GCSE

Electronics

44301

Mark scheme

4430

June 2016

Version: 1.0 Final

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.

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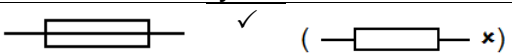
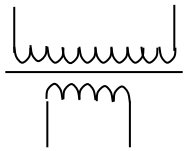
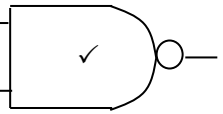
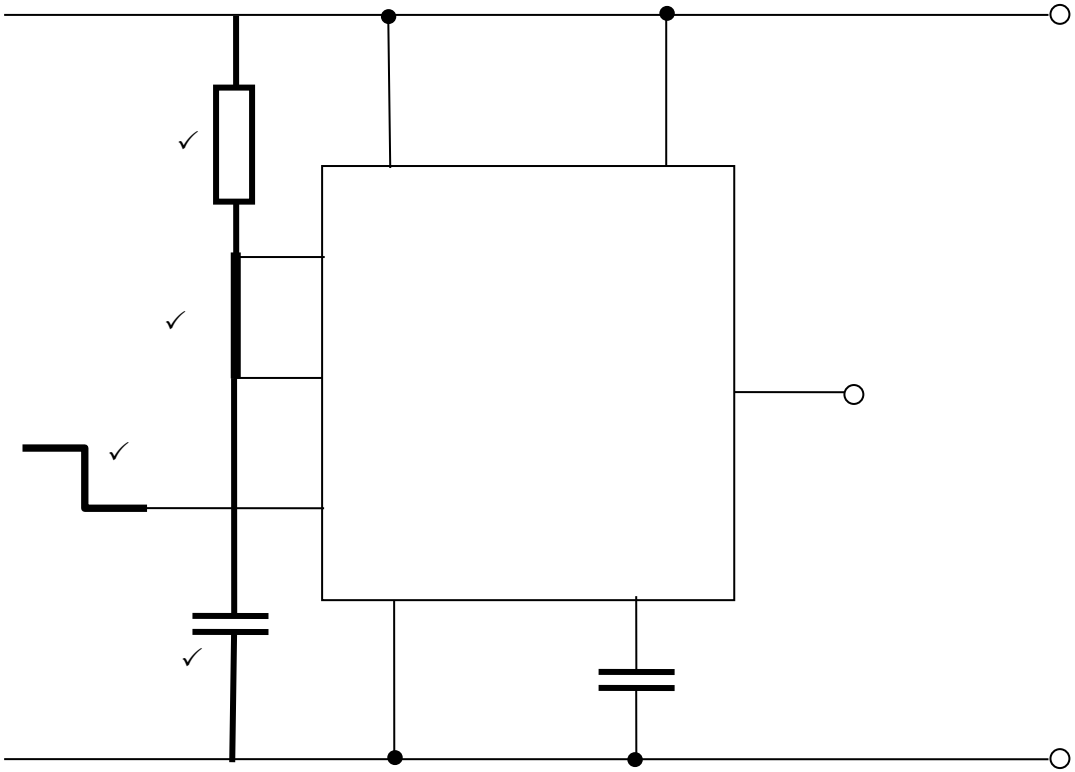
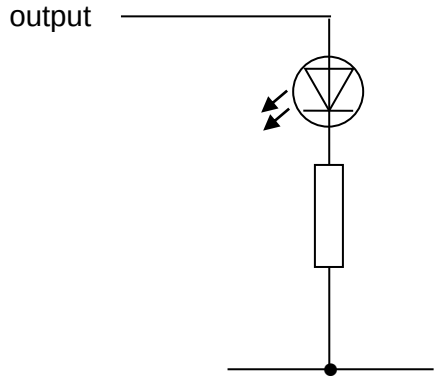
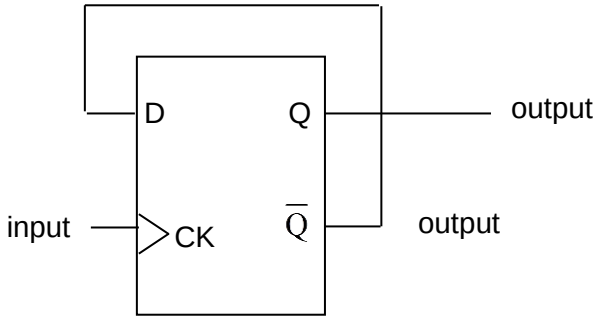
<table>
<tr><th>Question</th><th>Answers</th><th>Additional Comments/Guidance</th><th>Mark</th></tr>
<tr><td>1a</td><td>(skin) burns / fibrillation = irregular heart rate / muscular spasm = stop heart / arrest breathing / damage internal organs ✓✓</td><td>(2 max)</td><td>2</td></tr>
<tr><td>1b</td><td>call for help / turn off supply = remove from supply (using insulator) / place in recovery position / clear airways / CPR (if trained) / check pulse / check breathing ✓✓✓</td><td>(3 max)</td><td>3</td></tr>
<tr><td>1c</td><td>
<table>
<tr><th>Name</th><th>Symbol</th></tr>
<tr><td>Fuse ✓</td><td>✓  </td></tr>
<tr><td>Electrolytic capacitor ✓</td><td>  ✓ ✓</td></tr>
<tr><td>(step down) transformer ✓</td><td>✓ 
Can be loops 
Not 
Any no. of lines between coils and can be dashed</td></tr>
</table>
</td><td></td><td>7</td></tr>
<tr><td>Total</td><td></td><td></td><td>12</td></tr>
</table>

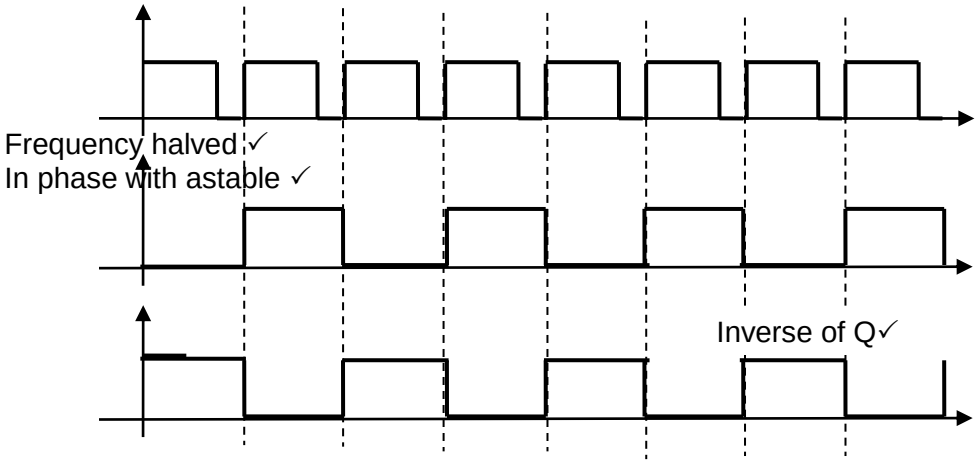
Question	Answers	Additional Comments/Guidance	Mark
2ai	timer✓ light sensor✓		2
2aii	lamp✓		1
2bi	logic✓		1
2bii	light sensor✓		1
2biii	driver✓		1
2biv	comparator✓		1
2ci	light sensor✓		1
2cii	logic✓ accept driver		1
2ciii	comparator✓		1
Total			10

<table>
<tr><th>Question</th><th>Answers</th><th>Additional Comments/Guidance</th><th>Mark</th></tr>
<tr><td>3ai</td><td>
<table>
<tr><td>Sensor 1</td><td>Sensor 2</td><td>Output</td></tr>
<tr><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>0</td></tr>
</table>
✓ ✓
</td><td></td><td>2</td></tr>
<tr><td>3aii</td><td>NAND✓</td><td></td><td>1</td></tr>
<tr><td>3aiii</td><td>inputs ✓  ✓ output ✓</td><td></td><td>3</td></tr>
</table>

3bi			4

3bii		Symbol for LED ✓ Orientation of LED ✓ Resistor symbol in series ✓	3
Total			13

Question	Answers	Additional Comments/Guidance	Mark
4a	correct symbol ✓ with polarity ✓ in parallel with R ✓		3
4bi	9 – 3.3 = 5.7 (V) ✓		1
4bii	0.005 (A) ✓		1
4biii	R=V/I ✓ = 5.7/0.005✓ = 1140 (Ω)✓ 2 max or ecf		2
4biv	1200 (Ω)/1.2k(Ω)✓ or ecf		1
4ci	D✓ to bar Q✓ CK as input✓ Q and $\overline{Q}$ as outputs✓ 		4

4cii			3
Total			15

Question	Answers	Additional Comments/Guidance	Mark
5ai	convert electrical energy✓ into sound energy / produce sound✓		2
5aii	select/choose✓ the desired frequency/station✓ (from all the others)		2
5bi	amplitude✓	Accept voltage or power	1
5bii	A carrier wave at constant frequency ✓ varying in amplitude at a frequency significantly lower than the carrier frequency✓		2
5c	In an analogue signal the amplitude of the signal varies (with time) ✓ and can have a range of values✓ between a minimum and a maximum value.✓ In a digital signal the amplitude can only have one of two values✓ which are represented by 0 and 1. ✓ A simple radio receiver is an analogue system✓because the (radio and audio) signals have a range of values. ✓ (See notes on QWC below)		5
Total			12

QWC Mark Scheme

question	answers	extra information	mark

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking.

Level 1 (0—1 marks)

Answer is largely incomplete. It may contain valid points which are not clearly linked to an argument structure.
Unstructured answer .
Errors in the use of technical terms, spelling, punctuation and grammar or lack of fluency.

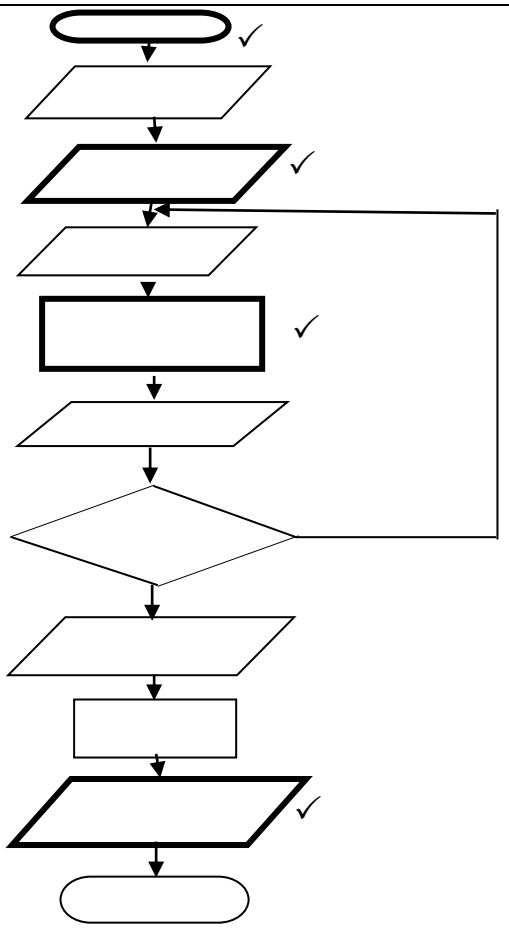
Level 2 (2—3 marks)

Answer has some omissions but is generally supported by some of the relevant points below:
- the argument shows some attempt at structure
- the ideas are expressed with reasonable clarity but with a few errors in the use of technical terms, spelling, punctuation and grammar.

Level 3 (4—5 marks)

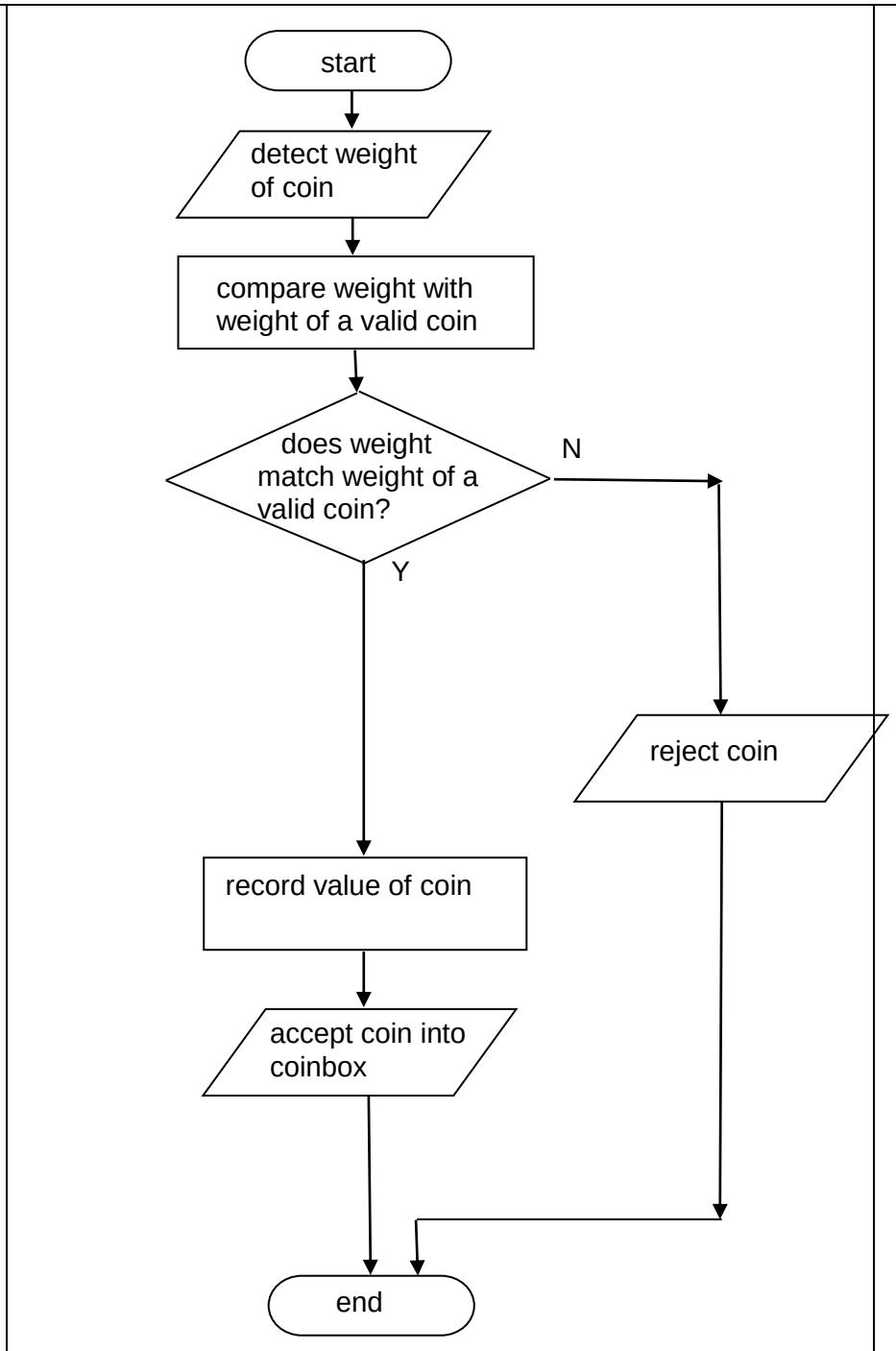
Answer is full and detailed and is supported by an appropriate range of relevant points such as those given below:
- argument is well structured with minimum repetition or irrelevant points
- accurate and clear expression of ideas with only minor errors in the use of technical terms, spelling and punctuation and grammar.

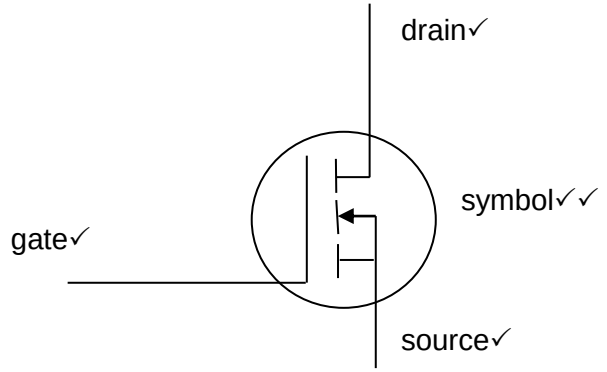
examples of the points made in the response	extra information
In an analogue signal the amplitude of the signal varies (with time) ✓ and can have a range of values✓ between a minimum and a maximum value.✓ In a digital signal the amplitude can only have one of two values✓ which are represented by O and 1. ✓ A simple radio receiver is an analogue system✓because the (radio and audio) signals have a range of values. ✓ (5 maximum)	Example only.

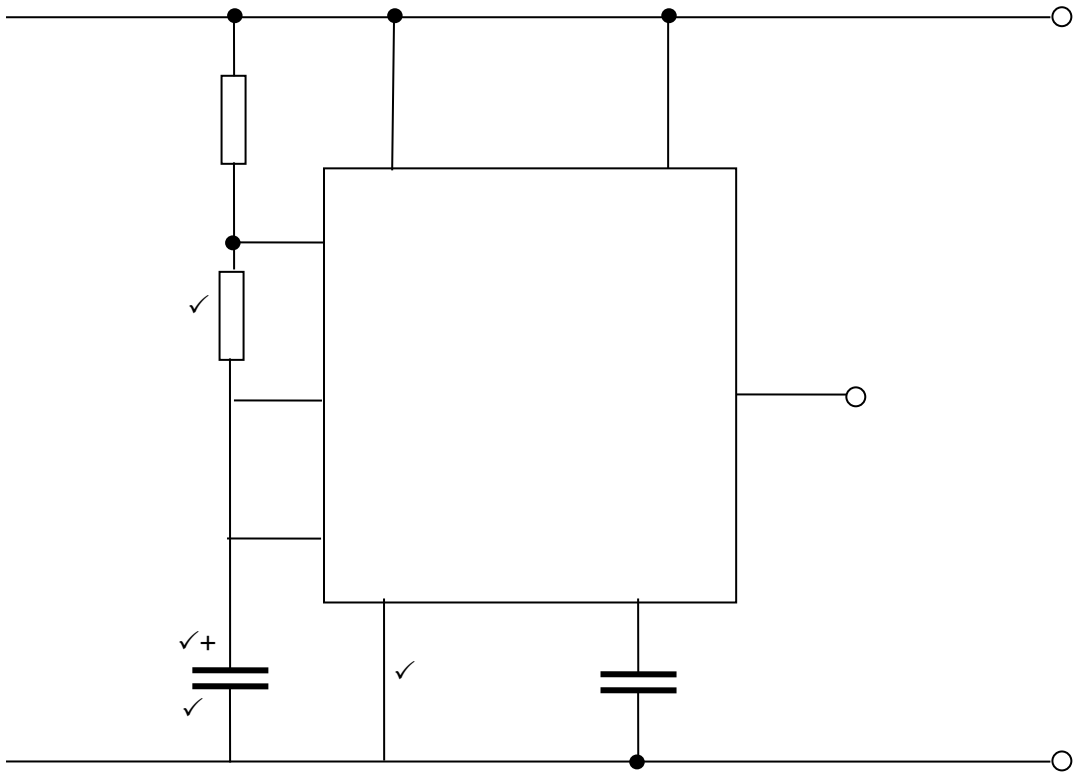
Question	Answers	Additional Comments/Guidance	Mark
6 a)			4
6 b)	input = either “detect” box✓ output = “display” or “release” box ✓ decision = diamond ✓ loop = arrow upwards✓ process=any rectangle✓		5

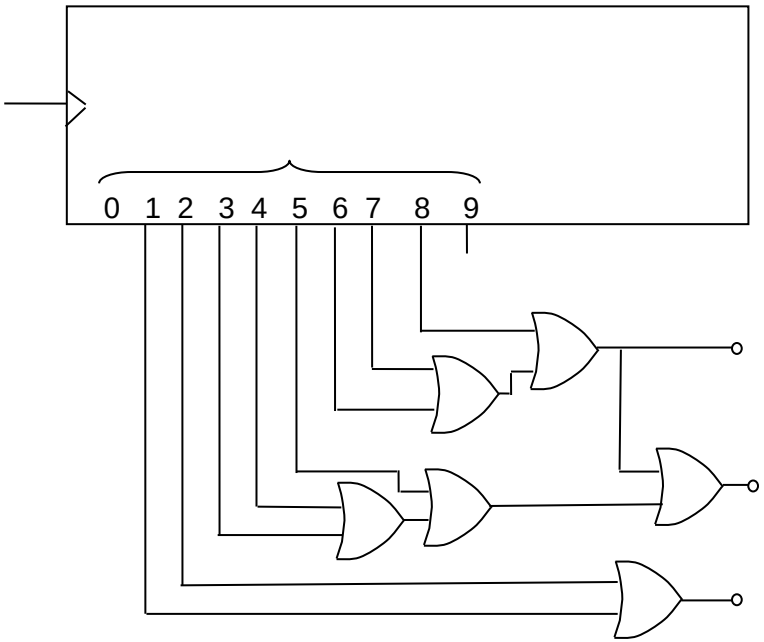
6 c	Detect weight✓ Compare weight✓ Weight OK, accept coin and record value✓ Weight not OK reject✓ Join outcomes and end✓	Minus 1 mark for incorrect box shape	5
Total			**14**

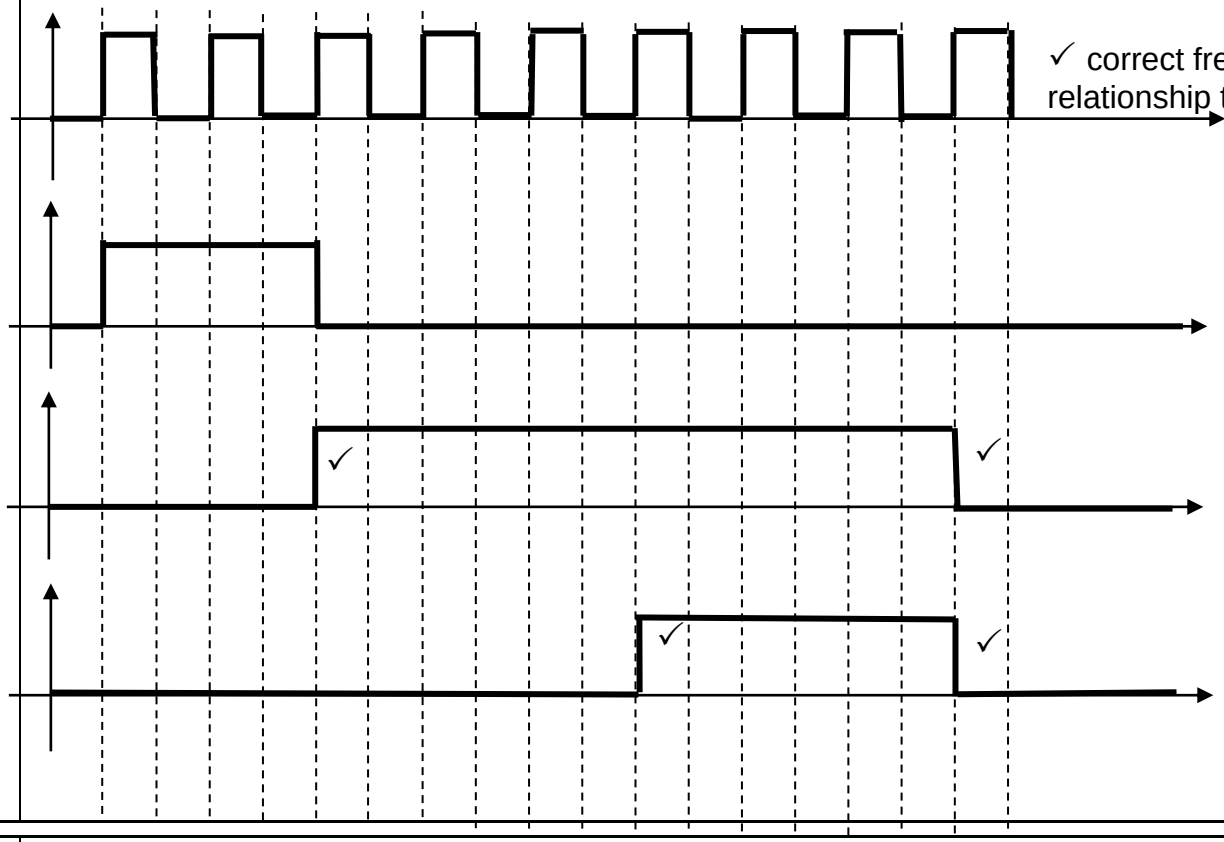
6 c example

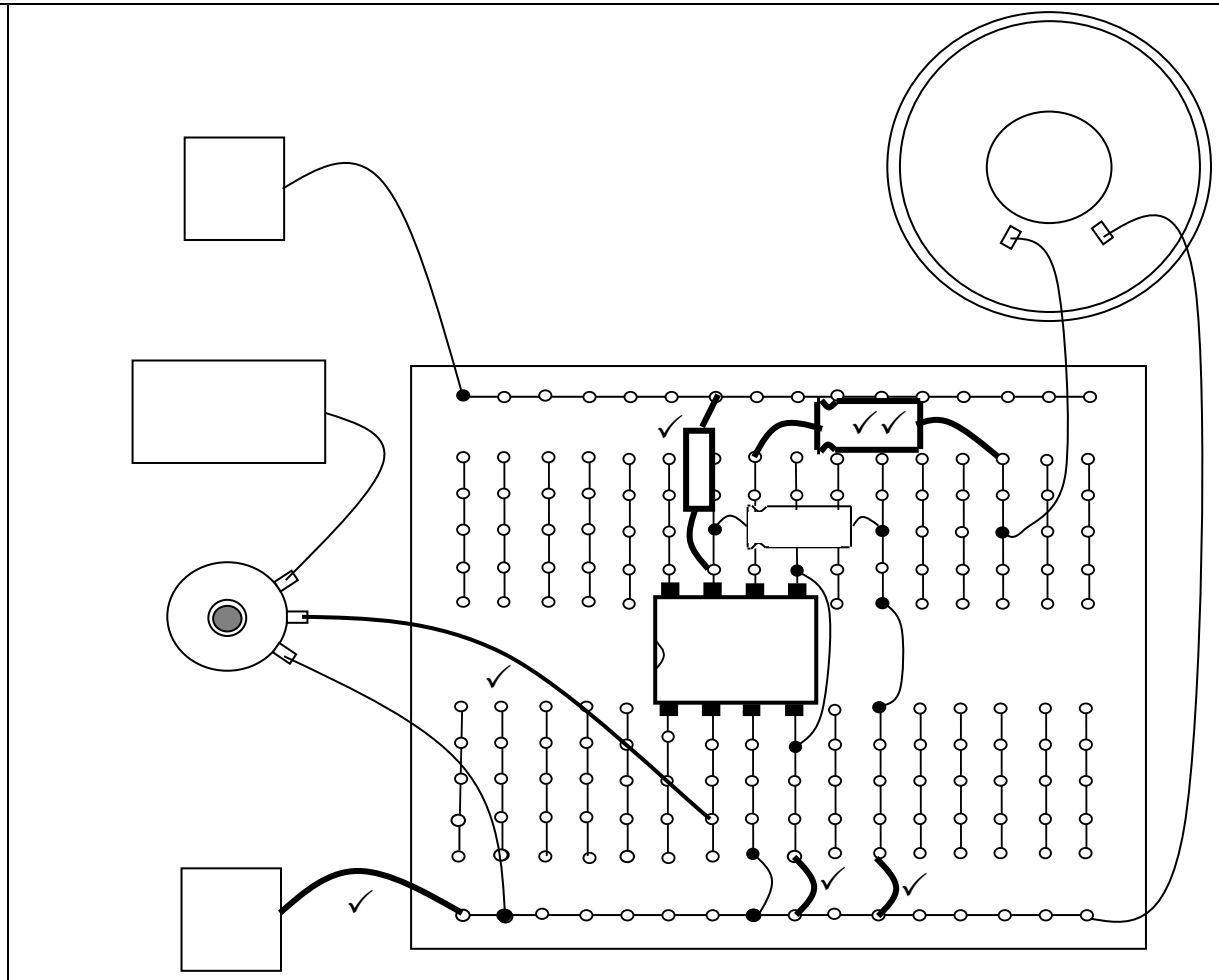


Question	Answers	Additional Comments/Guidance	Mark
7ai	non-inverting ✓		1
7aii	two resistors in series ratio 1:2 ✓ values 1k to 100k ✓		3
7aiii	in range 4 to 6 V inclusive✓		1
7aiv	in range 0 to 2 V inclusuve✓		1
7bi	10 (^{o}C) ✓		1
7bii	120 (Ω)✓		1
7biii	240 Ω✓✓	Answer by ratio/formula ✓	2
7c		symbol ✓✓ gate to comparator ✓ source to 0V ✓ drain to buzzer ✓	5
7d	1st and 2nd (blue and grey)✓ 3rd brown✓ 4th gold✓		3
Total			18

Question	Answers	Additional Comments/Guidance	Mark
8a	Capacitor 0 V to trigger✓resistor discharge to threshold and trigger✓ polarity of C marked ✓ link ground to O V. ✓ 		4

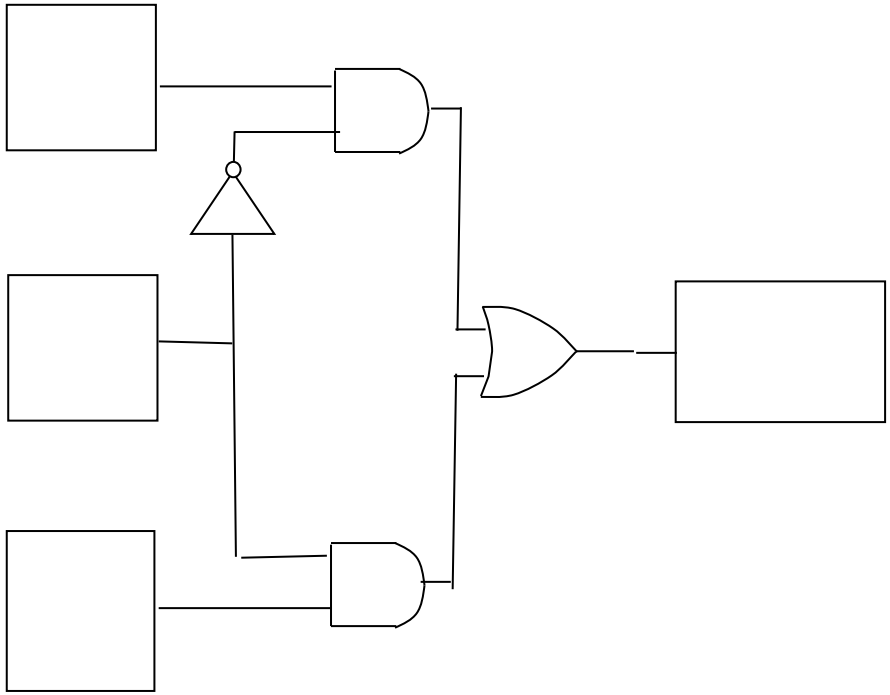
8b	T = (5 + 2×200)×10^3 ×2200 × 10^{-6} /1.44 ✓ = 6.19✓ ×10^2 (s) ✓		3
8ci	1000 ✓		1
8cii	5 ✓		1
8di	outputs 6,7 and 8 ORed together✓ to heater 2✓ to heater 1✓ 		3
8dii	Connect to Q9 output (and zero volts)		1

8diii			5
Total			18

Question	Answers	Additional Comments/Guidance	Mark
9a		Two wires in same hole minus 1 1 mark for capacitor the right way	7

9bi	3÷3 = 1✓ V/div ✓		2
9bii	Gain = V_o/V_{in} = 3/0.2 ✓ = 15 ✓		2
9biii	(Vrms = V/√2 =) 3/√2 ✓ = 2.1V ✓		2
9biv	P=VI = 2.12 × 0.26✓ = 0.56 W ✓ => $P=V^2/R = 2.12^2/R$		2
9bv	2 × 5✓ = 10 ms ✓		2
9bvi	f = 1/T = 1/0.01✓ = 100 Hz ✓ (0.1 Hz = 1 mark		2
9c	Range of frequencies ✓ over which half rated(max) power is produced/over which output voltage is Vmax/√2 ✓		2
9d	act as heat sink/cooling/dissipate heat /remove excess heat by conduction to copper ✓✓ to produce a very low resistance connection to 0 V to aid the stability of the amplifier ✓		2 max
Total			23

<table>
<tr><th>Question</th><th>Answers</th><th>Additional Comments/Guidance</th><th>Mark</th></tr>
<tr><td>10ai</td><td>NOR</td><td></td><td>1</td></tr>
<tr><td>10aii</td><td>
<table>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>1</td></tr>
<tr><td></td><td></td><td>0</td></tr>
<tr><td></td><td></td><td>0</td></tr>
<tr><td></td><td></td><td>0</td></tr>
<tr><td></td><td></td><td>✓</td></tr>
</table>
</td><td></td><td>1</td></tr>
<tr><td>10aiii</td><td>
<table>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>1</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td>0</td><td>0</td><td>1</td></tr>
<tr><td></td><td></td><td>1</td><td>0</td><td>0</td></tr>
<tr><td></td><td></td><td>0</td><td>0</td><td>0</td></tr>
<tr><td></td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>
</td><td></td><td>3</td></tr>
<tr><td>10aiv</td><td>Only one LED is lit at a time ✓ /
Current/voltage same for either LED lit ✓</td><td></td><td>1 max</td></tr>
<tr><td>10av</td><td>LED 2 ✓ Neither ✓ LED 1 ✓</td><td></td><td>3</td></tr>
</table>

10b	Sensor 1 to AND✓, sensor 2 to another AND ✓, SW to top AND via NOT✓, SW to lower AND ✓ Both ANDs to OR ✓ OR to boiler✓ 		6
Total			15