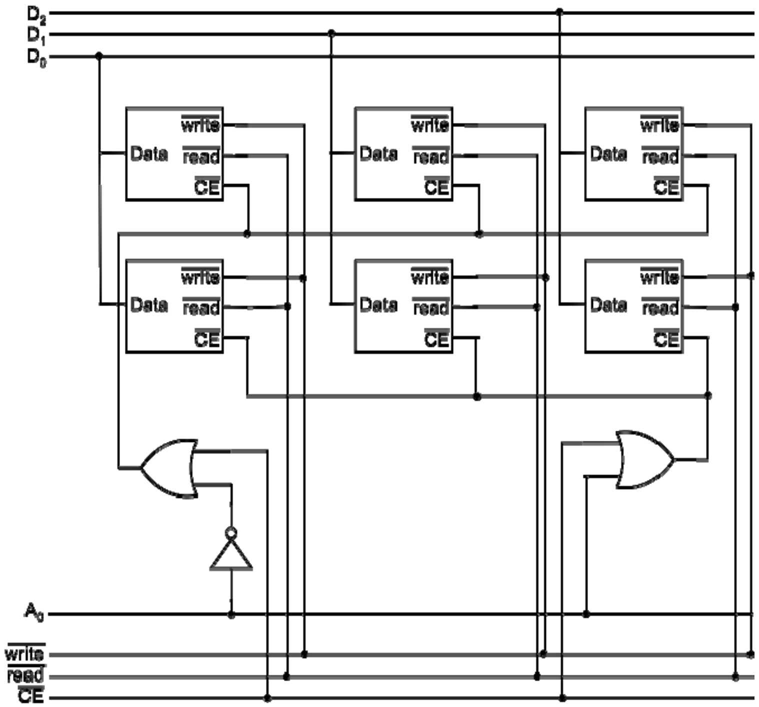
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
</table>
All combinations of $\overline{\text{CE}}$, $\overline{\text{Read}}$ and $\overline{\text{Write}}$
CK correct
E correct</td><td>3</td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td>$\overline{\text{CE}}$, $\overline{\text{Read}}$ and $\overline{\text{Write}}$ initially high
hold $\overline{\text{Read}}$ high throughout
make data high
make $\overline{\text{CE}}$ low and $\overline{\text{Write}}$ low
make $\overline{\text{Write}}$ highand/or $\overline{\text{CE}}$ high.</td><td>5</td><td>data must be high before CE and Write both low

Allow pulse write/CE low for 2 marks with other held low

Sequence incorrect or no sequence can only get data mark</td></tr>
<tr><td></td><td>(d)</td><td></td><td><u>3 cells per address</u>
x <u>2 addresses</u> (= 6)</td><td>2</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
	(e)		D_0, D_1 and D_2 connected to 2 different cells writes and reads all connected A_0 decoded to operate different cells when high and low A_0 connects through logic to CE global CE operates correctly 	5	 BOD missing pull-up resistors if tristates/analogue switches used

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