

General Certificate of Education  
January 2005  
Advanced Subsidiary Examination



**DESIGN & TECHNOLOGY:  
SYSTEMS AND CONTROL TECHNOLOGY  
Unit 1 Materials and Components**

**SCT1**

Monday 10 January 2005 Morning Session

**In addition to this paper you will require:**

- a lined answer book (AB08) which is provided separately;
- normal writing and drawing instruments.

Time allowed: 1 hour 30 minutes

**Instructions**

- Use blue or black ink or ball-point pen. Pencil and coloured pencils should be used only for drawing.
- Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is SCT1.
- Answer Question 1 and any **two** of Questions 2 to 4.

**Information**

- The maximum mark for this paper is 100.
- Mark allocations are shown in brackets.
- 40 marks are allocated to Question 1, 28 to each of Questions 2 to 4, and 4 marks overall for Quality of Written Communication.
- This paper carries 30 per cent of the total marks for Advanced Subsidiary awards and 15 per cent for Advanced awards.
- You are reminded of the need for good English and clear presentation. The Quality of your Written Communication will be assessed across all questions.

**Advice**

- Your answers should be illustrated with sketches and/or diagrams wherever you feel it is appropriate.

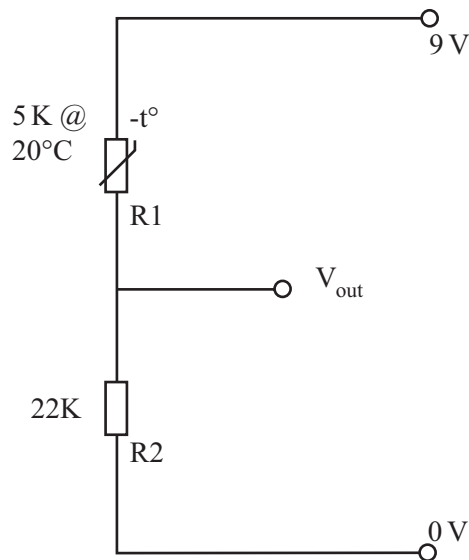
## Answer Question 1.

1 LDRs and thermistors are two types of input transducer.

- (a) Making reference to both their sensing and resistance properties, describe the operation of these **two** devices. (2 × 3 marks)
- (b) A thermistor with a resistance of 5 KΩ at 20 °C is connected in series with a 22 KΩ resistor to create a potential divider shown in the diagram **Figure 1**.

The supply voltage is 9 V.

Given that:  $V_{out} = \frac{R_2}{(R_1 + R_2)} \times V_{in}$  Calculate  $V_{out}$ .



**Figure 1**

(4 marks)

- (c) Design a circuit which uses the potential divider shown in **Figure 1** and will:
- (i) light a green LED when the temperature exceeds 20 °C.
- (ii) light a red LED when the temperature drops below 20 °C. (12 marks)
- (d) The circuit in part (c) could be housed in a case made from a thermoplastic.
- (i) Name a suitable thermoplastic for the case of the circuit. (1 mark)
- (ii) Explain your choice making reference to **two** properties of the material. (4 marks)
- (e) With the aid of annotated sketches, describe a suitable manufacturing process for a casing using the plastic you identified in part (d)(i). (7 marks)
- (f) Quality Control and Quality Assurance are two procedures used in manufacturing industries. Describe **three** differences between Quality Control and Quality Assurance. (6 marks)

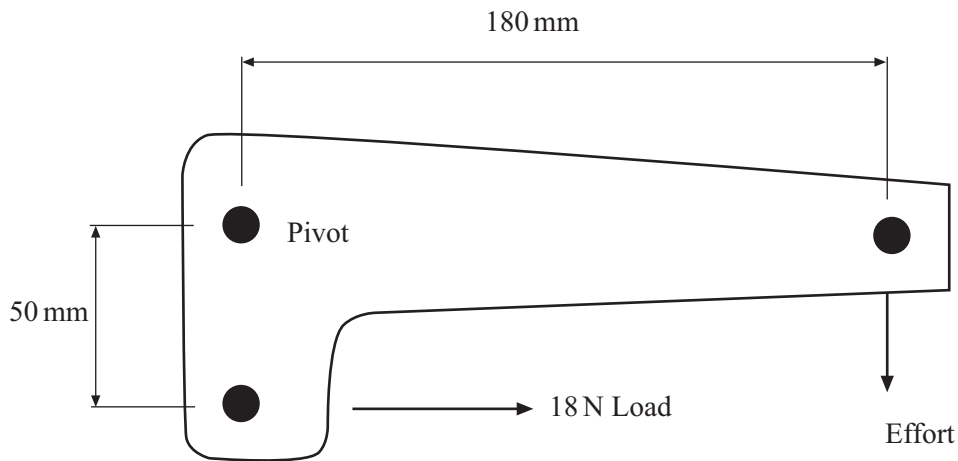
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Answer any **two** of Questions 2 to 4.

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2 Braking systems are an example of the beneficial use of friction forces in mechanical systems.

- (a) Using annotated sketches describe the operation of **two** types of braking system used on mechanisms or machinery of your choice. (2 × 5 marks)
- (b) Describe **two** situations where frictional forces are *undesirable* in mechanical systems, and explain how they may be reduced. (2 × 3 marks)
- (c) The brake lever on a pedal cycle is shown in the diagram **Figure 2**.  
Given that  $\text{Force}_A \times \text{Distance}_A = \text{Force}_B \times \text{Distance}_B$ , calculate the effort required to balance the load. (4 marks)



**Figure 2**

- (d) Describe in detail **two** ways that the use of pedal cycles rather than motor cars could help reduce the amount of pollution of the environment. (2 × 4 marks)

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

- 3 The entrance to a car park is controlled by a system using a barrier and two lights.
- A red light indicates that the barrier is in the lowered position.
  - As a car approaches the barrier the light changes to a green light and the barrier lifts to allow the car through.
  - Once the car has driven under the barrier the light changes back to red and the barrier lowers.
- (a) Using an annotated sketch describe an input sensor that would allow a car to trigger the system. (4 marks)
- (b) Using the correct symbols draw in detail a circuit diagram of a system that could control the operation of the lights. (8 marks)
- (c) Light bulbs or LEDs could be used for the car park entry system. Describe the advantages and/or disadvantages of the use of light bulbs and LEDs in this application. (8 marks)
- (d) The voltage drop across an LED is 2 V and its working current is 20 mA. Showing all your working, calculate the protection resistor required if the LED is to be operated from a 12 V supply. ( $V=IR$ ) (4 marks)
- (e) The indicator lights for the car park will be housed in a casing made from aluminium sheet. Making reference to its characteristics, describe the advantages and/or disadvantages of using aluminium sheet in this application. (4 marks)
- 4 (a) Giving an example of each material, explain the following terms:
- (i) Softwood (3 marks)
  - (ii) Thermosetting plastic. (3 marks)
- (b) Mild Steel and Chipboard are two materials that often require a surface finish to improve their durability. Selecting a *different* finish for *each* of the two materials:
- (i) name a suitable surface finish for each material;
  - (ii) describe the process of applying each finish;
  - (iii) describe the characteristics and reasons for choice of each finish. (2 × 5 marks)
- (c) The recycling of materials is becoming more common. Describe the recycling opportunities for the following groups of materials. (3 × 4 marks)
- (i) Woods
  - (ii) Metals
  - (iii) Plastics

**END OF QUESTIONS**