GCE MARKING SCHEME

ELECTRONICS
AS/Advanced

JANUARY 2014

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2014 examination in GCE ELECTRONICS. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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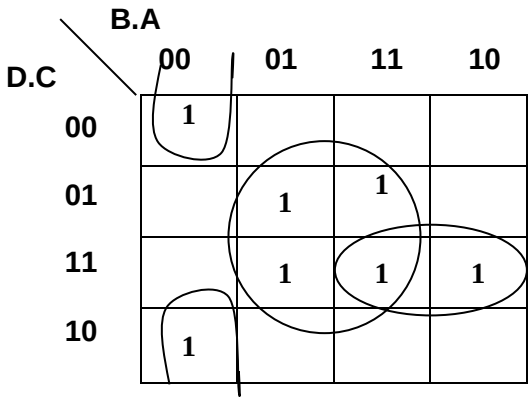
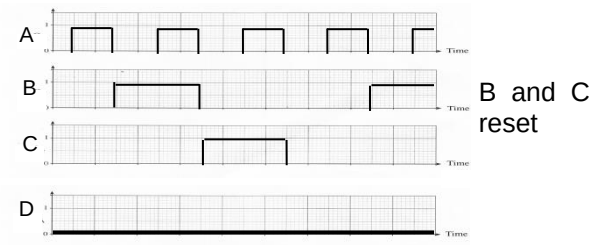
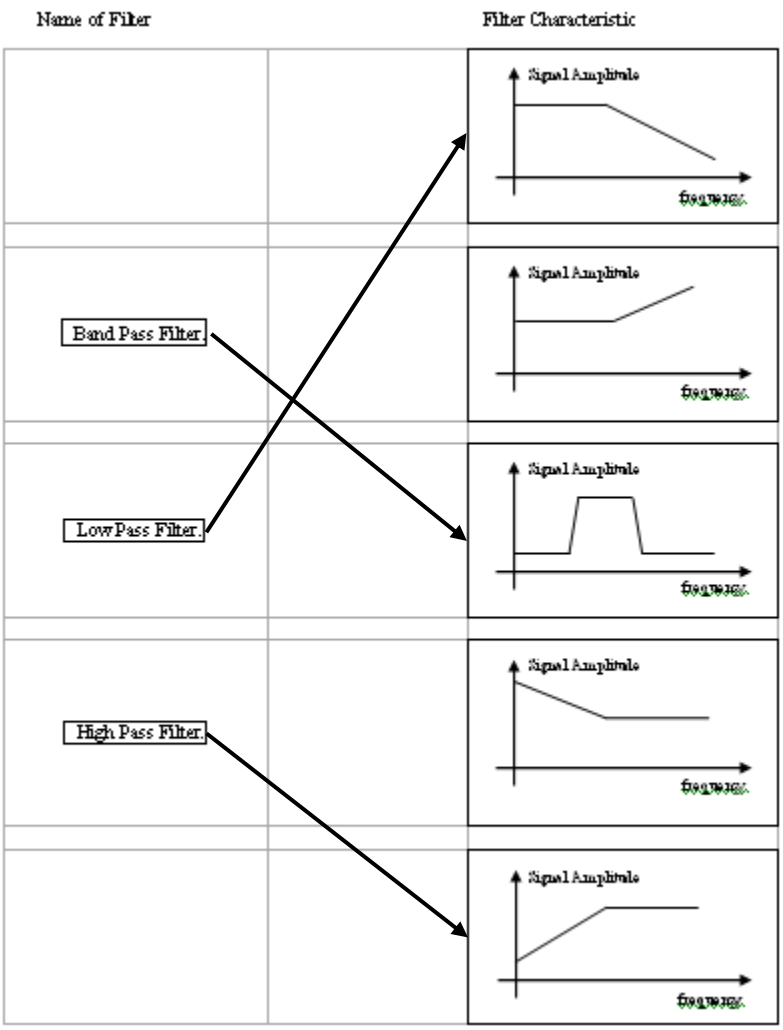
Question			Marking details	Marks Available
1	*(a)*	(i)	AND gate	1
		(ii)	NOR gate	1
	(b)	(i)	EXOR	1
		(ii)	Correct symbol for EXOR gate **ecf** from (i)	1
				[4]
2	*(a)*		L = $\overline{(A + B)}$ or $\overline{A}.\overline{B}$ (1) M = $\overline{B}.\overline{\overline{C}}$ or $\overline{B}$ +C (1) Q = $\overline{A}.\overline{B} + \overline{B}$ .C or $\overline{(A + B)} + \overline{B}$ .C (1) need dot between first A and B	3
	(b)	(i)	Correct replacement NOT and AND by NAND **(both required)** (1) Correct replacement NOR by NAND (1) Correct replacement OR by NAND (1)	3
		(ii)	Two <u>correct</u> redundancies ***clearly*** identified	2
				[8]

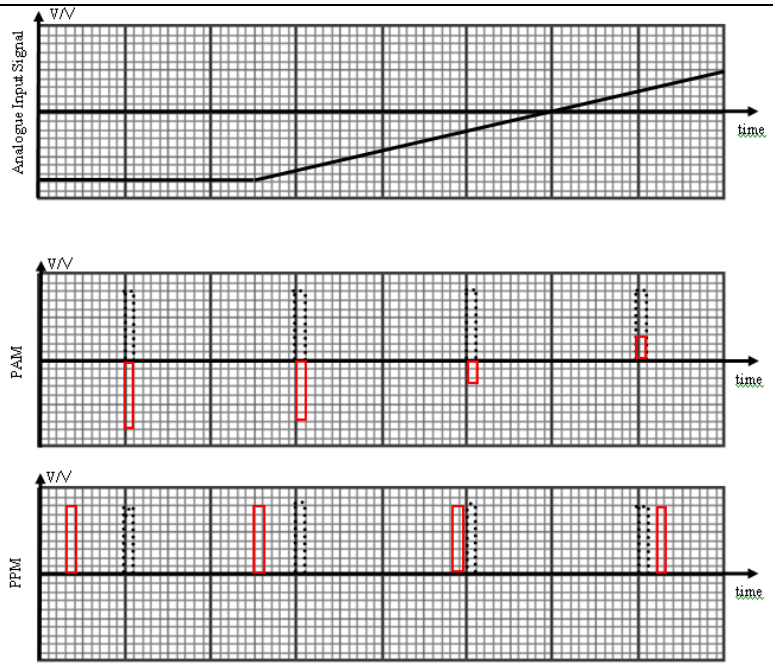
Question			Marking details	Marks Available
3.	*(a)*		<table><tr><th>Wiper switch C</th><th>Moisture sensor B</th><th>Ignition Switch A</th><th>Wiper motor Q</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> Column Q completely correct	1
	(b)		$Q = \overline{C}.B.A. + C.\overline{B}.A + C.B.A$ Q completely correct = 2 marks (one mistake = 1 mark); **ecf** table (allow simplifications)	2
	(c)		Multiplexer connections correct. D_3, D_5 and D_7 to 5 V D_0, D_1, D_2, D_4 and D_6 to 0 V	1
				[4]

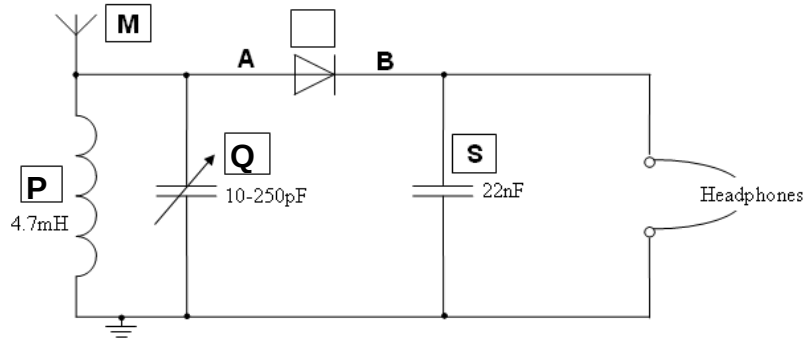
Question			Marking details	Marks Available
4	*(a)*	(i)	$A + 1 = \mathbf{1}$	1
		(ii)	$\overline{C}.D + C = \mathbf{C + D}$	1
	(b)			
			Correct map and minimum groups clearly identified	1
			$Q = C.A + \overline{C}.\overline{B}.\overline{A} + D.C.B$ 1 mark each correct term (**ecf** map 3 max)	3
			Correct Boolean algebra solution = 4 marks	
	(c)		$Q = \overline{\overline{(A + \overline{B})} + \overline{B}}$ OR $\overline{\overline{(\overline{A}.B)} + \overline{B}}$ $Q = \overline{(A + \overline{B})}.B$ $(A + \overline{B}).B$ $Q = (A + \overline{B}).B$ $A.B + \overline{B}.B$ $Q = A.B + \overline{B}.B$ $A.B$ $Q = A.B$	
			Answer must be consistent with working	3
				[9]

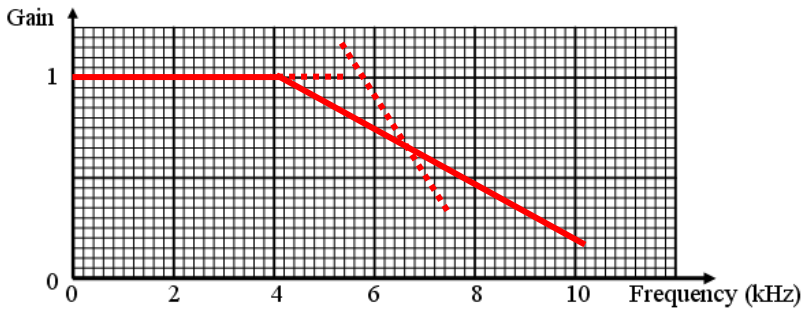
Question			Marking details	Marks Available
5	*(a)*		Resistor and switch across power rails and centre connected to clock. (1) Correct orientation of components (1)	2
	(b)		$\overline{Q} = 0$	1
	(c)	(i)	Q = 1	1 1
		(ii)	H = OFF T = ON Both answers needed	1
	(d)		High enough frequency **to make it random**/unpredictable/ impossible to cheat (owtte)	
				[6]
6.	*(a)*		Time taken for the **output** to respond to a **change in input** signal.	1
	(b)		▪ B starts at logic 1 (1) ▪ B goes to logic 0 at 45 ns (1) ▪ C is 30 ns notch (1) ▪ C notch between 25 and 55 ns (1) ▪ Q inverted C [pulse] shifted by 10 ns (1)	5
				[6]
7.	*(a)*		5	1
	(b)		 One mark for each correct output B and C. D must have the line drawn in	2 1
				[4]

Question			Marking details	Marks Available
8.	*(a)*		Feedback resistor between output and inverting input (1) Non-inverting input connected to sensor. (1) Resistor between inverting input and 0 V (1)	3
	(b)		▪ Suitable scales chosen (1) ▪ All points correctly plotted (1) ▪ Suitable lines drawn (diagonal and horizontal lines meeting at a sharp angle, not curved) (1)	3
	(c)	(i)	8.8 V	1
		(ii)	5.0 ± 0.1 V	1
		(iii)	7.3 ± 0.1 kg for extrapolation to 8.8 V saturation (allow 7.0 as last data point given)	1
	(d)	(i)	5 x 30 = 150 mV	1
		(ii)	$\frac{6.0}{0.15}$ (1) $= 40 \pm 1$ (1) {using 6.0 ± 0.1 V}	2
				[12]
9.	*(a)*	(i)	$\frac{300}{5} = -60$ (minus sign needed)	1
		(ii)	R_F and R_{IN} in ratio 60:1 (1) Both resistors 1 kΩ or greater (1)	2
	(b)		$\frac{3.2 \times 10^6}{40}$ (1) 80 k[Hz] ; 0.08 M[Hz] ; 80 000 (1)	2
	(c)		time = $\frac{30}{6.25}$ (1) 4.8 μs (1)	2
				[7]

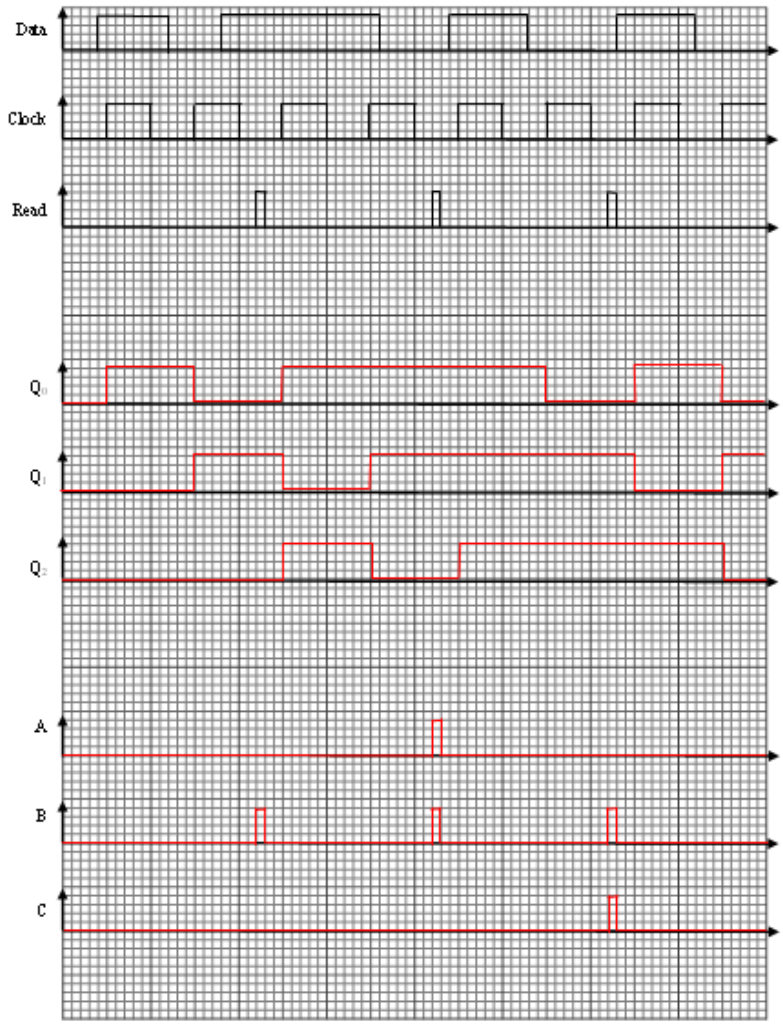
Question			Marking details	Marks Available
1.			 1 mark per correct link 2 or more links per box = -1	3
				[3]

Question			Marking details	Marks Available
2.	*(a)*		False	1
			False	1
			True	1
			True	1
	(b)	(i)	$\beta = \frac{\Delta f_c}{f_i} = \frac{90}{18} = 5$ Correct formula / substitution (1) Answer (1)	2
		(ii)	$bandwidth = 2(\Delta f_c + f_i) = 2(90+18) = 216\text{kHz}$ *or* $bandwidth = 2(1+\beta)\, f_i = 2(1+5)\times 18 = 216\text{kHz}$ Correct formula / substitution (1) Answer (1)	2
				[8]
3.		(i)	 Correct interpretation of modulation technique – 2 x 1 mark	2
		(ii)	Accurate and consistent interpretation – 2 x 1 mark	2
				[4]

Question			Marking details	Marks Available
4.	*(a)*			
		(i)	**S** label correct	1
		(ii)	**M** label correct	1
		(iii)	**P and Q** labels correct (either order) Any label on diode = -1	1
	(b)	(i)	Full AM wave with presence of carrier.	1
		(ii)	Rectified AM wave, i.e. audio signal only.	1
	(c)		$f_{o(\max)} = \frac{1}{2\pi\sqrt{LC}}$ $= \frac{1}{2\pi\sqrt{4.7\times10^{-3}\times10\times10^{-12}}} = 734127\text{Hz} \approx 734\text{kHz}$ Correct substitution of correct L and C values = 1 mark Correct calculation of highest frequency = 1 mark	1 or 2
			Statement that 909 kHz is outside the range of frequencies accessible by this tuning circuit and therefore Radio 5 Live could not be received.	1
			Or	Or
			$C = \frac{1}{4\pi^2 f_o^2 L}$ $= \frac{1}{4\pi^2\times909000^2\times3.3\times10^{-3}} = 6.52\times10^{-12} \approx 6.5\text{pF}$	2
			This is outside the range 10-250 pF so Radio 5 Live can not be received.	1
				[8]

Question			Marking details	Marks Available
5.	*(a)*		Low Pass Filter	1
	(b)		$X_C = \dfrac{1}{2\pi fC}$ $= \dfrac{1}{2\pi \times 100 \times 47 \times 10^{-9}}$ $= 33863\Omega$	
			substitution **and** multipliers	1
			correct answer	1
	(c)		$338.63\,\Omega$ or (b) ÷ 100.	1
	(d)		$f_b = \dfrac{1}{2\pi RC}$ $f_b = \dfrac{1}{2 \times \pi \times 560 \times 47 \times 10^{-9}}$ $f_b = 6.046\text{kHz}$	
			substitution **and** multipliers	1
			correct answer	1
	(e)			
			Shape consistent with (a)	1
			Break frequency consistent at 70% point with (d) (6 kHz)	1
				[8]

Question			Marking details	Marks Available
6.	*(a)*		$\frac{-14-V_{IN}}{55}=\frac{-14-1}{33}$ $-14-V_{IN}=\frac{-15\times 55}{33}$ $-14-V_{IN}=-25$ $V_{IN}=-14+25$ $V_{IN}=+11\text{V}$ correct formula / substitution correct answer	 1 1
	(b)		$\frac{14-V_{IN}}{55}=\frac{14-1}{33}$ $14-V_{IN}=\frac{13\times 55}{33}$ $14-V_{IN}=21.67$ $V_{IN}=14-21.67$ $V_{IN}=-7.67\text{V}$ correct formula / substitution correct answer	 1 1
	(c)		Regenerate a digital signal / Remove noise from signal / Return to original digital signal.	1
				[5]

Question			Marking details	Marks Available
7.		(i)		1 1 1
		(ii)	1 mark per correct output.	1 1 1
				[6]

Question			Marking details	Marks Available
8.	*(a)*		<table><tr><td>D_7</td><td>D_6</td><td>D_5</td><td>D_4</td><td>D_3</td><td>D_2</td><td>D_1</td><td>D_0</td><td>P_3</td><td>P_2</td><td>P_1</td><td>P_0</td></tr><tr><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td></tr></table> 4 correct (even parity) 4 correct (odd parity) Any error	2 1 0
	(b)	(i)	P_1 and P_2 fail	1
		(ii)	<table><tr><td>D_7</td><td>D_6</td><td>D_5</td><td>D_4</td><td>D_3</td><td>D_2</td><td>D_1</td><td>D_0</td><td>P_3</td><td>P_2</td><td>P_1</td><td>P_0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>**1**</td><td>**0**</td><td>**0**</td><td>**1**</td></tr></table>	1
	(c)	(i)	Only parity bit P_0 fails (1), and this is linked to Data Bit D_3. As D_3 is not linked with any other parity bit, it is impossible to say whether it is P_0 or D_3 that is incorrect. (1)	2
		(ii)	Indication that more parity bits are needed (1) Indication that an extra parity bit is generated using D_2, D_3, D_6 and D_7 (1)	2
				[8]

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