



**GENERAL CERTIFICATE OF SECONDARY EDUCATION**  
**DESIGN AND TECHNOLOGY**  
**ELECTRONICS AND CONTROL SYSTEMS**

**A514/01**

Technical aspects of designing and making  
 Electronics

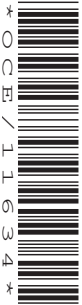
**Tuesday 26 January 2010**  
**Morning**

**Duration: 1 hour 15 minutes**

Candidates answer on the Question Paper

**OCR Supplied Materials:**  
 None

**Other Materials Required:**  
 • A calculator may be used



Candidate Forename		Candidate Surname	
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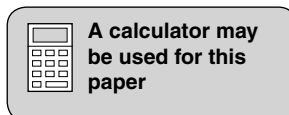
Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- 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.
- Show all your working out for calculations.

**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 **60**.
- Marks will be awarded for the use of correct conventions.
- Your Quality of Written Communication is assessed in questions marked with an asterisk (\*).
- Dimensions are in millimetres unless stated otherwise.
- This document consists of **16** pages. Any blank pages are indicated.



**Section A**

Answer **all** questions.

1 Fig. 1 shows a battery operated radio with the following features:

- a combined on / off and volume control switch;
- a filament bulb operating when the 'light' button is pressed;
- a scan button to tune to a different radio station each time the button is pressed;
- a reset button to return to the start of the frequency range when the button is pressed;
- a power indicator LED;
- sound through speaker or earphones.



**Fig. 1**

(a) (i) The scan, reset and light buttons all use the same type of switch.

Choose the most suitable type of switch from the list below.

- microswitch      push to make      toggle      rocker**

..... [1]

(ii) The circuit symbol for the volume control is shown in Fig. 2.

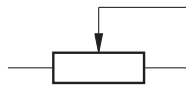


Fig. 2

Give the name for the component used.

..... [1]

(b) (i) Power consumption could be reduced by using a white LED instead of a filament bulb as the light source.

Give **one** other reason why an LED may be a better choice.

..... [1]

(ii) In the box below draw the symbol for a component used to limit current in an LED.

[1]

(c) Fig. 1 shows that the designer of the radio has considered ergonomics.

Give **two** features which support this statement.

1 ..... [1]

2 ..... [1]



2 (a) A potential divider circuit to provide input for a temperature sensor unit is shown in Fig. 5.

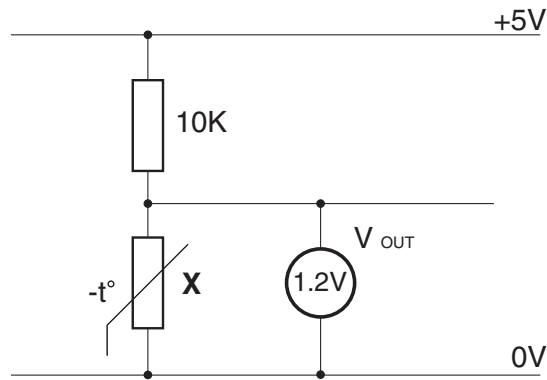


Fig. 5

(i) Describe the change in component X when the temperature rises.

..... [1]

(ii) Calculate the resistance in component X.

Use the formula  $V_{out} = \frac{R2}{R1 + R2} \times \text{supply voltage}$ .

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

(b) The voltage from the potential divider is input to an analogue to digital converter pin on a PIC IC.

Explain the process of analogue to digital conversion.

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

- (c) Many ICs including the PIC are stored in materials that will protect against static electricity as shown in Fig. 6.

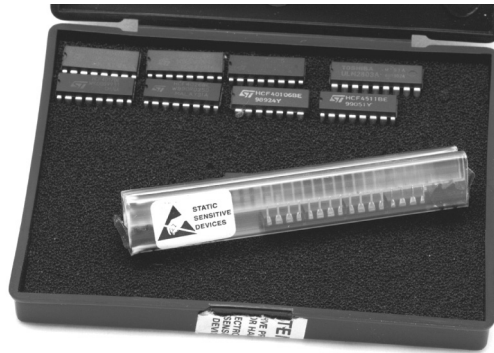


Fig. 6

- (i) Give **one** likely cause of static electricity when working with ICs.  
 ..... [1]
- (ii) Give **one** method of preventing damage from static electricity when handling an IC.  
 ..... [1]

- (d) Fig. 7 shows part of the temperature sensor PCB ready for soldering.

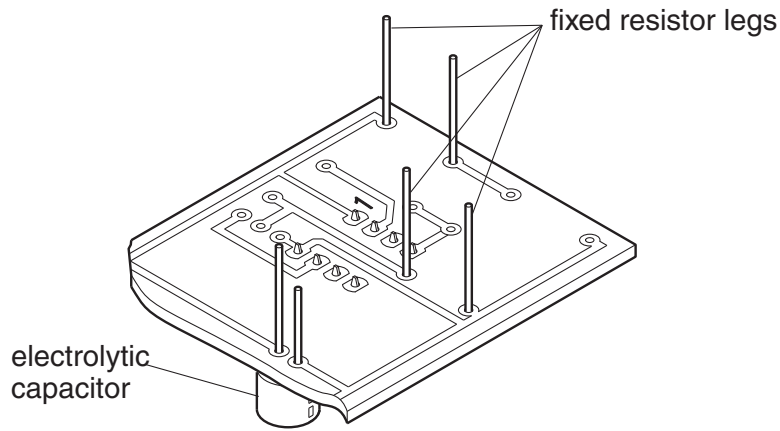
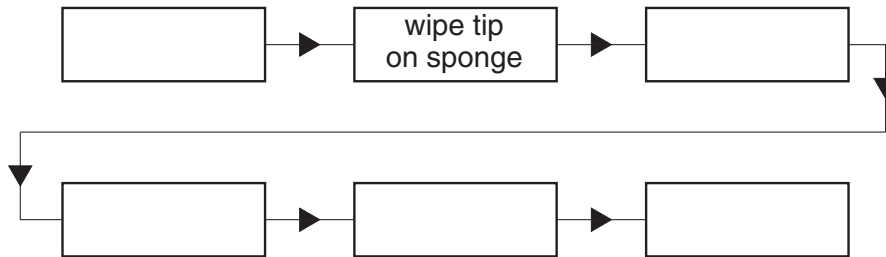


Fig. 7

- (i) State **two** checks that should be carried out before soldering the components shown.  
 Check 1 ..... [1]  
 Check 2 ..... [1]

- (ii) Complete the block diagram below to show the stages of soldering in the correct order. One stage has been completed for you.

**tin the iron**                      **wipe tip on sponge**                      **feed in solder**  
**allow iron to heat**                      **allow heat to conduct**                      **place iron on joint**



[2]

[Total: 12]

3 (a) Fig. 8 shows two examples of logic systems made from simple switches.

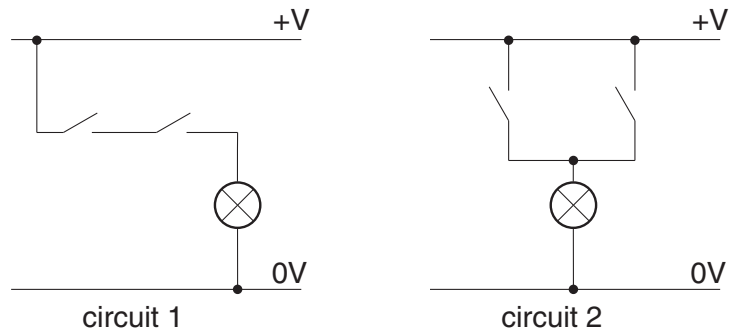


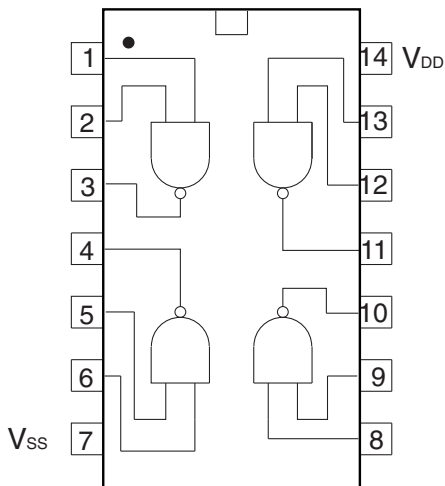
Fig. 8

(i) Name the type of logic used in each circuit.

Circuit 1 ..... [1]

Circuit 2 ..... [1]

(ii) Symbols are used to show logic gates in a circuit.



A	B	Q
0	0	
0	1	
1	0	
1	1	

Fig. 9

Describe the logic IC shown in Fig. 9.

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

(iii) Complete the truth table for one of the logic gates in Fig. 9. [1]



(b) The table below gives facts about the two main types of IC used in logic systems.

	TTL	CMOS
power supply	5V	3-15V
current	mA	$\mu$ A
static sensitive	no	yes
switching speed	10ns	300ns
fan out	10	50
logic high	2 - 5V	3.5 - 5V (5V supply)
logic low	0 - 0.8V	0 - 1.5V (5V supply)
unused inputs	can float	must be tied

Explain why CMOS is often preferred to TTL for small, portable projects.

.....

.....

..... [2]

(c) Inputs to a CMOS logic IC must not be allowed to float.

Complete Fig. 10 to show input **B** connected **low** through a resistor and **high** through a switch.

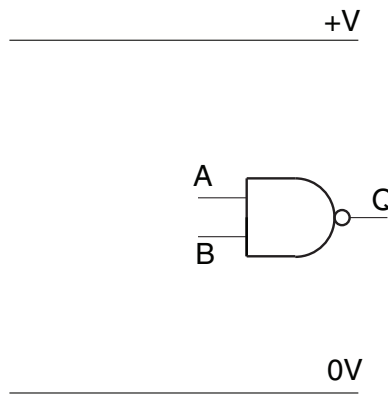


Fig. 10 [2]

(d) When testing a circuit it is sometimes necessary to know the voltage level at a pin on an IC.

Give **one** method of displaying the voltage level at a logic IC input.

..... [1]

(e) CAD simulation software allows circuits to be tested before using real components.

Give **two** benefits of using simulation software not relating to cost.

1 ..... [1]

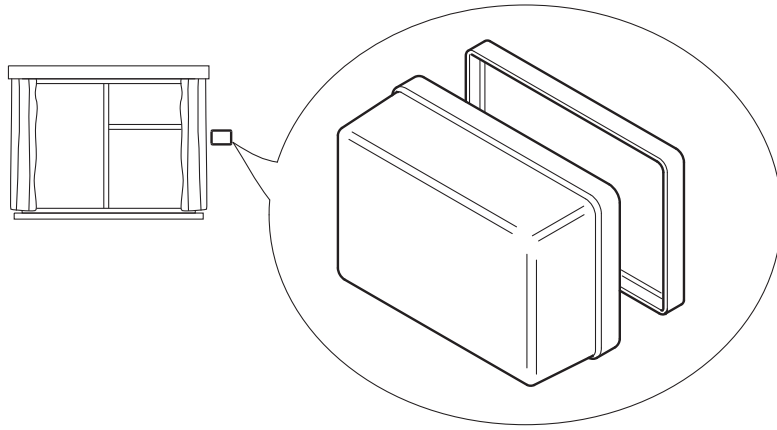
2 ..... [1]

[Total: 12]

**Section B**

Answer **all** questions.

- 4 (a) Fig. 11 shows the two parts of a vacuum formed casing for an electronic curtain closing device.



**Fig. 11**

- (i) Use notes and sketches to show **one** possible method of fastening the two parts together. The method should be non-permanent.

[2]

- (ii) Give **one** reason, apart from ease of recycling, for the method being non-permanent.

.....

..... [1]

- (b) The outside of the casing must show that the casing and circuit contain items that can be recycled.

Use notes and sketches to show **two** symbols that should be visible on the casing.

[2]

- (c) The circuit for the device uses a relay to operate a motor that will open and close the curtains.

Fig. 12 shows the circuit for controlling the relay.

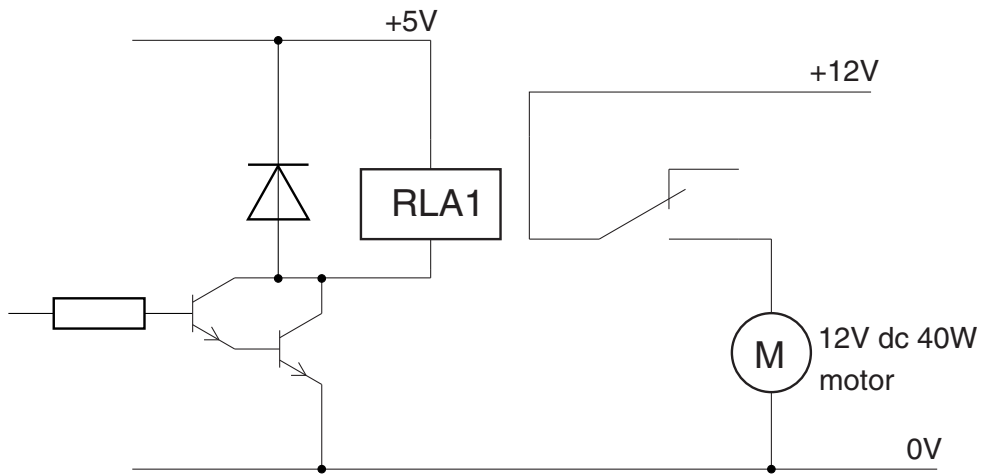


Fig. 12

State **two** factors that should be considered when choosing a relay for the circuit.

1 ..... [1]

2 ..... [1]

- (d) Connections from the relay output to the motor will be through a terminal block as shown in Fig. 13.

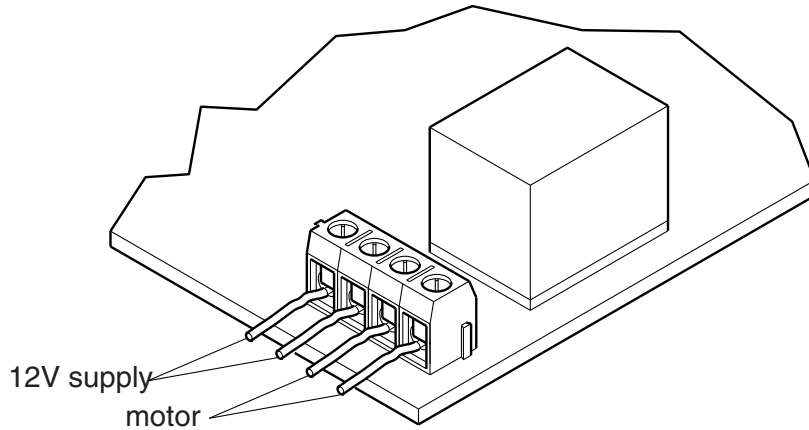


Fig. 13

Describe an alternative method that will allow easy connection and disconnection of the motor and power leads.

.....

.....

..... [2]

- (e) (i) Fig. 14 shows the motor cable passing through a hole in the casing.  
Use notes and sketches to show a method of strain relief for the motor cable.

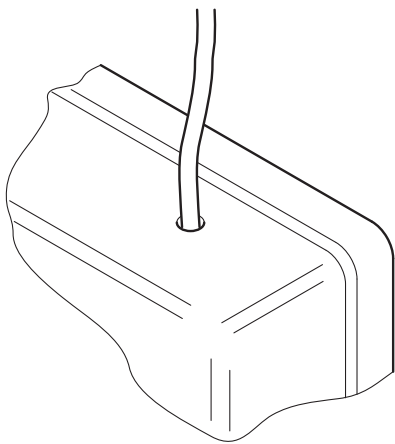


Fig. 14

[2]

- (ii) A grommet is used on the hole in the casing.  
State the reason for using a grommet.

..... [1]

[Total: 12]

Turn over

5 Time delays are often needed when designing a circuit.

(a) Fig. 15 shows a simple time delay circuit.

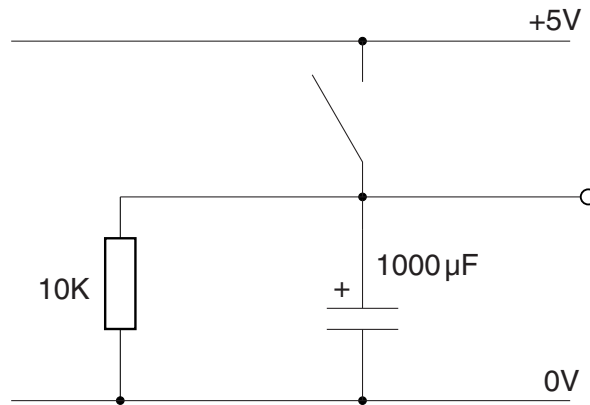


Fig. 15

(i) Give **one** factor that will influence the choice of capacitor when building this circuit.

..... [1]

(ii) A 1000µF capacitor was not available for breadboarding the circuit.

Two 470µF capacitors were used instead, connected in parallel to give a total value of 940µF.

Complete the breadboard on Fig. 16 to match the circuit diagram in Fig. 15.

Each hole on the breadboard can only be used for one connection.

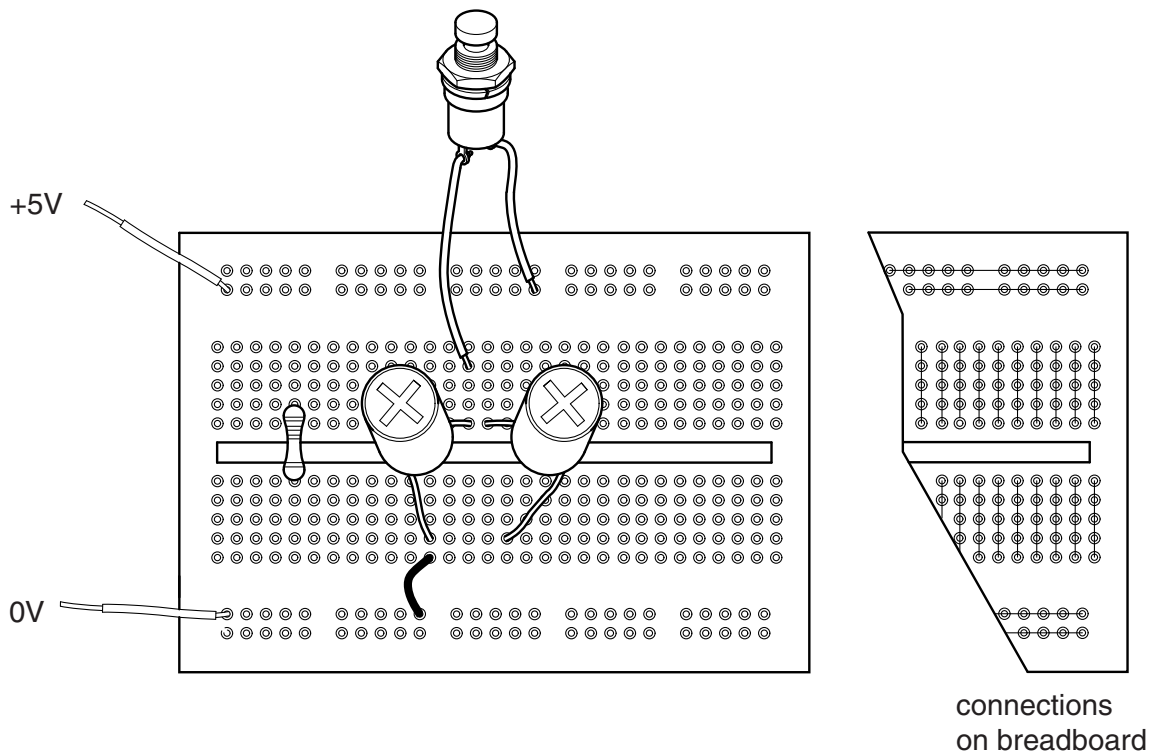


Fig. 16

[2]

(b) A time delay with much greater accuracy could be designed using a PIC circuit.

A connection to a computer is required to program the 14 pin PIC IC, as shown in Fig. 17.

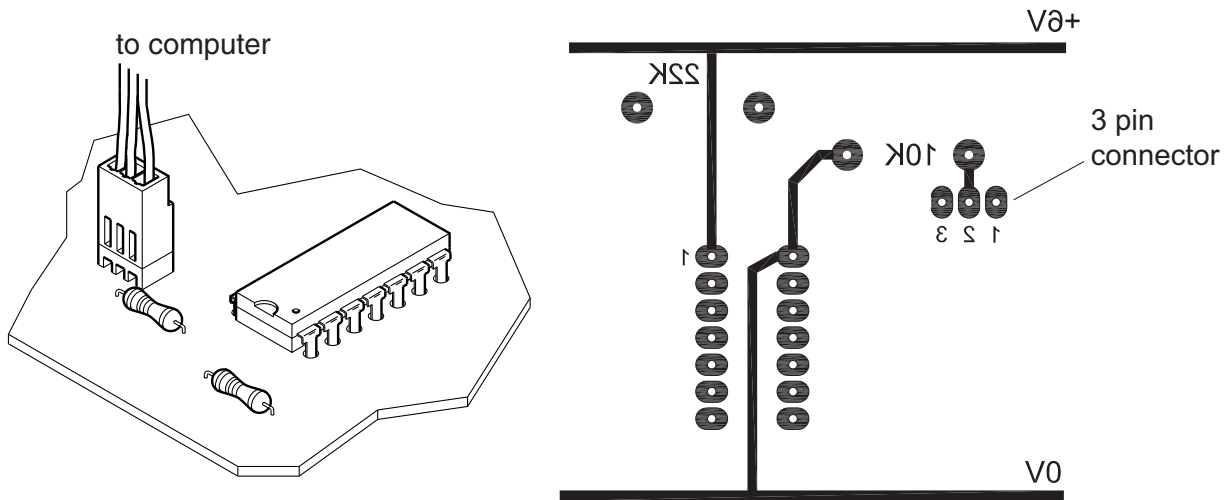


Fig. 17

Complete the following connections on the PCB layout in Fig. 17.

- 3 pin connector pin 1 to PIC pin 13;
- 3 pin connector pin 2 to PIC pin 2 through a 22K resistor;
- 3 pin connector pin 3 to 0V.

[3]

(c)\* Describe the changes that a prototype circuit board may need before going into batch production for an order of 5,000 circuits. The circuits will have ICs inserted by machine and discrete components by hand.

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[Total: 12]



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