OCR
RECOGNISING ACHIEVEMENT

Tuesday 15 May 2012 – Morning

AS GCE ELECTRONICS

F611 Simple Systems

F/6280/5061/2

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Scientific calculator

Duration: 1 hour 30 minutes

F 6 1 1

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **90**.
- You will be awarded marks for your Quality of Written Communication.
- You are advised to show all the steps in any calculations.
- This document consists of **16** pages. Any blank pages are indicated.

A scientific calculator may be used for this paper

Data Sheet

Assume, unless otherwise indicated, that:

- all op-amps operate from supply rails at +15V and –15V
- all logic gates operate from supply rails at +5V and 0V.

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	$T = 0.5RC$
frequency	$f = \frac{1}{T}$
Boolean Algebra	$A \cdot \overline{A} = 0$
	$A + \overline{A} = 1$
	$A \cdot (B + C) = A \cdot B + A \cdot C$
	$\overline{A \cdot B} = \overline{A} + \overline{B}$
	$\overline{A + B} = \overline{A} \cdot \overline{B}$
	$A + A \cdot B = A$
	$A \cdot B + \overline{A} \cdot C = A \cdot B + \overline{A} \cdot C + B \cdot C$

BLANK PAGE

TURN OVER FOR NEXT QUESTION

PLEASE DO NOT WRITE ON THIS PAGE

1 The system in Fig. 1.1 makes a warning light glow when a printer runs out of paper.

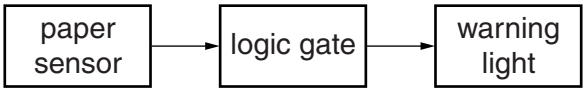


Fig. 1.1

(a) State the meaning of the arrows in Fig. 1.1.

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

(b) The warning light subsystem is built from a red LED and a resistor. The LED glows when there is a 5V output from the logic gate.

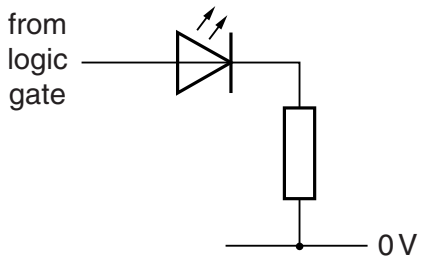


Fig. 1.2

(i) Explain why the resistor is needed in Fig. 1.2.

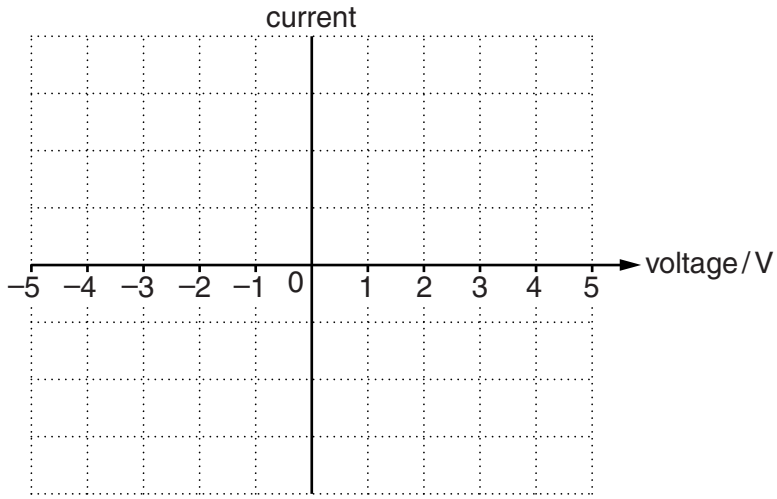
.....

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

(ii) Calculate the value of the resistor to make the LED operate at 2V, 1.5mA.

resistor value = ... Ω **[5]**

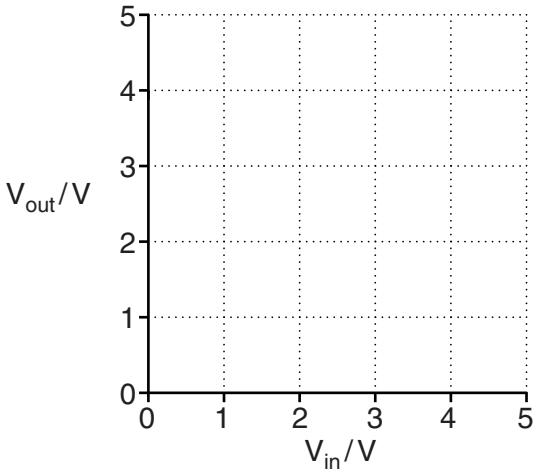
(iii) Draw a graph of the current against voltage for the LED.



[2]

(c) A NOT gate is used for the logic gate sub-system.

(i) Draw a graph to show how the output voltage of the NOT gate depends on the input voltage of the NOT gate.



[3]

(ii) The paper sensor outputs 3.9 V when there is paper in the printer and outputs 0.8 V when the printer has run out of paper. Explain why the NOT gate is suitable for the logic gate in the system.

.....

.....

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

[Total: 15]

2 A circuit used to turn on a warning light when a car engine gets too hot is shown in Fig. 2.1.

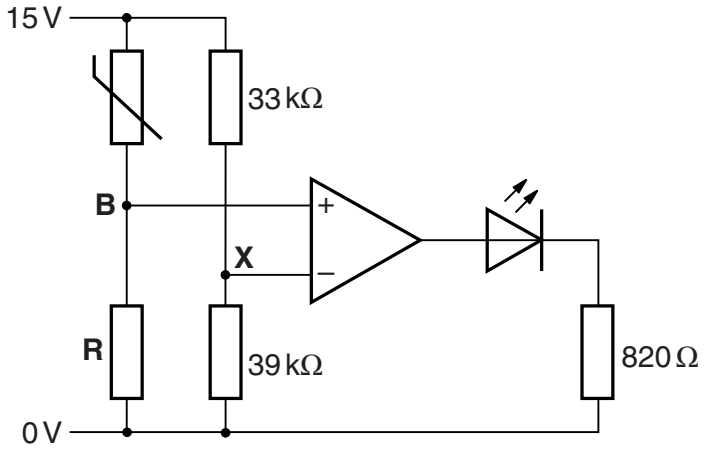


Fig. 2.1

(a) Put a ring around the thermistor in Fig. 2.1. **[1]**

(b) Describe the electrical characteristics of the thermistor.

.....

.....

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

(c) Do a calculation to show that the voltage at **X** is about 8 V.

[3]

(d) When the temperature of the engine is 70 °C the resistance of the thermistor is 2.1 kΩ and the voltage at **B** is 6 V. Calculate the value of **R**.

R = ... Ω **[4]**

(e) Explain the state of the LED when the temperature of the engine is 70 °C.

.....

.....

.....

.....

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

(f) Complete the circuit of Fig. 2.2 so that the LED turns on when it is dark outside. This warns the driver that the headlights should be on. You do not need to show component values in your circuit.

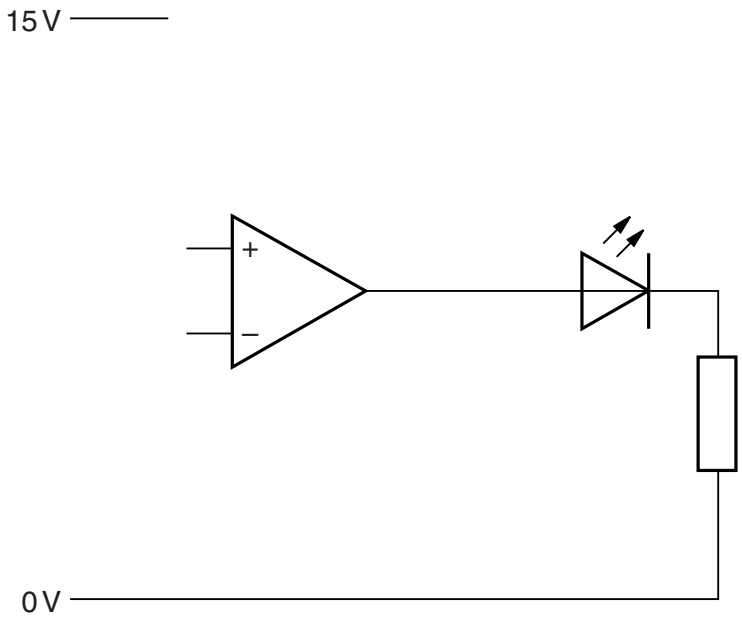


Fig. 2.2

[3]

[Total: 16]

3 Fig. 3.1 shows part of a logic system.

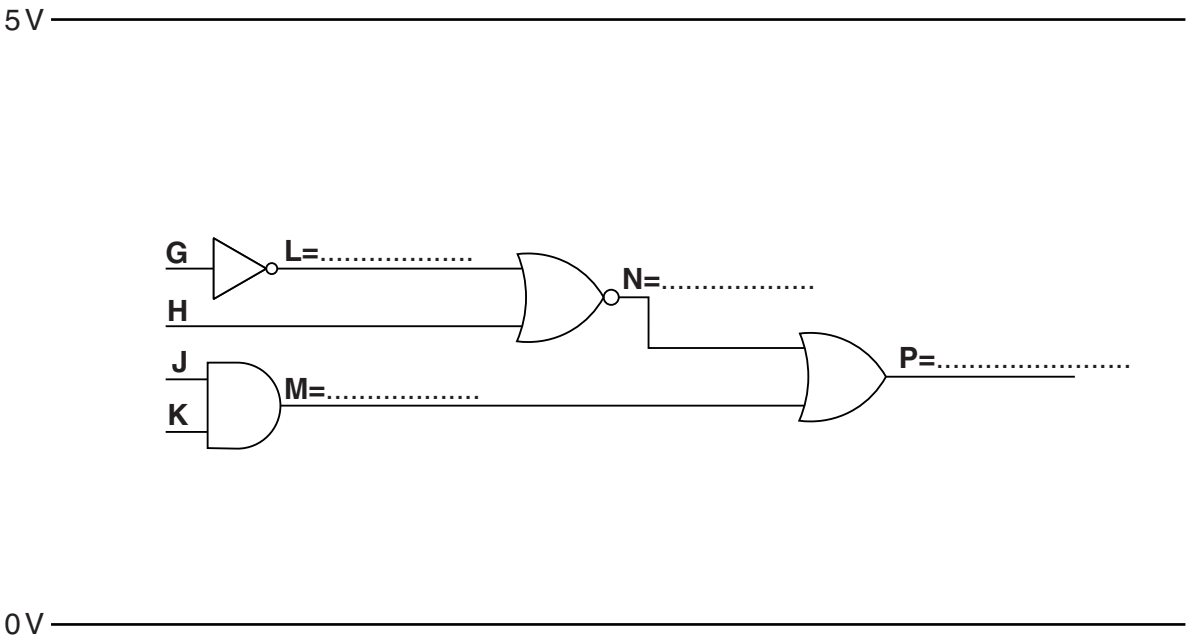


Fig. 3.1

(a) On Fig. 3.1 write the Boolean expression for the output of each gate using only the letters **G**, **H**, **J** and **K**. **[4]**

(b) Draw a switch and resistor on Fig. 3.1 to make the input **H** high when the switch is closed and to make the input low when the switch is open. **[2]**

[Total: 6]

4 Use the rules of Boolean algebra to join the expression in column 1 to the equivalent expression in column 2 with a line. One has already been done for you.

Column 1	**Column 2**
$X \cdot \overline{Y} + X \cdot Z$	$\overline{\overline{X} + \overline{Y}} + X \cdot Z$
$\overline{X} \cdot Y + X \cdot Z$	$\overline{X} \cdot (Y + Z)$
$\overline{X} \cdot Y + \overline{X} \cdot Z$	$\overline{X} \cdot Y + X \cdot Z + Y \cdot Z$
$X \cdot Y + X \cdot Z$	$\overline{\overline{X \cdot \overline{Y}}} + X \cdot Z$
$(X + Y) \cdot (\overline{X} + Z)$	$X \cdot Y + X \cdot Z + \overline{Y} \cdot Y$

[3]

[Total: 3]

5 An oscillator circuit is shown in Fig. 5.1.

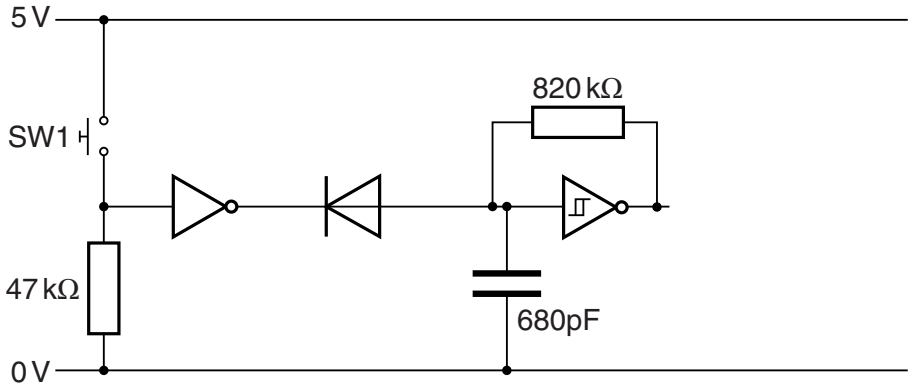


Fig. 5.1

(a) Draw on Fig. 5.1 to show how a MOSFET and speaker can be connected to produce a loud sound when the oscillator is operating. **[4]**

(b) Show that the period of the oscillator is about 300 μs.

[4]

(c) Calculate the frequency of the oscillator.

frequency = ...Hz **[2]**

(d) Fig. 5.2 shows the screen of an oscilloscope connected to the output of the oscillator.

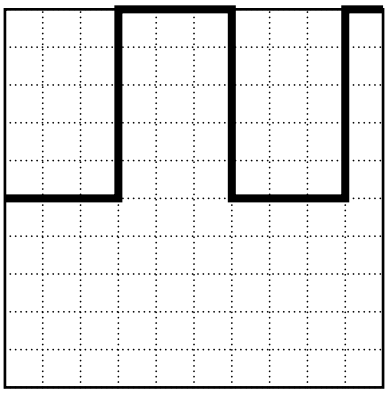


Fig. 5.2

(i) The output of the circuit oscillates between 0V and 5V. State the Y sensitivity of the oscilloscope.

Y sensitivity = ... V/div **[1]**

(ii) Put a ring around the value of the timebase being used on the oscilloscope in Fig. 5.2.

10 μs/div 20 μs/div 50 μs/div 100 μs/div 200 μs/div 500 μs/div

[1]

(iii) The oscilloscope is moved to measure how the voltage across the **capacitor** varies with time. Draw on Fig 5.1 to show how the oscilloscope should be connected to measure how the voltage across the **capacitor** varies with time. **[1]**

(iv) Draw on Fig. 5.2 to show how the voltage across the capacitor varies with time. The oscilloscope settings are not changed. **[3]**

(e) Explain why the circuit only makes a noise when the switch is released.

.....

.....

.....

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

[Total: 19]

6 The circuit of Fig. 6.1 contains a monostable.

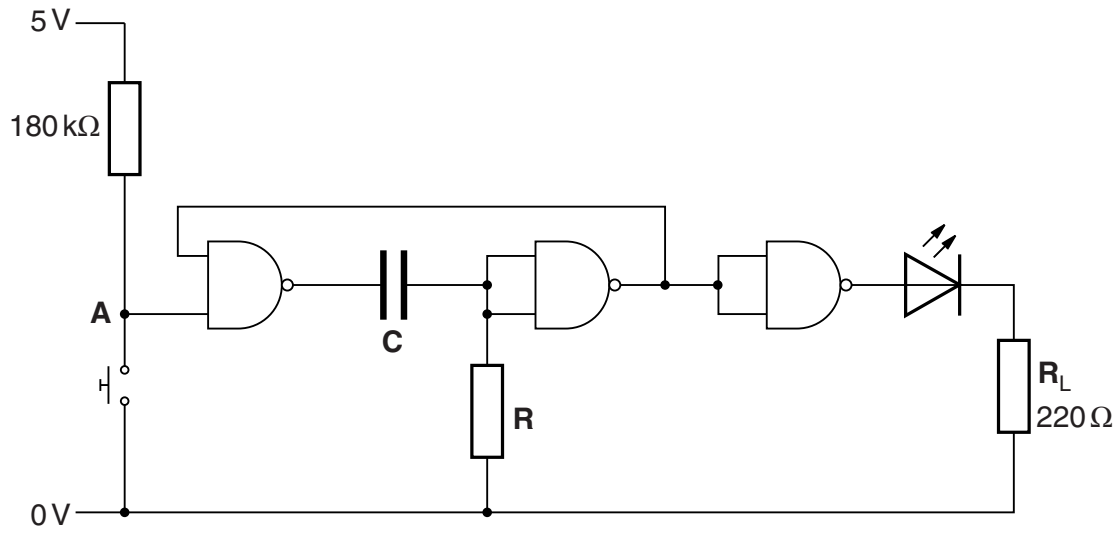


Fig. 6.1

(a) Calculate values of **R** and **C** to make the pulse length of the monostable 30s.

R = ...Ω **C** = ... F **[3]**

(b) State what happens to the LED in Fig. 6.1 when the switch is briefly pressed and released.

.....

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

(c) **(i)** Draw a voltmeter on Fig. 6.1 to measure the voltage at **A**. **[2]**

(ii) State the voltage at **A** when the switch is pressed.

Voltage at **A** = ...V **[1]**

(d) When the LED in Fig. 6.1 glows there is 1.2V across it. Show that the power dissipated in the resistor, $\mathbf{R_L}$, is about 70 mW.

[3]

(e) The table below shows a selection of resistors from an electronics catalogue.

	Resistance / Ω	**Maximum voltage / V**	**Maximum power / mW**	**Price**
A	180	100	100	£0.0029
B	220	100	100	£0.0029
C	180	50	63	£0.0022
D	220	50	63	£0.0022

(i) Choose the correct resistor for $\mathbf{R_L}$ from the table.

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

(ii) Explain your choice of $\mathbf{R_L}$.

.....

.....

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

[Total: 14]

7 Here is the truth table for a logic system.

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

(a) Write a Boolean expression for **R** in term of the inputs **C**, **D** and **E**. You do not need to simplify your expression.

.....

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

(b) Draw a logic circuit for the truth table. Label the inputs **C**, **D** and **E** and the output **R**. Use NOT, AND and OR gates.

[4]

[Total: 7]

8 The logic circuit of Fig. 8.1 controls the LED.

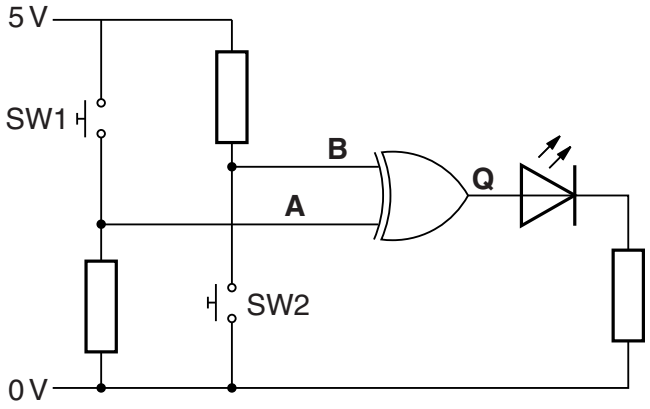


Fig. 8.1

(a) Name the logic gate in Fig. 8.1.

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

(b) Complete the truth table for the logic gate in Fig. 8.1.

A	B	Q

[2]

(c) (i) Give the state of the LED when both switches, SW1 and SW2, are open.

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

(ii) Explain your answer to **(c)(i)**.

.....

.....

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

[Total: 7]

Quality of Written Communication [3]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE