OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

Advanced Subsidiary GCE

Electronics

Unit F611: Simple Systems

Specimen Paper

F611 QP

Candidates answer on the question paper.
Additional Materials:
Scientific calculator

Time: 1 hour 30 mins

Candidate Name	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- Unless otherwise indicated, you can assume that :
  - op-amps are run off supply rails at +15 V and -15 V
  - logic circuits are run off supply rails at +5 V and 0 V
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **90**.

FOR EXAMINERS' USE		
Qu.	**Max.**	**Mark**
1	**11**	
2	**10**	
3	**3**	
4	**18**	
5	**20**	
6	**12**	
7	**8**	
8	**8**	
TOTAL	**90**	

This document consists of **16** printed pages.

  [QAN 500/2581/8] **[Turn Over**

Data Sheet

resistance	$R = \frac{V}{I}$
power	$P = VI$
series resistors	$R = R_1 + R_2$
time constant	$\tau = RC$
monostable pulse time	$T = 0.7RC$
relaxation oscillator period	$T = RC$
frequency	$f = \frac{1}{T}$

Answer **all** questions.

1 **(a)** Fig. 1.1 shows a two-input AND gate with inputs A and C and output P.

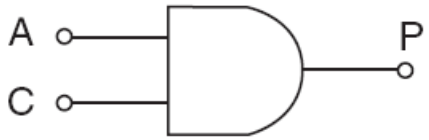


Fig. 1.1

(i) Complete the truth table for this gate.

A	C	P
0	0	
0	1	
1	0	
1	1	

[2]

(ii) Write down a Boolean expression for the output P.

P = ... **[1]**

(b) Fig. 1.2 shows a two-input NOR gate with inputs A and B and output G.

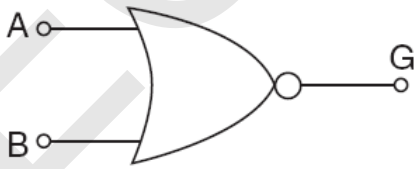


Fig. 1.2

(i) Complete the truth table for this gate.

A	B	G
0	0	
0	1	
1	0	
1	1	

[2]

(ii) Write down a Boolean expression for the output G.

G = ... **[1]**

(c) **(i)** For the circuit shown in Fig. 1.3, write down a Boolean expression for C, P, G and Q in terms of **only** A and B.

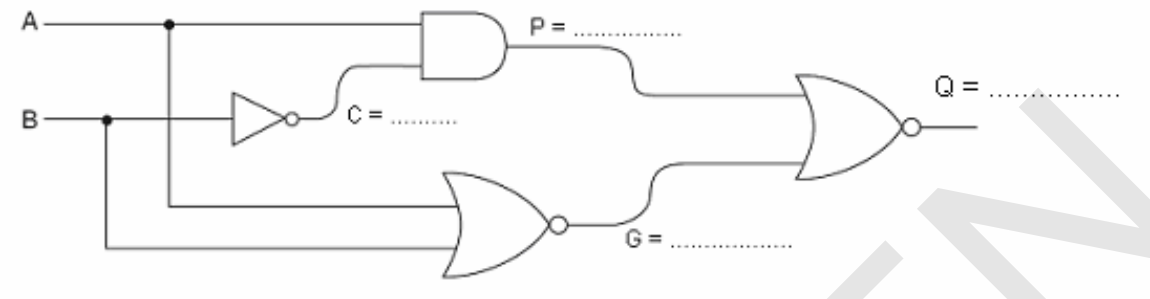


Fig. 1.3

[3]

(ii) Use the rules of Boolean algebra to show that Q does not depend on A.

[2]

2 The lamp of Fig. 2.1 glows whenever the switch is closed. This indicates that 15 V is applied to the system.

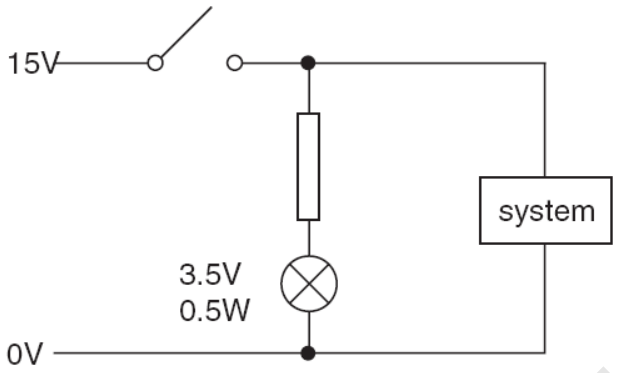


Fig. 2.1

(a) The lamp is rated at 3.5 V, 0.5 W. Show that the current in the lamp is about 150 mA when it operates at its rated voltage.

[3]

(b) Calculate a suitable value for the resistor in series with the lamp. Include the unit with your answer.

resistance = ... Ω **[3]**

(c) Calculate the power dissipated in the resistor when the lamp is on.

power = ... W **[2]**

(d) (i) Put a ring around the most suitable power rating for the resistor

0.5W 1W 1.5W 2W 3W 5W 10W

[1]

(ii) Justify your choice .....

..... **[1]**

3 **(a)** A logic circuit has the following truth table.

C	D	E
0	0	0
0	1	1
1	0	0
1	1	0

$E = C \cdot \overline{D}$ $E = C + \overline{D}$ $E = \overline{C} \cdot D$ $E = \overline{C} + D$

Circle **one** of the Boolean expressions above which correctly describes this truth table.

[1]

(b) A logic circuit has the following truth table.

K	L	M
0	0	1
0	1	1
1	0	1
1	1	0

$M = \overline{K} \cdot \overline{L}$ $M = \overline{K} + \overline{L}$ $M = \overline{K \cdot L}$ $M = K + L$

Circle **one** of the Boolean expressions above which correctly describes this truth table.

[1]

(c) A logic circuit has the following truth table.

F	G	H
0	0	0
0	1	0
1	0	0
1	1	1

$H = \overline{F \cdot G}$ $H = \overline{F + G}$ $H = F + G$ $H = \overline{\overline{F} + \overline{G}}$

Circle **one** of the Boolean expressions above which correctly describes this truth table.

[1]

4 A relaxation oscillator circuit is shown in Fig. 4.1

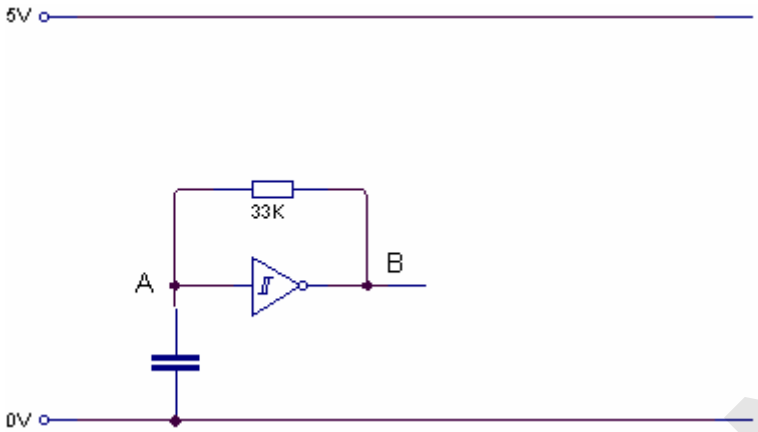


Fig. 4.1

(a) The oscillator has a frequency of 270Hz. Show that the period of the oscillator is about 4ms.

[3]

(b) Calculate the value of the capacitor required to produce a period of 4ms.

Value of capacitor = ... nF **[3]**

The signal at A has been drawn on the graph below. Draw the signal at B on the graph below.

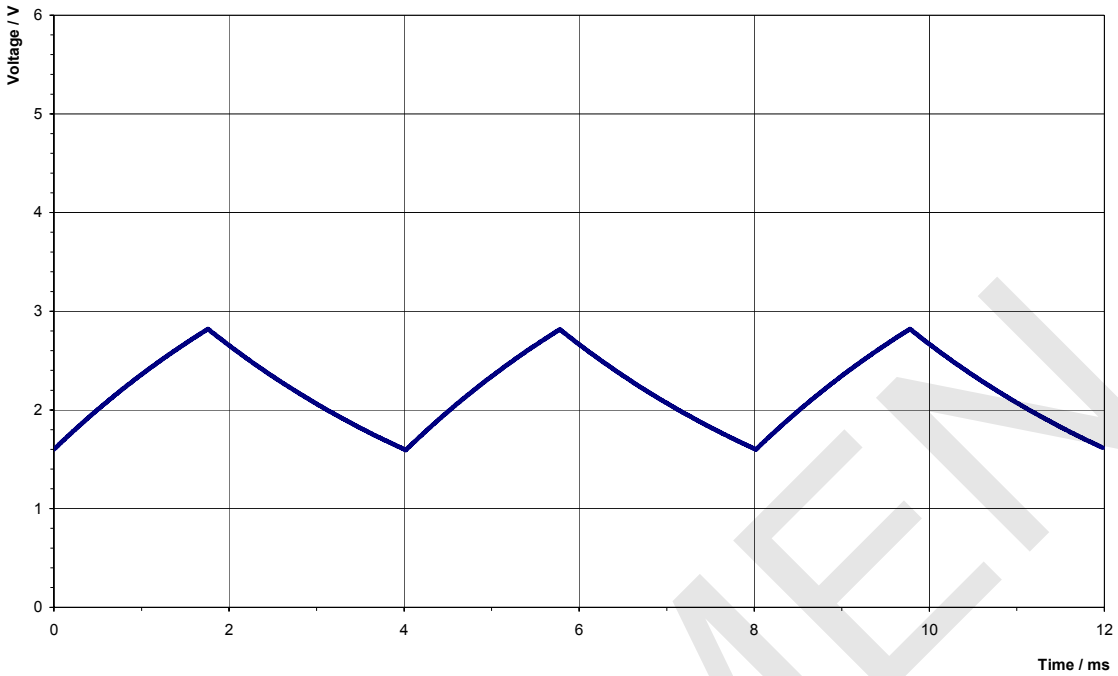


Fig. 4.2

[4]

(c) The circuit is used to make a loud sound for an alarm.

(i) Draw on the diagram of Fig. 4.1 to show how you would connect a speaker and driver to produce a loud sound.

[5]

(ii) Label the three terminals of the MOSFET

[1]

(iii) Explain why the driver is needed.

.....

.....

..... **[2]**

5 A light sensor circuit is shown Fig. 5.1.

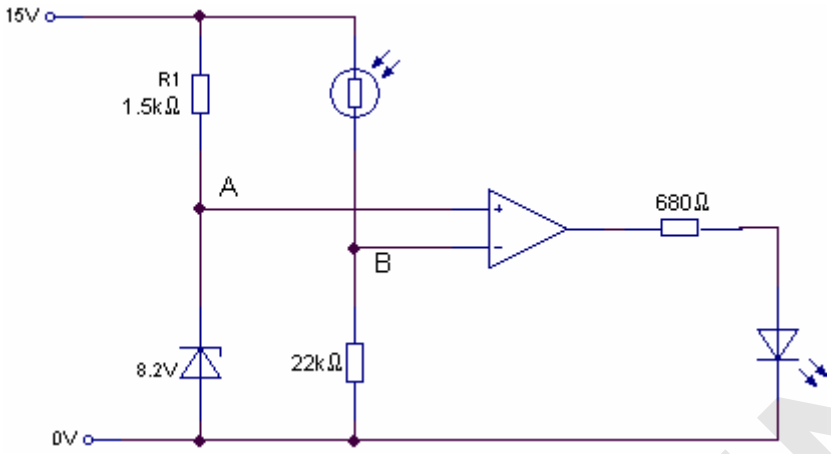


Fig. 5.1

(a) The circuit contains a 8.2V zener diode.

(i) Sketch a graph on the axes in Fig. 5.2 to show the behaviour of a 8.2V zener diode.

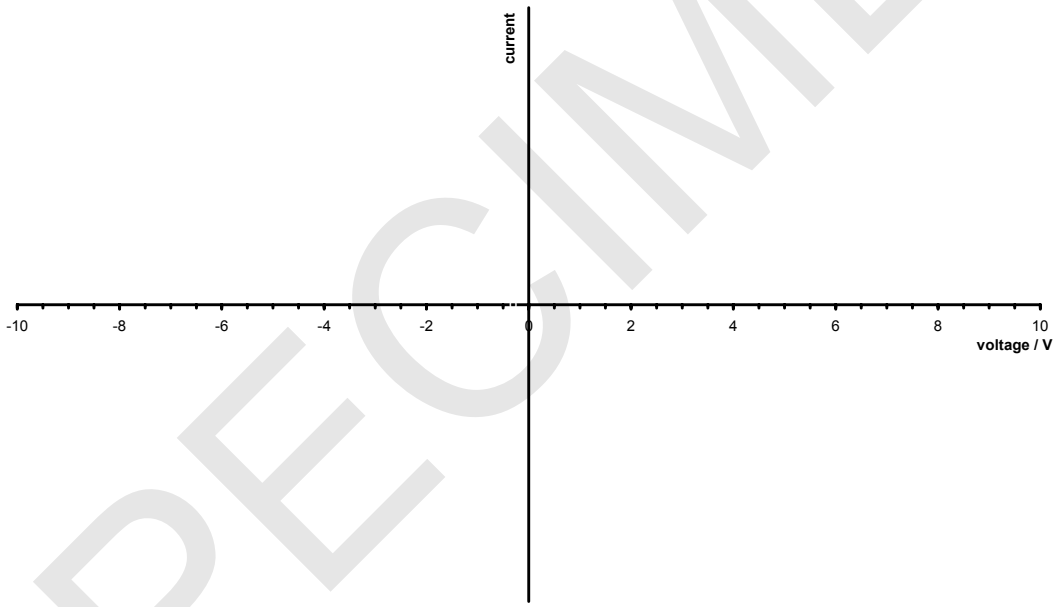


Fig. 5.2

[3]

(ii) Explain why the voltage at A is held at 8.2V.

.....

.....

.....

..... **[3]**

(iii) State the voltage across the resistor R1.

Voltage across R1 = ... V **[1]**

(iv) Calculate the current through the resistor R1.

Current = ... mA **[2]**

(v) State the current in the zener diode.

Current = ... mA **[1]**

(b) (i) The resistance of the LDR is 1kΩ when the light intensity is 100 lux. Calculate the voltage at B when the light intensity on the LDR is 100 lux.

Voltage at B = ... V **[2]**

(ii) Describe what will happen to the LED when the light intensity on the LDR is 100 lux. The quality of your written communication will be assessed in this question.

.....

.....

.....

.....

.....

..... **[8]**

6 The circuit of Fig. 6.1 uses two NAND gates.

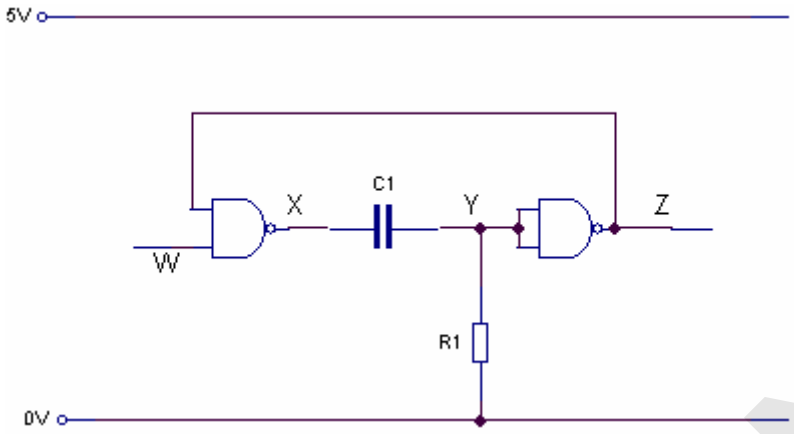


Fig 6.1

(a) State the name of the circuit in Fig. 6.1.

..... **[1]**

(b) Calculate the values of the capacitor and resistor in Fig. 6.1 to produce a pulse width of 2.5s.

C1= ..... μF

R1= ..... kΩ **[3]**

(c) Complete the timing diagram in Fig. 6.2 for the voltages at the labelled points in Fig. 6.1.

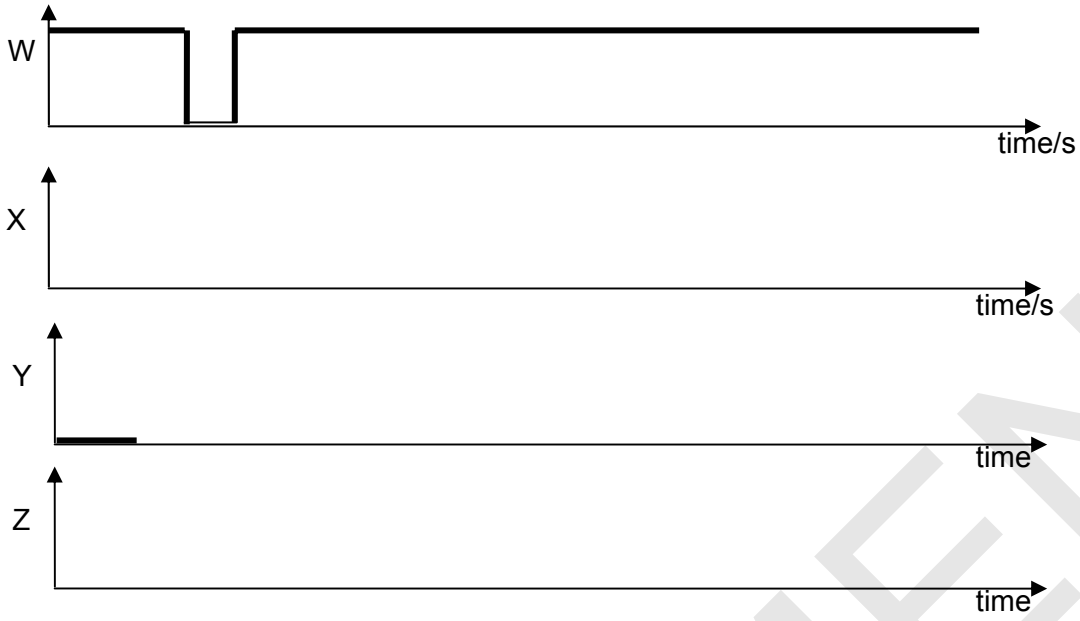


Fig 6.2

[5]

(d) The signal at W is produced by a switch which produces a logic 0 when the switch is pressed. Draw the switch and a resistor on Fig. 6.1.

[3]

7 A student uses an oscilloscope to investigate the output from a circuit. Fig. 7.1 shows the screen of the oscilloscope. The Y sensitivity is 2v/division and the timebase is 5ms/division.

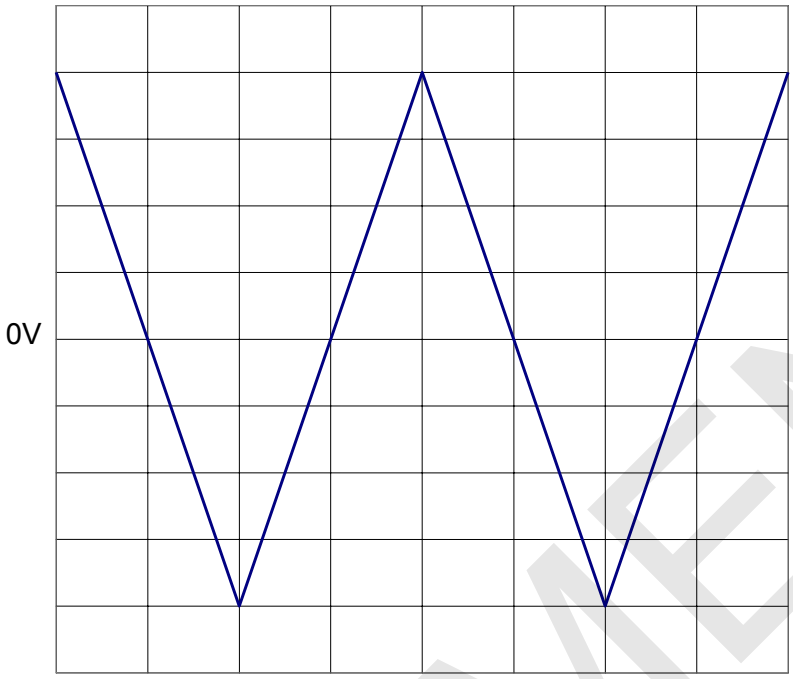


Fig. 7.1

(a) Calculate the amplitude of the signal in Fig. 7.1

Amplitude = ... V **[3]**

(b) Calculate the period of the signal in Fig. 7.1

Period = ... ms **[3]**

(c) Calculate the frequency of the signal in Fig. 7.1

Frequency = ... Hz **[2]**

8 A circuit to produce a time delay is shown in Fig. 8.1.

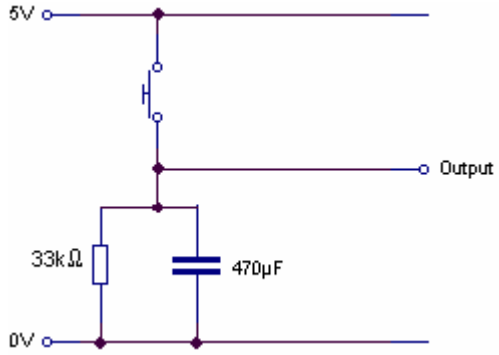


Fig. 10.1

(a) Calculate the time constant of the resistor-capacitor network in Fig. 8.1.

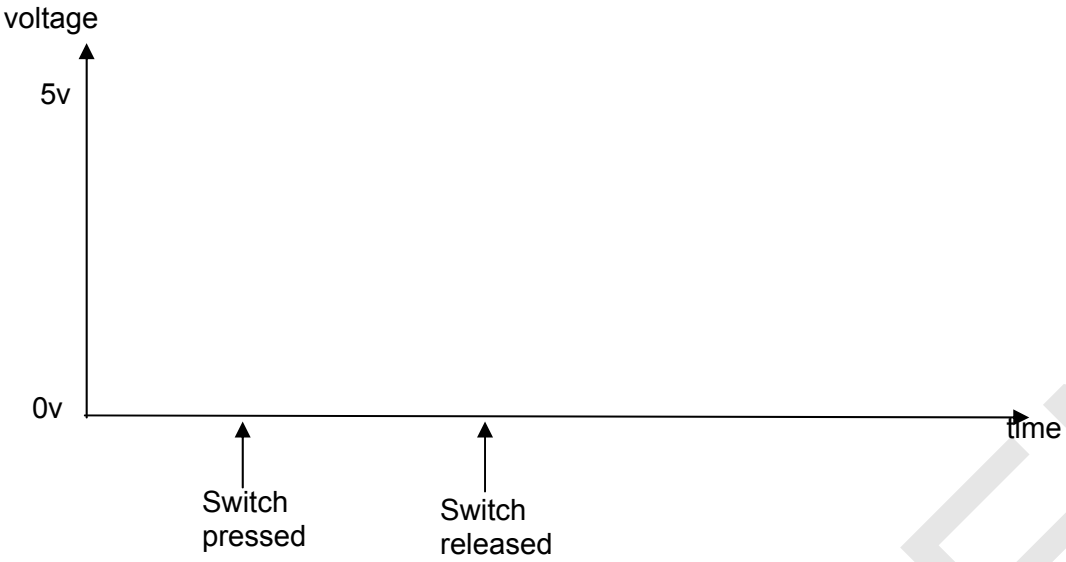
Time constant = ... **[2]**

(b) When the switch is pressed the voltage at the output is 5v. Calculate how long after the switch is released does the voltage at the output become 2.5v.

Time to get to 2.5v = ... **[1]**

(c) Draw a voltmeter with connections to measure the output voltage on Fig. 8.1. **[1]**

(d) Sketch a graph on the axes below to show how the voltage at the output changes with time.



[4]

Paper Total [90]

OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

GCE ELECTRONICS F611

Unit F611: *Simple Systems*

Specimen Mark Scheme

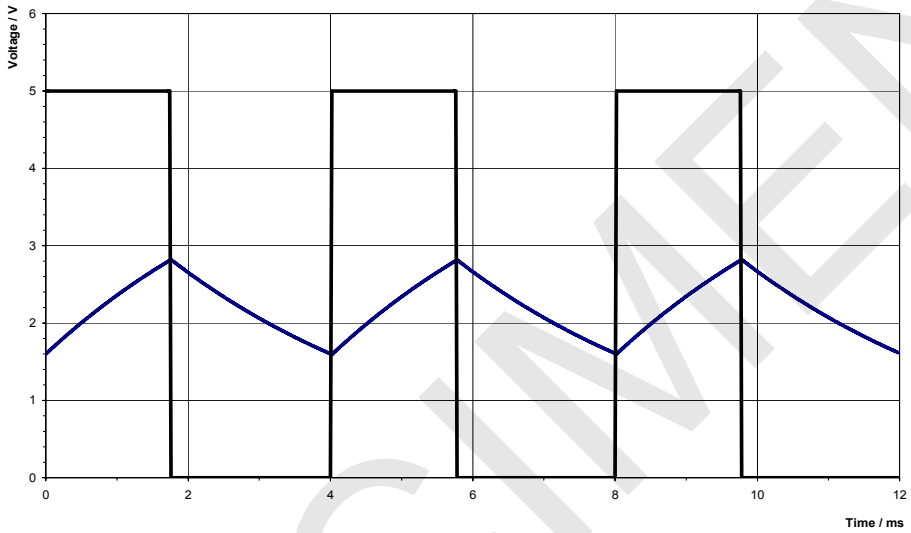
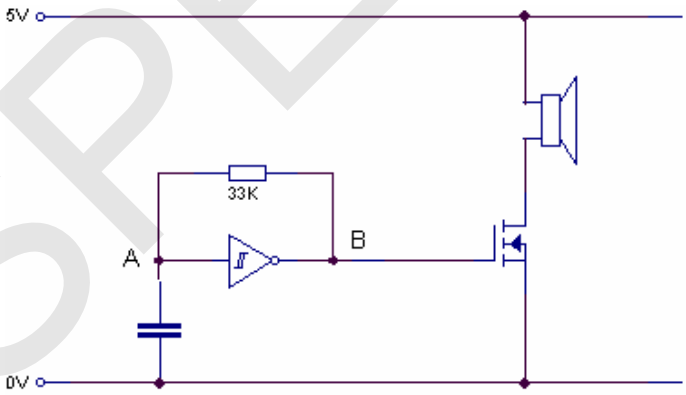
The maximum mark for this paper is **90**.

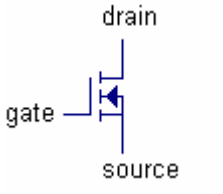
This document consists of **12** printed pages.

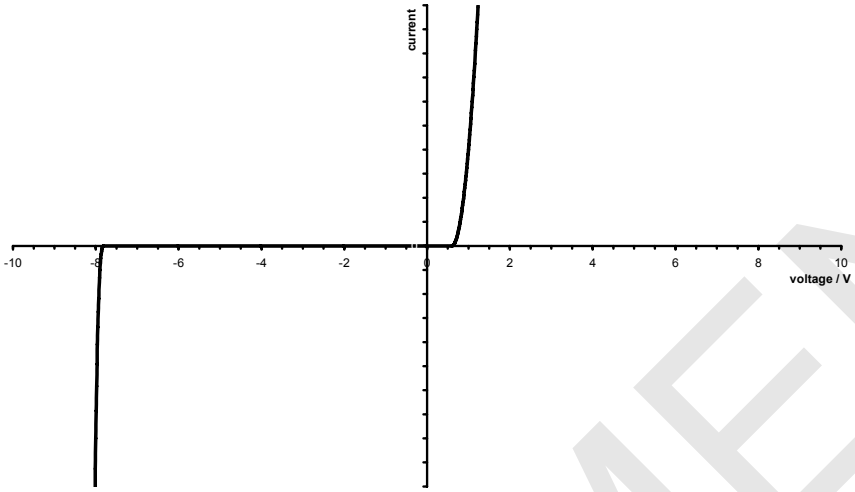
Question Number	Answer	Max Mark
1(a)(i)	<table><tr><th>A</th><th>C</th><th>P</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table>	
	correct logic 0	[1]
	correct logic 1	[1]
(ii)	$P = A \cdot C$	[1]
(b)(i)	<table><tr><th>A</th><th>B</th><th>G</th></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table>	
	correct logic 0	[1]
	correct logic 1	[1]
(ii)	$G = \overline{A + B}$	[1]
(c)(i)	$C = \overline{B}$	[1]
	$P = A \cdot \overline{B}$	
	$G = \overline{A + B}$ No marks here - already awarded for 1b	[1]
	$Q = \overline{(A + \overline{B}) + \overline{(A + B)}}$	[1]
(ii)	$Q = \overline{A \cdot \overline{B} + \overline{A} \cdot \overline{B}}$ (by de Morgan's theorem)	
	$Q = \overline{\overline{B} \cdot (A + \overline{A})}$ (by Redundancy)	[1]
	$Q = B$	[1]
	Accept alternatives: 1 mark per correct rule applied. Maximum 2 marks	

Question Number	Answer	Max Mark
2(a)	0.5/3.5	[1]
	=0.143A	[1]
	(0.143x1000)=143mA (correct conversion to mA)	[1]
(b)	$\frac{(15-3.5)}{0.143}$	[1]
		[1]
	=81 Ω ecf incorrect voltage	[1]
(c)	11.5×0.143 accept 150mA	[1]
	=1.64 W not answer in mW	[1]
(d)(i)	2W	[1]
(ii)	2W is <u>maximum</u> power, this the lowest value/smallest that will operate at 1.64W	[1]

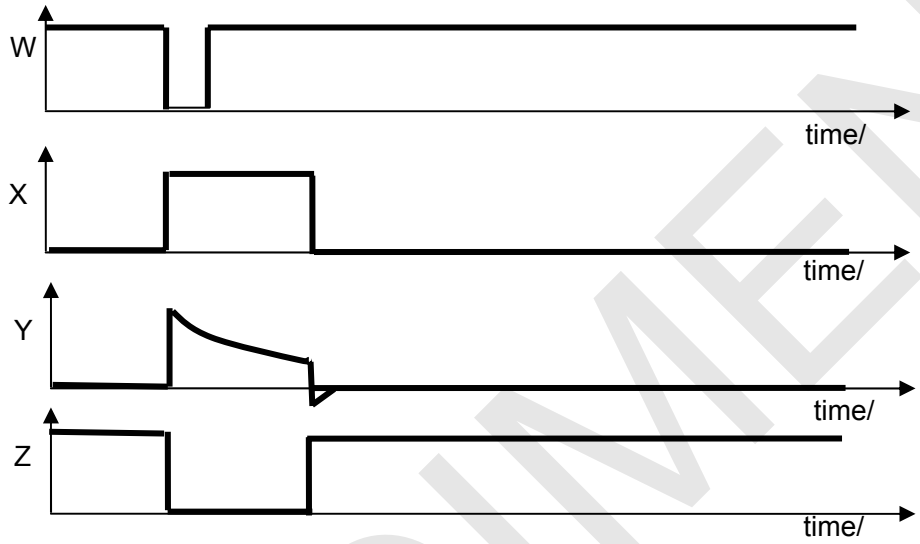
Question Number	Answer	Max Mark
3(a)	$E = \overline{C} \cdot D$	[1]
(b)	$M = \overline{K \cdot L}$	[1]
(c)	$H = \overline{\overline{F} + \overline{G}}$	[1]

Question Number	Answer	Max Mark
4(a)	1/270	[1]
	=0.0037s	[1]
	(0.0037 x 1000) = 3.7ms OR (4/1000) = 0.004s	[1]
(b)	C=0.004/33000 eor C=T/R	[1]
	=1.2 x 10^{-7}F	[1]
	=120nF	[1]
(c)		
	Square wave	[1]
	Oscillating between 0v and 5v	[1]
	In phase with A - changes at transition of A	[1]
	Phase correct	[1]
d(i)		[1]
	Correct symbol for speaker	[1]
	Correct symbol for MOSFET	[1]
	B connected to gate of MOSFET	[1]
	Speaker connected between supply and MOSFET	[1]
	Source of MOSFET connected to 0v	

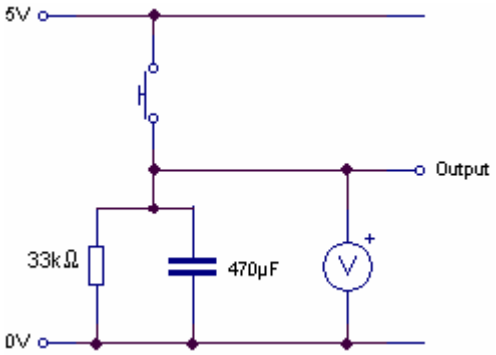
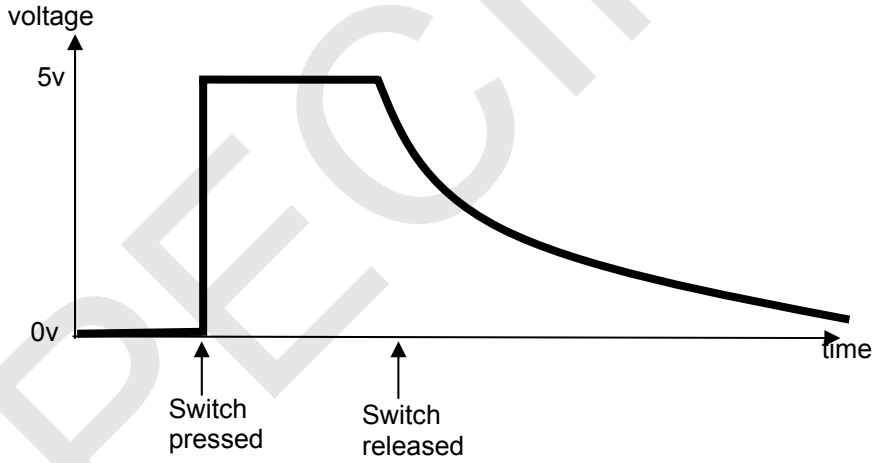
Question Number	Answer	Max Mark
(ii)		[1]
(iii)	Schmitt trigger cannot provide sufficient current to drive speaker wtte driver acts as current amplifier wtte	[1] [1]

Question Number	Answer	Max Mark
5(a)(i)		
	I = 0 between -8.2v and 0.7v	[1]
	I goes steeply negative at -8.2v	[1]
	I goes positive at ~0.7v	[1]
(ii)	zener is reverse biased so voltage positive	[1]
	voltage across R ensures *current is flowing through zener*	[1]
	zener conducts at 8.2v	[1]
(iii)	15 - 8.2 = 6.8v	[1]
(iv)	6.8/1500 (eor)	[1]
	= 4.5mA	[1]
(v)	4.5mA (ecf)	[1]
(b)(i)	15 x 22000 / (10000 + 22000) OR R=R1+R2 I=V/R etc	[1]
	= 10.3v	[1]

Question Number	Answer	Max Mark
(b)(ii)	1 mark for each of the following points: inverting input > non-inverting input output saturates low when output low LED reverse biased so no current flows through LED so LED will be off. This question is assessed for the 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.	[1] [1] [1] [1] [1] [3]

Question Number	Answer	Max Mark
6(a)	Monostable	[1]
(b)	R ≥ 10kΩ	[1]
	C = 2.5/(0.7 x R) eor	[1]
	0.7RC = 2.5s	[1]
(c)		
	X starts low then rises straight up at falling of W	[1]
	Y rises straight up at falling of W	[1]
	and then decays exponentially and then goes low at end of pulse	[1]
	Z low when Y high, Z high when Y low	[1]
	X inverse of Z	[1]
(d)	switch and resistor in series between powers supplies	[1]
	one end of switch connected to 0v	[1]
	mid point of switch and resistor connected to W	[1]

Question Number	Answer	Max Mark
7(a)	4squares	[1]
	x 2v/square	[1]
	= 8v	[1]
(b)	4squares	[1]
	x 5ms/square	[1]
	=20ms	[1]
(c)	f = 1 / 0.020 (eor)	[1]
	= 50Hz (0.05Hz [1 mark])	[1]

Question Number	Answer	Max Mark
8(a)	$33\times10^{3}\times470\times10^{-6}$ (eor)	[2]
(b)	0.7 x 15.5 = 10.8s (ecf)	[1]
(c)	 correct symbol and connections	[1]
(d)	0v until switch pressed	[1]
	sudden rise to 5v at switch pressed	[1]
	steady 5v from switch pressed until switch released	[1]
	exponential decay after switch released	[1]
		
	Paper Total	**[90]**

Assessment Objectives Grid (includes QWC)

Question	AO1	AO2	AO3	Total
1(a)(i)	2			2
1(a)(ii)	1			1
1(b)(i)	2			2
1(b)(ii)	1			1
1(c)(i)		3		3
1(c)(ii)		2		2
2(a)		3		3
2(b)		3		3
2(c)		2		2
2(d)	2			2
3(a)		1		1
3(b)		1		1
3(c)		1		1
4(a)	3			3
4(b)	1	2		3
4(c)	2	2		4
4(d)(i)		5		5
4(d)(ii)	1			1
4(d)(iii)	2			2
5(a)(i)	2	1		3
5(a)(ii)	3			3
5(a)(iii)		1		1
5(a)(iv)	2			2
5(a)(v)	1			1
5(b)(i)		2		2
5(b)(ii)	3	5		8
6(a)	1			1
6(b)		3		3
6(c)	5			5
6(d)	1	2		3
7(a)	2	1		3
7(b)	2	1		3
7(c)	1	1		2
8(a)	2			2
8(b)	1			1
8(c)		1		1
8(d)	1	3		4
Totals	**44**	**46**	**0**	**90**