Surname		Other Names	
Centre Number			Candidate Number								
Candidate Signature											

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General Certificate of Education
June 2004
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

ELECTRONICS ELE1
Unit 1 Foundation Electronics

Wednesday 26 May 2004 Morning Session

In addition to this paper you will require:
- a calculator;
- a pencil and a ruler.

Time allowed: 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen. Use pencil for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.
- A *Data Sheet* is provided on pages 3 and 4. Detach this perforated sheet at the start of the examination.

Information
- The maximum mark for this paper is 72.
- Mark allocations are shown in brackets.
- Any correct electronics solution will gain credit.
- The paper carries 30% of the total marks for Electronics Advanced Subsidiary and 15% of the total marks for Electronics Advanced Level awards.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Data Sheet

- A perforated *Data Sheet* is provided on pages 3 and 4 of this question paper.
- This sheet may be useful for answering some of the questions in the examination.
- Detach this perforated sheet at the start of the examination.

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

1 The Boolean equation for a logic circuit with inputs A and B and output Q is

$$\mathbf{Q = (A + B) \ . \ (\overline{A \ . \ B})}$$

(a) Complete the diagram below to show how this logic circuit can be constructed from one 2-input OR gate, one 2-input NAND gate and one 2-input AND gate.

(5 marks)

(b) Label the **two** intermediate points in the diagram above as C and D.
Complete the truth table to show the logic values of C, D and Q.

A	B	C	D	Q
0	0			
0	1			
1	0			
1	1			

(4 marks)

(c) State what single logic function the complete circuit provides.

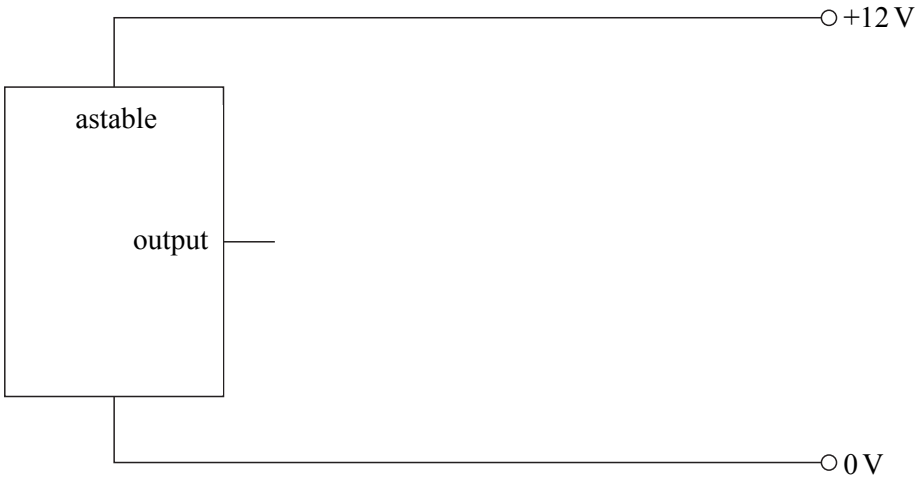
.....

(1 mark)

10

2 An LED and its series resistor are connected to the output of an astable circuit. The LED lights when the output goes high.

(a) Complete the circuit diagram below to show the LED and resistor.



(3 marks)

(b) The LED has a forward voltage drop of 3.6 V at 20 mA.

(i) Calculate the voltage across the resistor under these conditions.

.....

(ii) What function does the resistor have in this circuit?

.....

(iii) Calculate the value of resistance required.

.....

.....

(iv) Which preferred value should be chosen for this resistor if the 20 mA current is a maximum and should **not** be exceeded?

.....

(v) Give the complete colour code for your chosen preferred value if it has a tolerance of 5%.

.....

(vi) Calculate the power dissipated by the resistor in this circuit. Use the original resistor value given by the calculation in part (b)(iii).

.....

.....

(vii) Resistors having the following power ratings are available. Choose the smallest rating that will **not** overheat in this application. Circle the correct answer.

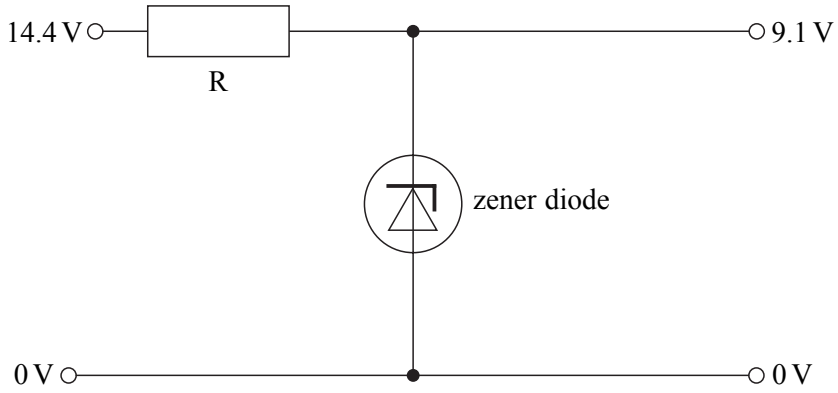
$\frac{1}{10}$ W $\frac{1}{8}$ W $\frac{1}{4}$ W $\frac{1}{3}$ W $\frac{1}{2}$ W

(10 marks)

13

TURN OVER FOR THE NEXT QUESTION

3 The power supply shown below gives a regulated output voltage of 9.1 V from an input voltage of 14.4 V.



(a) (i) What property of the zener diode enables it to perform the function of a voltage regulator?

.....

.....

.....

(ii) The zener diode must conduct a minimum of 10 mA at all times in this circuit. Why is this?

.....

.....

(4 marks)

(b) The maximum power supply output current is 250 mA.

(i) What is the total current flowing through the resistor R when the output current is 250 mA?

.....

(ii) Calculate the voltage drop across R.

.....

(iii) Calculate the value of R under these conditions.

.....

.....

(6 marks)

(c) The output current from this power supply falls to zero, but the input voltage is still present.

(i) What is the current now flowing through the zener diode?

.....

(ii) Calculate the power dissipated by the zener diode in this situation.

.....

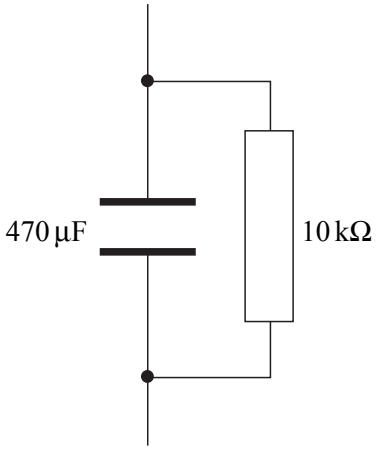
.....

(3 marks)

13

TURN OVER FOR THE NEXT QUESTION

4 A capacitor in a power supply unit has a resistor connected in parallel with it to discharge the capacitor when the power supply is switched off.



(a) Calculate the time constant of the circuit.

.....

(2 marks)

(b) Calculate the time for the capacitor to discharge to half the power supply voltage.

.....

(2 marks)

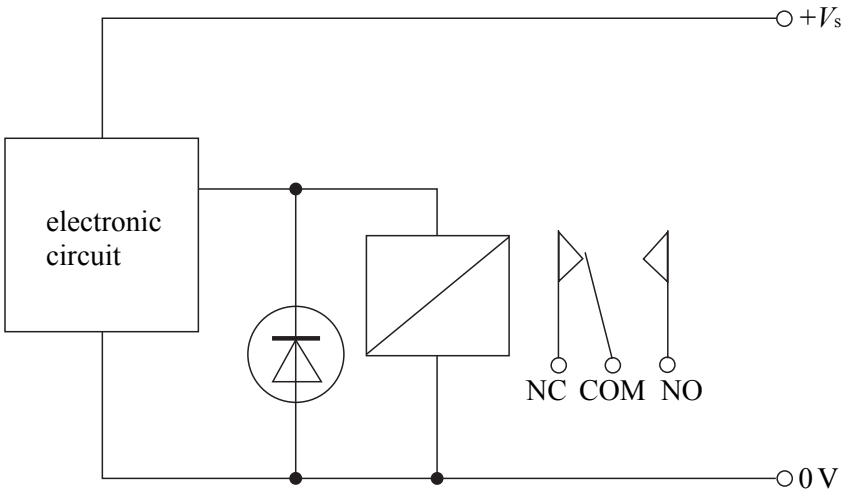
(c) After what time will the capacitor have almost completely discharged?

.....

(2 marks)

6

5 The circuit below shows a relay connected to the output of an electronic circuit.



(a) What is the purpose of the diode?

.....

.....

(1 mark)

(b) What does NC stand for?

.....

(1 mark)

(c) What does NO stand for?

.....

(1 mark)

(d) Describe what happens to the COM (common) contact of the relay when current starts to flow through its coil.

.....

.....

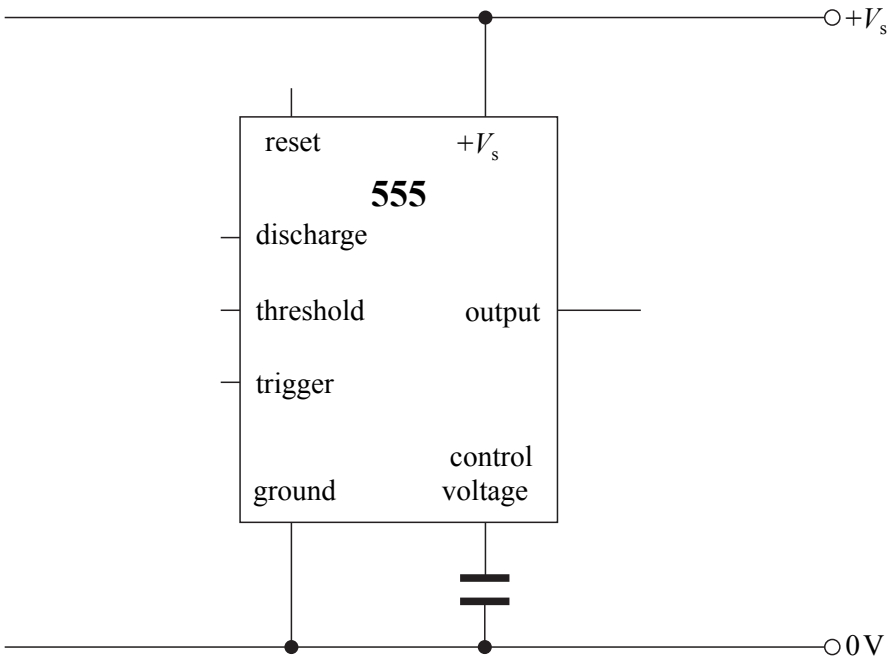
(2 marks)

5

6 A circuit is designed to switch a lamp on for a set time when the light level falls below a certain value.

(a) A 555 monostable circuit is used to produce an output of a set duration.

(i) Complete the diagram of the monostable below, by adding the timing resistor, R, and capacitor, C, and any more links required.



(ii) The timing resistor, R, is 2.2 MΩ and the capacitor, C, is 470 µF. Calculate the duration of the output pulse.

.....

.....

(6 marks)

(b) (i) The voltage level on the trigger input falls below $\frac{1}{3}V_s$. What happens to the monostable?

.....

.....

(ii) How does the LDR's resistance change as the light level decreases?

.....

(iii) On the circuit diagram in part (a)(i), draw a voltage divider circuit containing an LDR that would give an output voltage that decreases as it gets darker. Label the components and show the output signal connected to the timer.

(iv) The LDR has a resistance of 200 kΩ at the triggering light level. Calculate the value of the fixed resistor required to give a voltage of $\frac{1}{3}V_s$ at the trigger input of the 555 timer.

.....

.....

(8 marks)

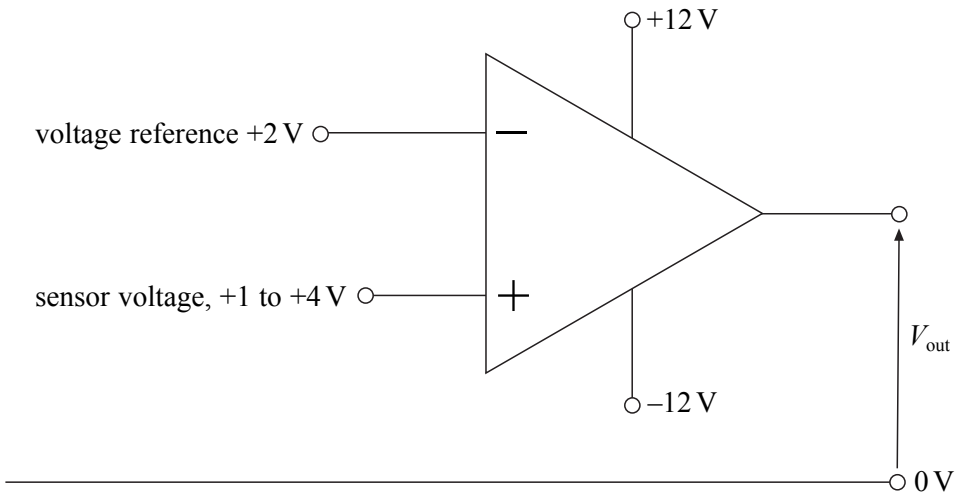
(c) A 555 output can only provide a current of 200 mA. The lamp requires a current of 1.75 A. Draw on the circuit diagram in part (a)(i) a solid state electronic device that will control the lamp from the output of the 555 timer. Label any components used and draw in the lamp.

(4 marks)

18

TURN OVER FOR THE NEXT QUESTION

7 An op-amp is used as a comparator.



(a) The op-amp is powered from a ±12 V power supply.

(i) State the output voltage from an ideal op-amp when the sensor voltage is +1.5 V.

.....

(ii) State the output voltage from an ideal op-amp when the sensor voltage rises to +2.5 V.

.....

(iii) In a real op-amp the output voltages are unlikely to reach either of the power supply voltages. Why is this?

.....

(5 marks)

(b) Describe how the op-amp is able to act as a comparator.

.....

.....

.....

(2 marks)

7

END OF QUESTIONS

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