Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
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5	
6	
7	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2009

Electronics ELEC2

Unit 2 Further Electronics

Monday 18 May 2009 9.00 am to 10.00 am

For this paper you must have:
- a pencil and ruler
- a calculator
- a Data Sheet as a loose insert.

Time allowed
- 1 hour

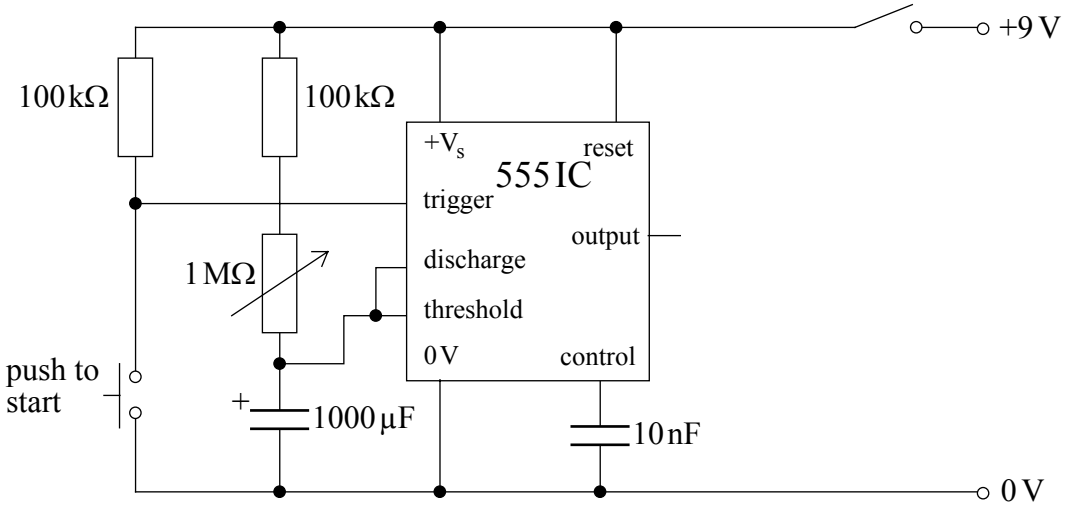
Instructions
- Use black ink or black ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- A Data Sheet is provided as a loose insert to this question paper.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 67.
- Any correct electronics solution will gain credit.

Answer **all** questions in the spaces provided.

1 A kitchen timer is made using a 555 monostable circuit. The time period is set by adjusting the 1 MΩ variable resistor. When the circuit is timing, an LED is lit and when the time period is completed, a buzzer sounds.

1 (a) Complete the circuit diagram of the kitchen timer by adding an LED, resistor and a buzzer.



(3 marks)

1 (b) Calculate the maximum time period of the timer.

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(3 marks)

1 (c) Describe how the circuit operates when the push to start switch is pressed.

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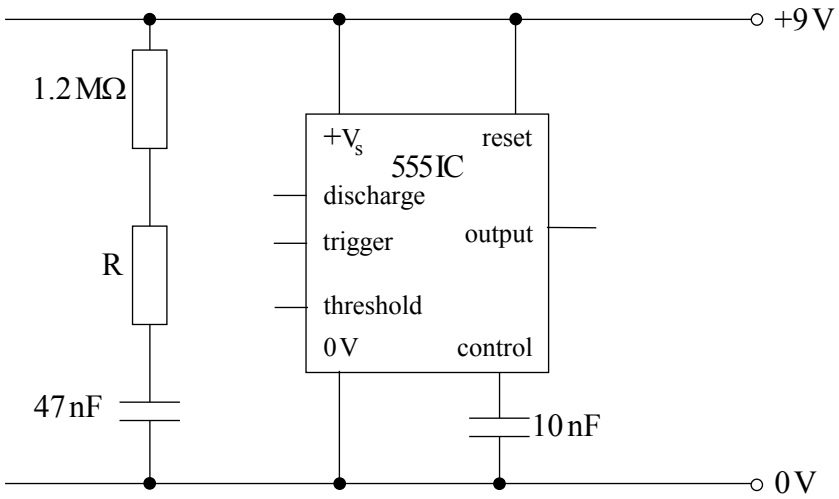
(3 marks)

9

2 An ultrasonic range finder module for the reversing assistance system on a car needs to be supplied with a 100 µs trigger pulse every 40 ms. A 555 astable is used to supply these pulses. The partly drawn circuit diagram of the 555 astable is shown below.

2 (a) Add the connections for the *trigger*, *threshold* and *discharge* inputs of the 555 IC.



(3 marks)

2 (b) Calculate a value for R which will make the output low for 100 µs.

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(3 marks)

2 (c) Show that the output will be high for approximately 40 ms.

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(2 marks)

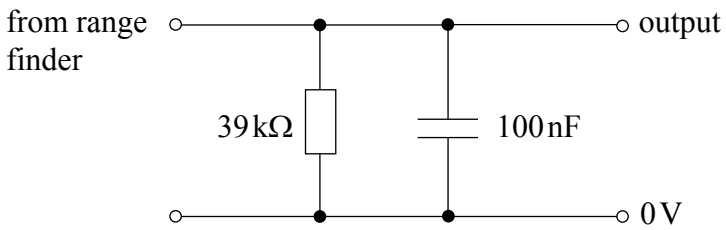
2 (d) The ultrasonic range finder requires 100 µs positive going pulses, but the 555 astable gives negative going pulses. Show, by adding to the circuit diagram in part (a), how the negative going pulses could be converted into positive going pulses.

(1 mark)

9

Turn over ▶

3 A range finder module for an 'ultrasonic tape measure' produces output pulses whose widths are dependent on the distance being measured. The range finder output is connected to the RC circuit below.



3 (a) Calculate the time constant for the RC circuit.

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(3 marks)

3 (b) The output of the circuit above is connected to a non-inverting op-amp amplifier with a voltage gain of +5.

3 (b) (i) Draw the circuit diagram of the non-inverting amplifier.

(3 marks)

3 (b) (ii) Give suitable values for the resistors so that the circuit has a voltage gain of +5.

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(2 marks)

3 (c) What property of an op-amp non-inverting amplifier makes it suitable for interfacing to the RC circuit?

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(1 mark)

9

4 A 4-bit modulo-10 counter is to be constructed from four rising edge triggered D-type flip-flops.

4 (a) Describe the operation of a rising edge triggered D-type flip-flop.

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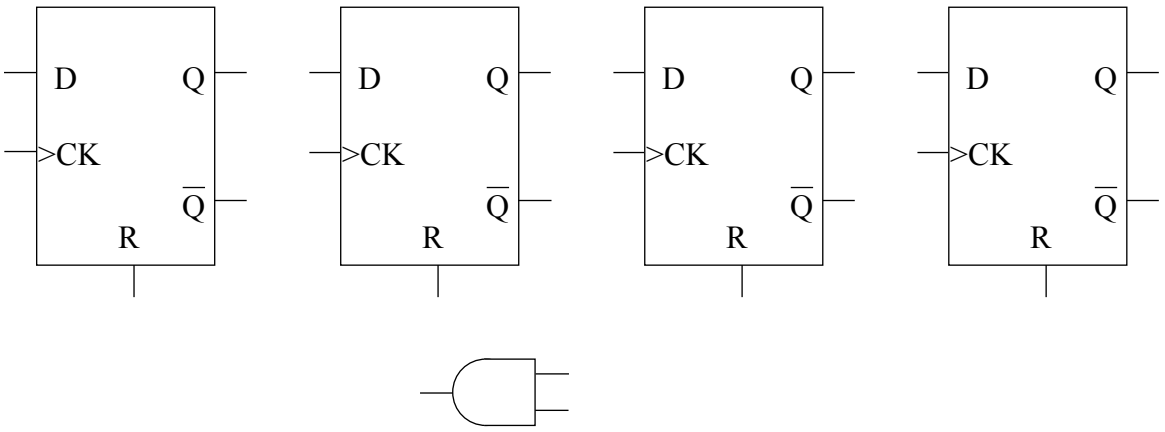
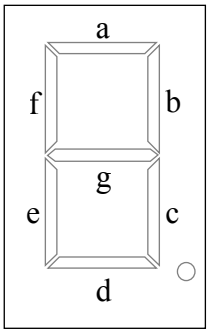
(2 marks)

4 (b) Complete the circuit diagram below for a modulo-10 counter.



(5 marks)

4 (c) The output from the counter is connected via a BCD decoder to a seven-segment display. Shade in the segments below on the seven-segment display to represent a binary output from the counter of 1001.

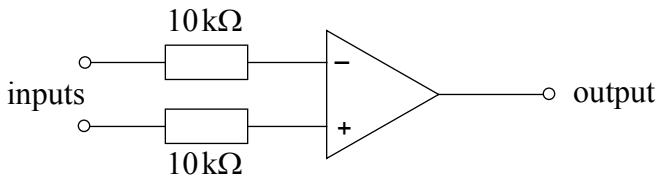


(2 marks)

9

Turn over ▸

5 (a) An op-amp difference amplifier has a voltage gain of 5. Complete the circuit diagram below for the difference amplifier by adding two resistors.



(3 marks)

5 (b) Calculate values for the two resistors to give a voltage gain of 5.

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(3 marks)

5 (c) A student connects the output of his MP3 player to the difference amplifier, the left channel being connected to one input and the right channel to the other.
He plays a track where the singer is recorded equally on both the left and right channels. When he listens to the output of the difference amplifier, he can hear the band but the singer is almost inaudible. Explain this effect.

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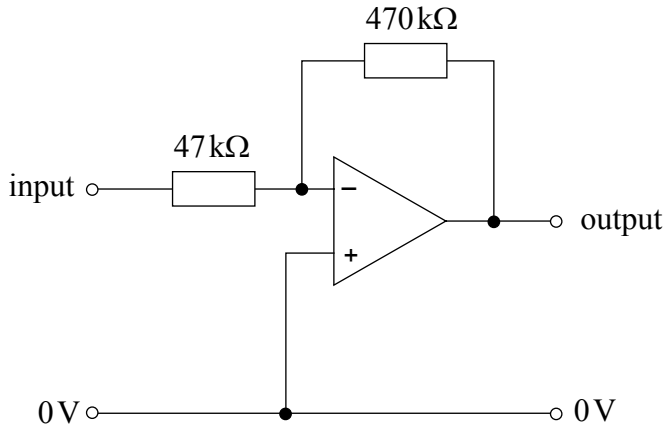
(3 marks)

9

6 (a) The circuit diagram below shows an op-amp amplifier designed to amplify the signal from a microphone so that it can be fed into the input of the sound card of a PC.



6 (a) (i) Clearly label the virtual earth point with the letter P. *(1 mark)*

6 (a) (ii) What is the input resistance of the amplifier circuit?

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(1 mark)

6 (a) (iii) Calculate the voltage gain of the amplifier circuit.

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(3 marks)

6 (b) Add a component to the circuit diagram in part (a) to convert it to a summing amplifier so that a second identical microphone could be connected to the circuit and the combined output of the microphones fed into the PC. Mark the value of the additional component on the diagram.

(3 marks)

6 (c) State the mathematical relationship between the two microphone signals and the output signal.

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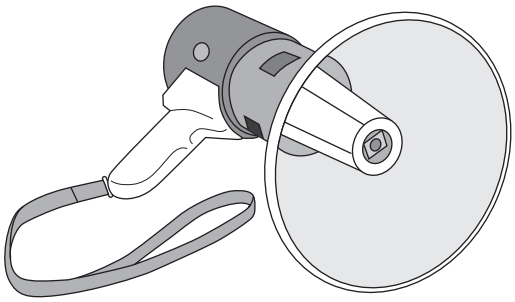
(1 mark)

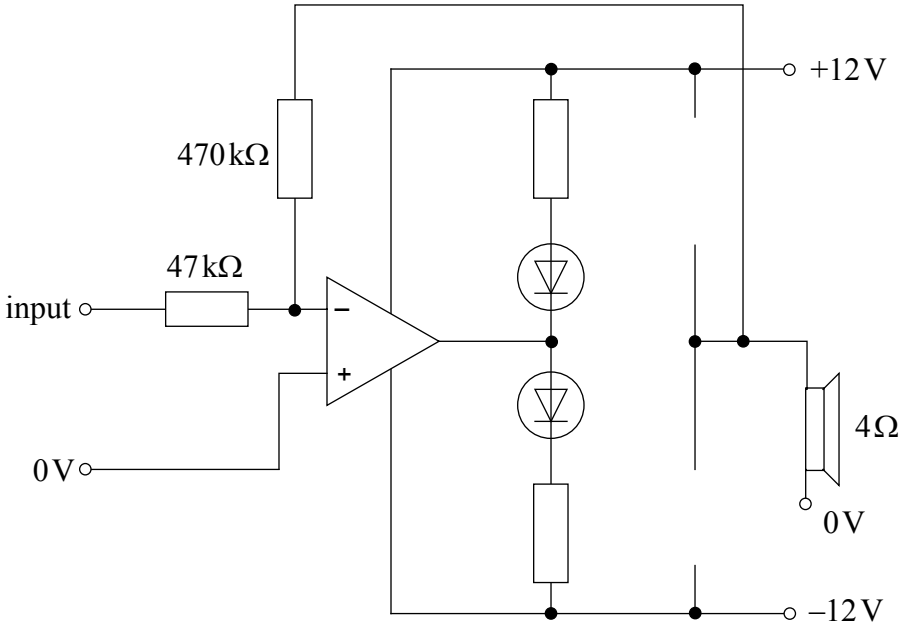
9

Turn over ▸

7 To convey instructions to his players during training, the coach of a local football team asks an electronics student to make a megaphone similar to the one shown in the picture below.



7 (a) The student starts by building a power amplifier that he had studied but cannot remember how the output MOSFETs are connected. Complete the circuit diagram below by adding the output MOSFETs.



(3 marks)

7 (b) *Cross-over distortion* is common with this type of circuit.

7 (b) (i) What is meant by cross-over distortion?

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(2 marks)

7 (b) (ii) Give **two** ways in which cross-over distortion has been reduced in the circuit in part (a).

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(2 marks)

7 (c) Calculate the theoretical maximum power output from this circuit.

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(3 marks)

7 (d) Give **three** reasons why the actual maximum power output will be less than the value calculated in part (c).

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(3 marks)

13

END OF QUESTIONS

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