THIS IS A LEGACY SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

ELECTRONICS

Control Circuits

2530

Candidates answer on the question paper

OCR Supplied Materials:
- Microprocessor Instruction Set (inserted)

Other Materials Required:
- Calculator

Tuesday 9 June 2009
Afternoon

Duration: 1 hour 15 minutes

OCE/11023

2530

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

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 may assume, unless otherwise stated, that:
  - **(i)** the p.d. across a forward-biased silicon diode is 0.70 V,
  - **(ii)** the base-emitter p.d. for a conducting silicon transistor is 0.70 V,
  - **(iii)** the power supplies for operational amplifiers are +15 V and –15 V,
  - **(iv)** the saturation levels for operational amplifiers are +13 V and –13 V,
  - **(v)** logic 1 = 5 V and logic 0 = 0 V.
- The quality of written communication will be assessed in your answers to all the questions.
- **QUESTION 6 REQUIRES THE MICROPROCESSOR INSTRUCTION SET INCLUDED.**
- This document consists of **16** pages. Any blank pages are indicated.

A calculator may be used for this paper

Examiner's Use Only:			
1			
2			
3			
4			
5			
6			
QWC			
Total			

DCA (SM/TC) 11023/8

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1 By describing their similarities and differences, distinguish between the following terms in the context of microprocessor systems.

(a) RAM and ROM

.....

.....

.....

.....

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

(b) Byte and Word

.....

.....

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

(c) Data bus and Address bus

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.....

.....

.....

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

(d) Binary Coded Decimal and Hexadecimal

.....

.....

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

2 Fig. 2.1 shows a transmission system to allow two signal sources A and B access to a data line.

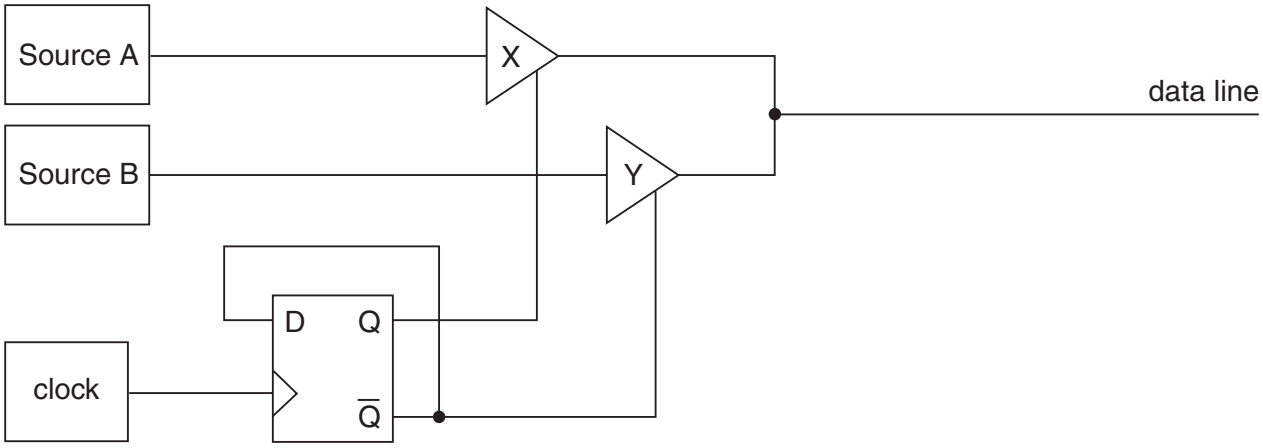

Fig. 2.1

(a) State the name of component X.

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

(b) Describe the behaviour of this component.

.....

.....

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

(c) State whether the sources A and B should be analogue or digital. Justify your answer.

.....

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

(d) Describe the behaviour of the D-type flip-flop as connected in this circuit.

.....

.....

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

(e) Explain how the transmission system operates.

.....

.....

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

3 Fig. 3.1 shows a circuit designed by a student to switch a lamp on or off under certain light conditions.

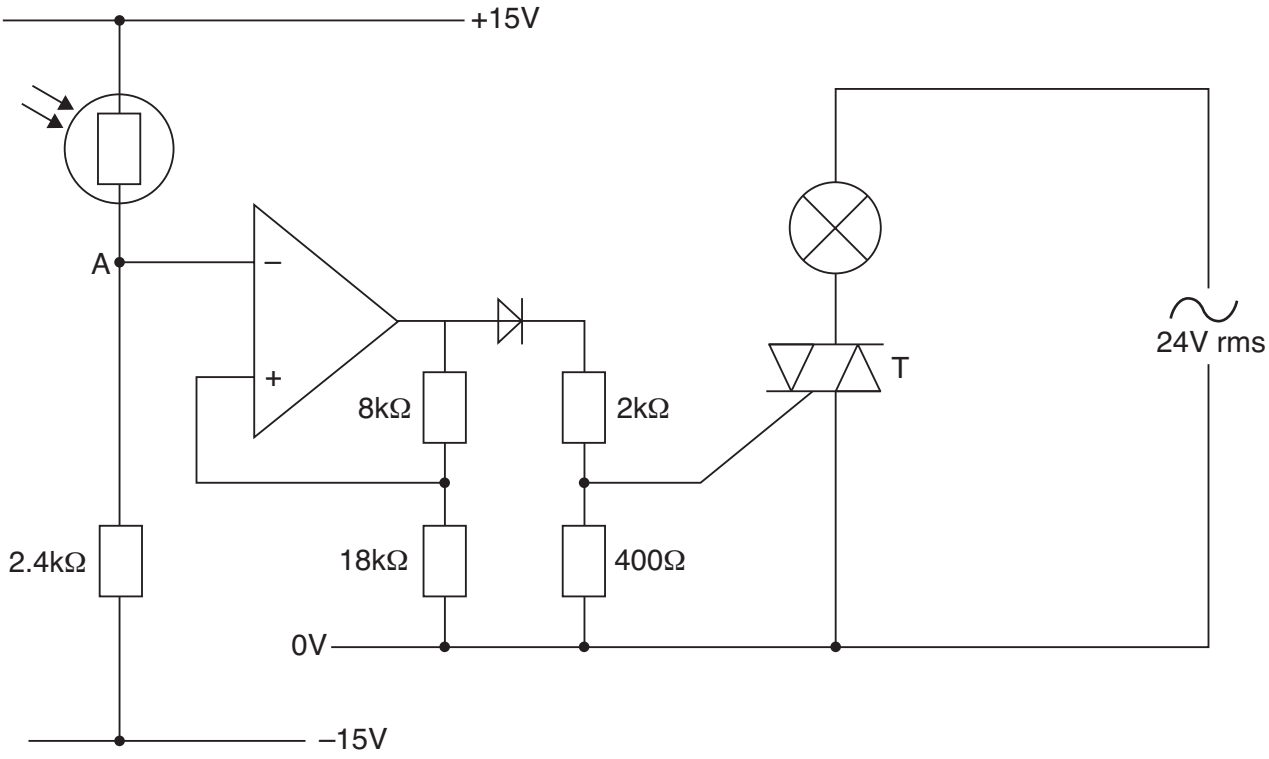

Fig. 3.1

(a) The circuit contains an LDR.

(i) Put an X next to this component. **[1]**

(ii) State what the letters LDR stand for.

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

(b) The op-amp is set up as an inverting Schmitt trigger.

(i) On the axes of Fig. 3.2, draw a sketch graph of the output/input characteristics of the Schmitt trigger.

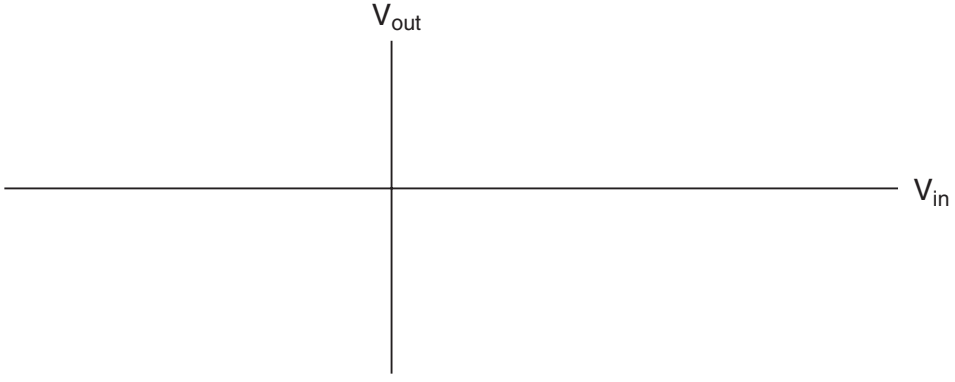

Fig. 3.2

[2]

(ii) Show that the switching thresholds for the Schmitt are ±9V.

[2]

(iii) Show that when the resistance of the LDR is 9.6kΩ the voltage at A is –9V.

[2]

(iv) Calculate the resistance of the LDR when the voltage at A is +9V.

resistance of LDR = ... Ω **[2]**

(c) The circuit of Fig. 3.1 contains a component labelled T.

(i) State the name of this component.

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

(ii) Calculate the voltage on the gate of this component when the Schmitt output is +13V.

gate voltage = ... V **[2]**

(d) The student found that without the diode the lamp remained on in all lighting conditions.

(i) Explain this observation.

.....

.....

.....

.....

.....

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

(ii) Explain how the circuit functions when the diode is in the circuit.

.....

.....

.....

.....

.....

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

(e) The lamp in the circuit is rated as 24V r.m.s. and 85W. Calculate the peak current in the component T.

peak current = ... A **[3]**

4 Fig. 4.1 shows a circuit set up to play a short and simple tune which has been digitised and stored in a memory.

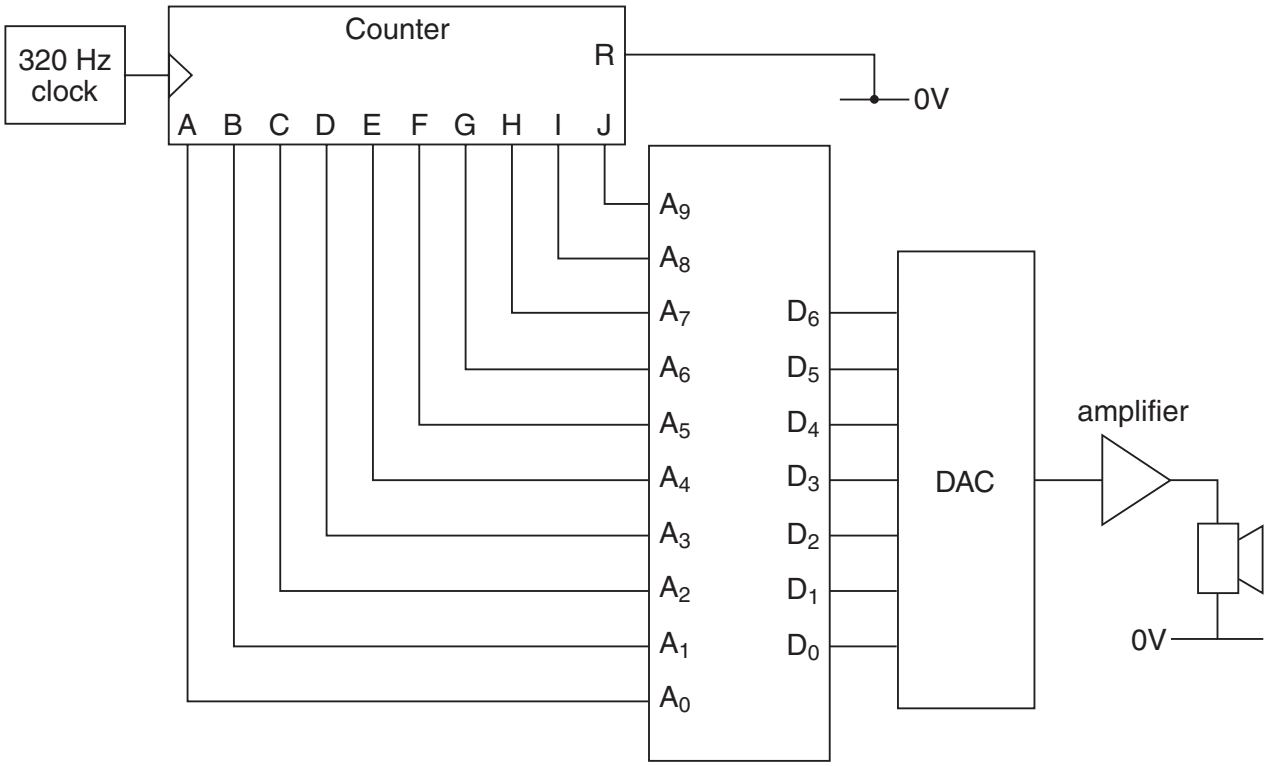

Fig. 4.1

(a) For the system of Fig. 4.1, calculate and show your working in each case:

(i) the total number of address locations inside the memory

number of addresses = ... **[2]**

(ii) the total number of memory cells inside the memory

number of cells = ... **[1]**

(iii) the maximum time for which a tune could last before repetition

maximum time = ... s **[2]**

(iv) the number of different voltage levels which the DAC can output to the loudspeaker

number of voltage levels = ... **[2]**

(v) the maximum frequency in the tune.

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

(b) Explain why the pin marked R has been connected to 0V.

.....

.....

.....

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

5 Fig. 5.1 shows a circuit designed to maintain a steady temperature in a box.

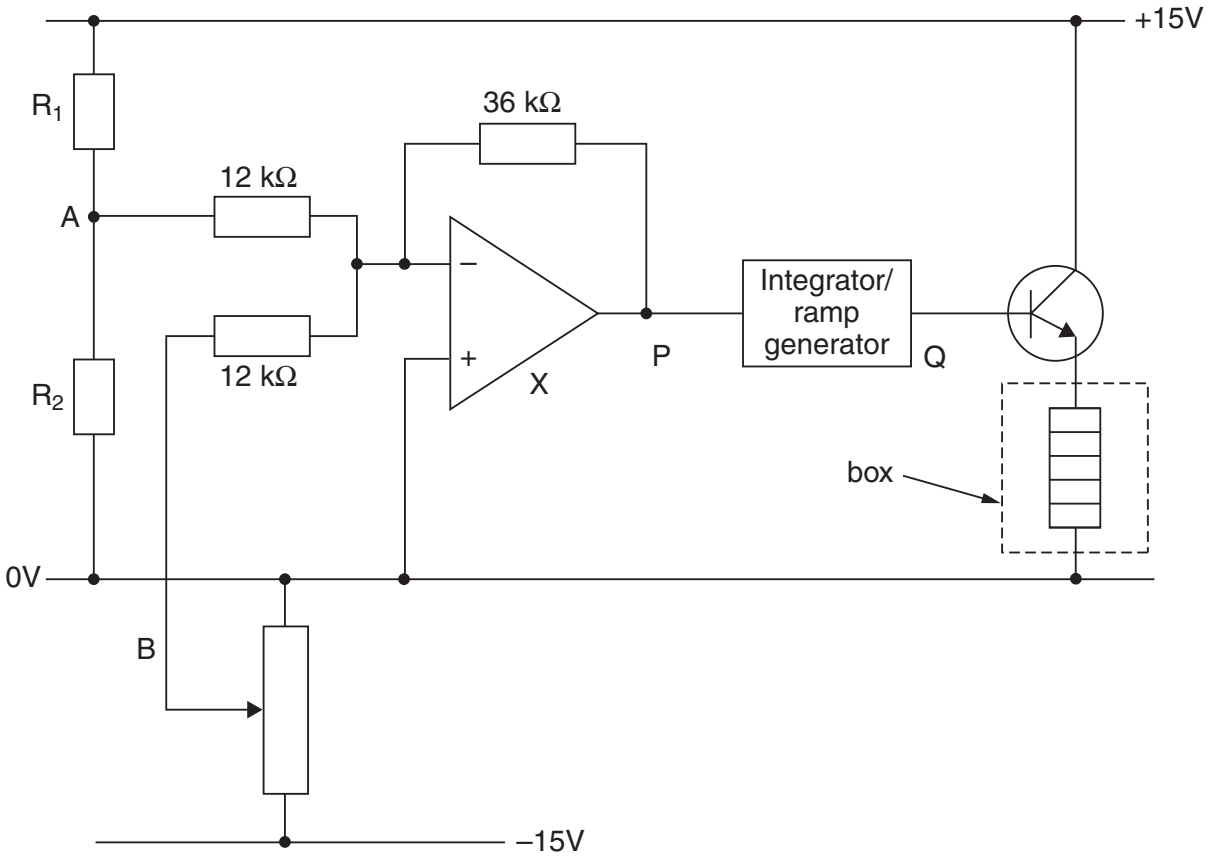

Fig. 5.1

(a) (i) State the name of the type of op-amp circuit in Fig. 5.1. Choose from:

Bass cut filter **Comparator** **Non-inverting amplifier** **Summing amplifier**

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

(ii) Write down a formula for the voltage **P** in terms of the voltages at **A** and **B**.

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

(iii) Explain why the voltage at B must be made negative.

.....

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

(b) (i) The circuit of Fig. 5.1 contains an integrator (sometimes called a ramp generator).
Draw the circuit of an integrator using the op-amp of Fig. 5.2.
You do not need to give component values but you should label the input and the output.

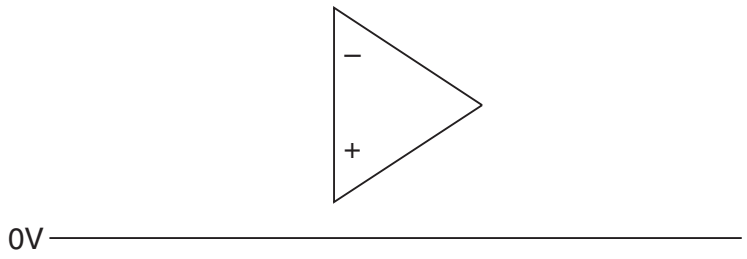

Fig. 5.2

[3]

(ii) Describe how the integrator output Q will respond when the input voltage P is made

a constant negative value .....

.....

.....

.....

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

(iii) State what the heater does when the integrator output voltage Q is

Positive .....

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

(c) The temperature of the box is sensed by a thermistor which is connected in series with a fixed resistor to form a potential divider. This arrangement is shown in R_1 and R_2 in Fig. 5.1.

(i) State and explain, by referring to the properties of the thermistor, which of the two resistors R_1 or R_2 should be the thermistor.

.....

.....

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

(ii) Explain how the circuit of Fig. 5.1 operates to keep a steady temperature.

.....

.....

.....

.....

..... **[4]**

6 Fig. 6.1 shows a microprocessor system designed to operate as a digitally controlled generator of saw-tooth waveforms.

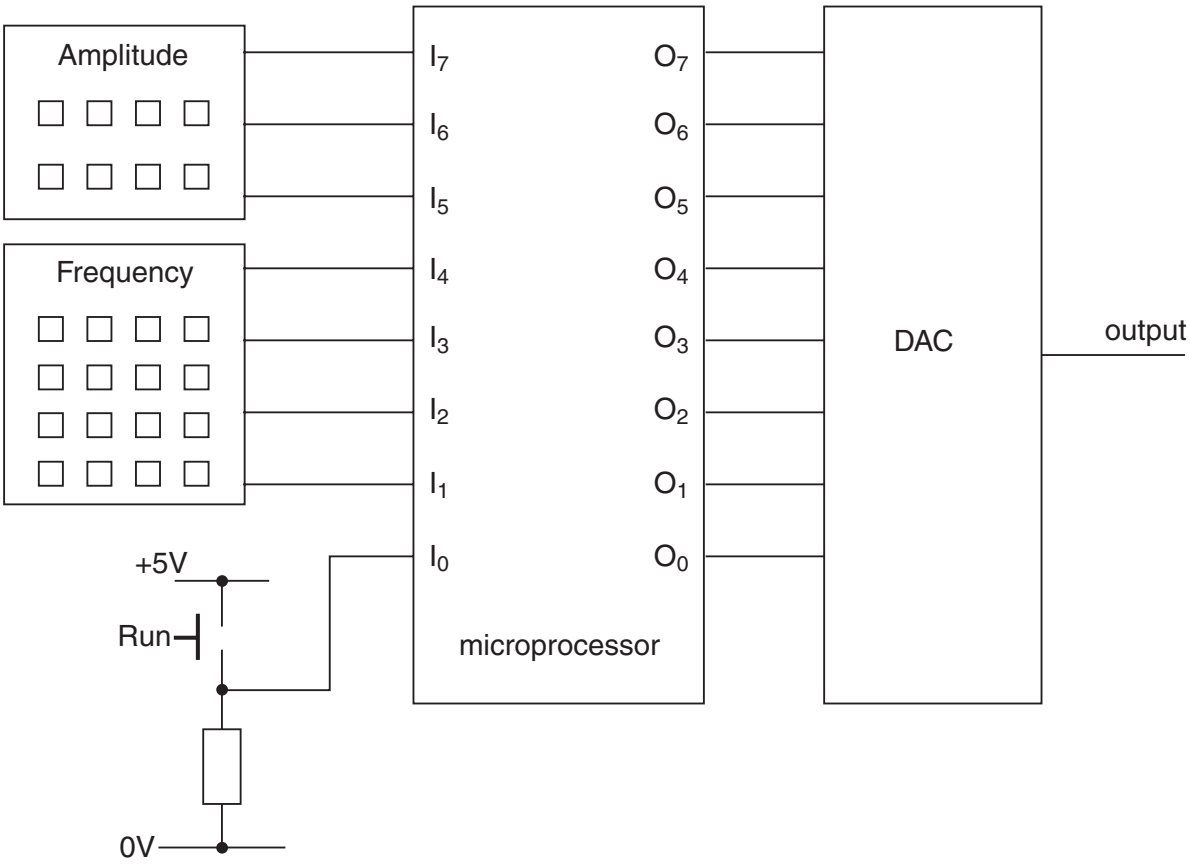

Fig. 6.1

The system of Fig. 6.1 is operated as follows:

The user presses one of the eight buttons on the amplitude keypad to produce one of eight possible amplitudes.

The user presses one of the sixteen buttons on the frequency keypad to produce one of sixteen possible frequencies.

The user then presses the Run button and, for as long as this is pressed, the DAC will output the saw-tooth waveform.

(a) The first part of the program to make the microprocessor operate in the required manner is shown below. Using the instruction set provided, explain the function of each section of program.

Address	Contents	Explanation
00	3A EF	.....
02	E6 E0	.....
04	C6 1F	.....
06	32 AA	.....
08	3A EF	.....
0A	E6 1E	.....
0C	C6 01	.....
0E	32 BB	.....

[6]

(b) The next part of the program should make the system test the Run button.
If it is pressed then the program should move to address 60.
If it is not pressed then the program should return to address 00.

In the space below, write out the appropriate coding. Include an explanation of each line.

Address	Contents	Explanation
10		.....
		.....
		.....
		.....
		.....
		.....
		.....
		.....
		.....
		.....

[5]

(c) The final part of the program enables the saw-tooth waveform to be produced.
Explain the function of each section of program.

Address	Contents	Explanation
60	3A AA	.....
62	32 CC	.....
64	3A CC	.....
66	32 FF	.....
68	D6 01	.....
6A	CA 10	.....
6C	32 CC	.....
6E	3A BB	.....
70	D6 01	.....
72	C2 70	.....
74	C3 64	.....

[8]

Quality of written communication [3]

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