A-LEVEL
Electronics

ELEC1 – Introductory Electronics
Mark scheme

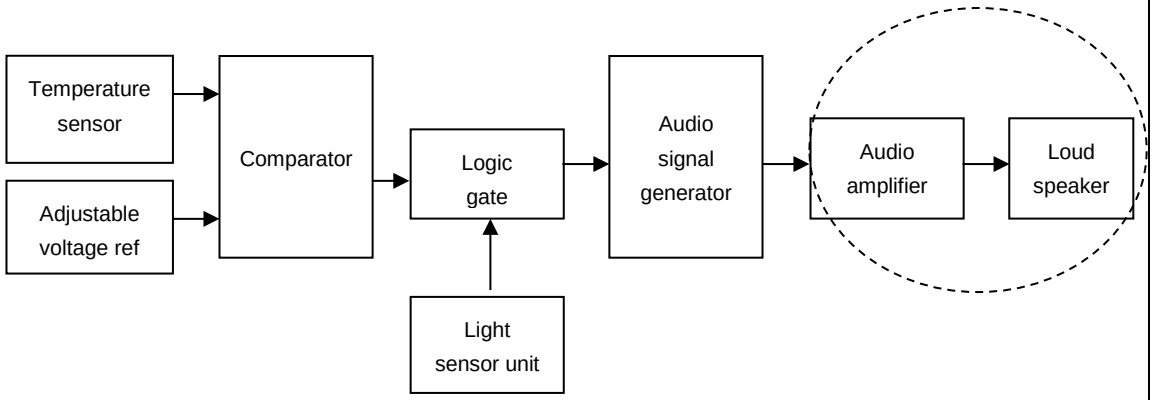
2430
June 2015

Version V1: Final Mark Scheme

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Question	Part	Subpart	Marking Guidance	Mark	Comments
1	(a)		 Each box or dotted combination to be worth 1 mark each if in correct sequence	**7**	
1	(b)		Op-amp – comparator OR – audio signal generator OR – light sensor unit Potentiometer – adjustable voltage reference Power MOSFET – audio amplifier	**1** **1** **1**	

<table>
<tr><td>2</td><td>(a)</td><td></td><td>
<table>
<tr><th>A</th><th>B</th><th>a</th><th>b</th><th>c</th><th>d</th><th>e</th><th>f</th><th>g</th><th>Display</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>L</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>S</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>S</td></tr>
<tr><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>1</td><td>H</td></tr>
</table>
</td><td>3</td><td>1 mark for row L
1 mark for row S (both)
1 mark for row H</td></tr>

<tr><td>2</td><td>(b)</td><td></td><td>EXOR gate</td><td>1</td><td></td></tr>

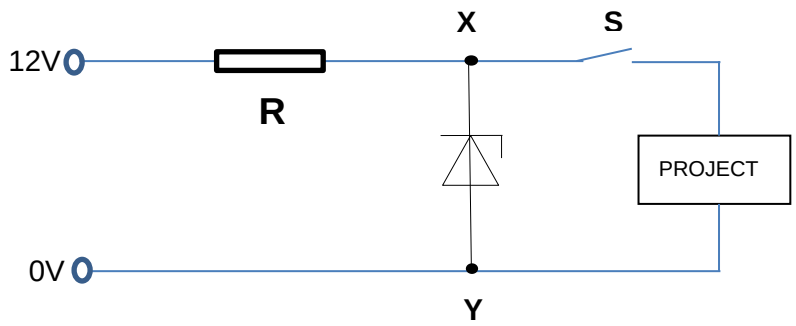
<tr><td>2</td><td>(c)</td><td></td><td>Common cathode display requires logic 1 applied to segment as all cathodes are held low

Common anode requires logic 0 to be applied to light each segment</td><td>2</td><td>Two points made</td></tr>

<tr><td>2</td><td>(d)</td><td>(i)</td><td>Different combinations produce different brightness</td><td>1</td><td>1 Disadvantage</td></tr>

<tr><td>2</td><td>(d)</td><td>(ii)</td><td>R=V/I; (5V – 2.2V) / 20mA; 2.8V/20mA = 140Ω</td><td>2</td><td>1 mark for 2.8V drop
1 mark for answer</td></tr>

<tr><td>2</td><td>(d)</td><td>(iii)</td><td>E24 = 150Ω</td><td>1</td><td>1 mark for answer</td></tr>
</table>

3	(a)		 1 mark for Zener symbol 1 mark for orientation	**2**	
3	(b)	(i)	80mA + 5mA = 85mA	**1**	Answer – 1
3	(b)	(ii)	12V – 5.1 V = 6.9V	**1**	Calculation and answer – 1
3	(b)	(iii)	R = 6.9V/ 85mA = 81Ω	**2**	Calculation and answer – 2
3	(c)	(i)	$P = V^2 / R$ P = (6.9 x 6.9) / 75 P = 0.64W Hence P is approx. 0.6W	**2**	Calculation and answer – 2
3	(c)	(ii)	I = V/R I = 6.9 / 75 I = 92mA	**2**	Calculation and answer – 2

4	(a)		D = C + B E = $\bar{A}$ G = $\overline{A + B}$	**3**	1 1 1

4	(b)			**5**	2 marks for each of correct columns D & G 1 mark for column E

INPUTS			**INTERMEDIATE OUTPUTS**		
C	**B**	**A**	**D**	**E**	**G**
0	0	0	**0**	**1**	**1**
0	0	1	**0**	**0**	**0**
0	1	0	**1**	**1**	**0**
0	1	1	**1**	**0**	**0**
1	0	0	**1**	**1**	**1**
1	0	1	**1**	**0**	**0**
1	1	0	**1**	**1**	**0**
1	1	1	**1**	**0**	**0**

<table>
<tr>
<td>4</td>
<td>(c)</td>
<td></td>
<td>
Q = ($\overline{A}$. $\overline{B}$) + ($\overline{A}$. C) + ($\overline{A}$. B)

Q = $\overline{A}$ (B + $\overline{B}$) + ($\overline{A}$. C)

Q = $\overline{A}$ (1) + ($\overline{A}$. C)

Q = $\overline{A}$ (1 + C)

Q = $\overline{A}$

Final gate is a NOT gate (Accept $\overline{A}$)

Karnaugh map alternative

OR

<table>
<tr><th></th><th>A.B</th><th>$\overline{A}$. B</th><th>$\overline{A}$. $\overline{B}$</th><th>A . $\overline{B}$</th></tr>
<tr><td>C</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>$\overline{C}$</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
</table>
</td>
<td>3</td>
<td>1 mark (X +$\overline{X}$) = 1 reduction

1 mark for (1+ X) =1

1 mark for final gate

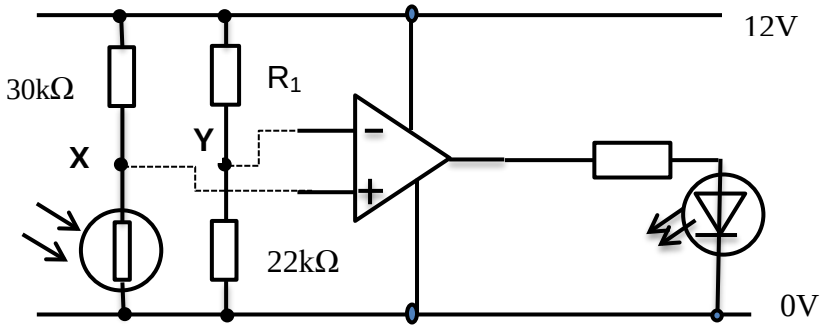
1 mark for table with values

1 mark for cluster

1 mark for final gate</td>
</tr>
</table>

5	(a)	(i)	Log graph enables a wide range of values to be displayed on the same axis. Allow – (enables values to be displayed as straight line)	**1**	

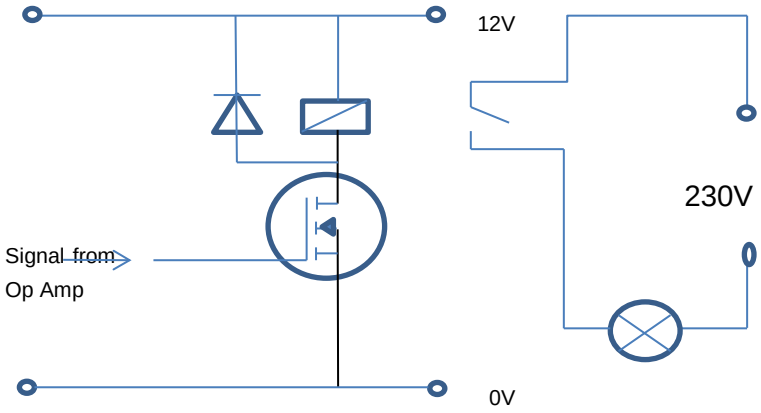
5	(a)	(ii)	7 lux	**1**	

5	(b)		 1 mark for connections correct way round	**1**	

5	(c)	(i)	60 kΩ / (60kΩ + 30kΩ)) x 12V = 8V	**2**	Working – 1 Answer – 1

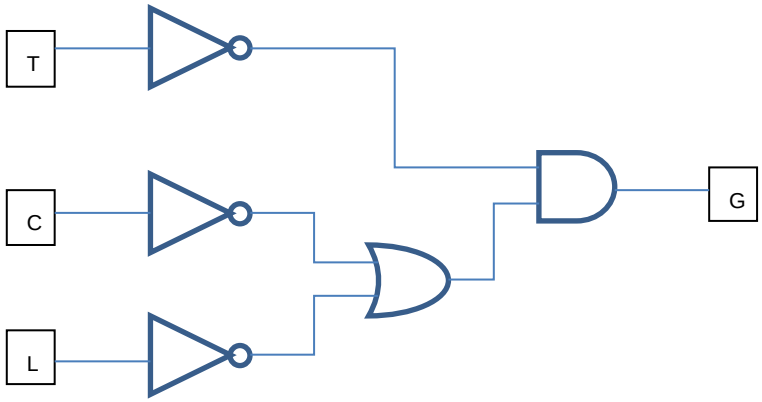
5	(c)	(ii)	R_1 = 11kΩ to give same value at Y as switching voltage at X (2:1 ratio) (No ecf on value)	**2**	Reason / calculation – 1 Answer – 1

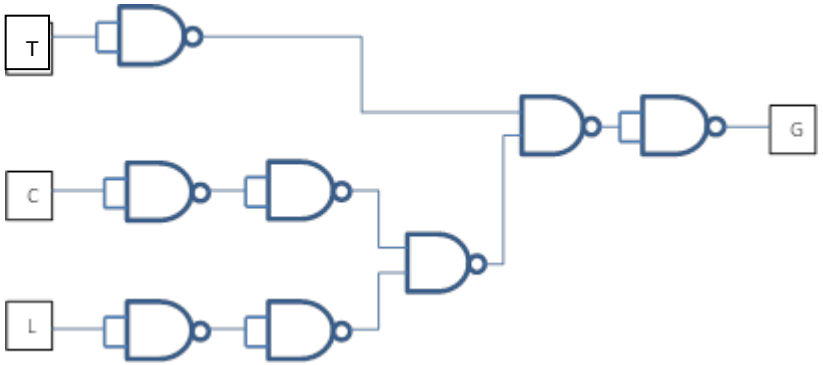
5	(d)		The op-amp is not ideal and will saturate above 0V Need to drop voltage Acceptable method	**3**	Saturation – 1 Voltage drop – 1 Method – 1

5	(e)		 Lamp in independent mains circuit in correct position. Electromagnetic relay in correct position. Protection diode in correct position. N-channel MOSFET in correct position.	**4**	1 mark 1 mark 1 mark 1 mark

6	(a)		<table><tr><th colspan="3">INPUTS</th><th colspan="3">OUTPUTS</th></tr><tr><th>Tunnel Sensor T</th><th>Car Sensor C</th><th>Lorry Sensor L</th><th>Message Display M</th><th>Red Stop light R</th><th>Green Go light G</th></tr><tr><td>0</td><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>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</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>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr></table> Column M – 2 marks Column G – 2 marks	**4**	

6	(b)		**R = T +(C.L)** Or for full expression **S = T +($\overline{T}$.C.L)**	**2**	1 mark for terms 1 mark for OR Max 1 mark

6	(c)	(i)		**3**	

6	(c)	(ii)	 Allow reduced solution	**3**	