

Candidate Name

Centre Number

Candidate  
Number

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**OXFORD CAMBRIDGE AND RSA EXAMINATIONS****General Certificate of Secondary Education****DESIGN AND TECHNOLOGY  
(ELECTRONIC PRODUCTS)****1953/4****PAPER 4 HIGHER TIER****Specimen Paper 2003**

Additional materials: Formulae Sheet OCR (Tables 2)

**TIME** 1 hour 15 minutes**INSTRUCTIONS TO CANDIDATES**

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers, in blue or black ink, in the spaces provided on the question paper.

Read each question carefully and make sure you know what you have to do before starting your answer.

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.

Question 1, Product Analysis is based on the theme 'Supermarket Checkouts' printed in the specification.

Marks will be awarded for the use of correct conventions.

Dimensions are in millimetres unless stated otherwise.

Total marks for this paper is **50**.

Question Number	For Examiner's use only
<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>4</b>	
<b>5</b>	
<b>TOTAL</b>	

## Product Analysis Question

- 1 (a) Supermarket checkouts often have an automatic conveyer belt to move goods towards the cashier. The belt stops when a light beam is broken.

(i) Name a suitable electronic sensor to detect when the light beam is broken.

\_\_\_\_\_ [1]

The sensor is usually placed in a tube. Fig. 1(a) and 1(b) show possible arrangements.



Fig. 1(a)



Fig. 1(b)

(ii) Give one reason why the arrangement shown in Fig. 1(a) is better than that shown in Fig. 1(b).

\_\_\_\_\_ [1]

(b) Barcode readers are used to enter information into the electronic cash register. Describe two ways in which this information can be used.

1 \_\_\_\_\_ [1]

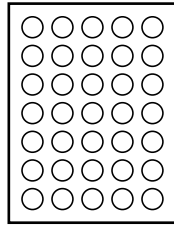
2 \_\_\_\_\_ [1]

(c) Electronic cash registers can use seven segment LED or LCD displays to show the amount entered.

(i) State what the letters LCD stand for.

\_\_\_\_\_ [1]

Matrix displays made up of LEDs as shown in Fig. 1 can also be used in electronic cash registers.

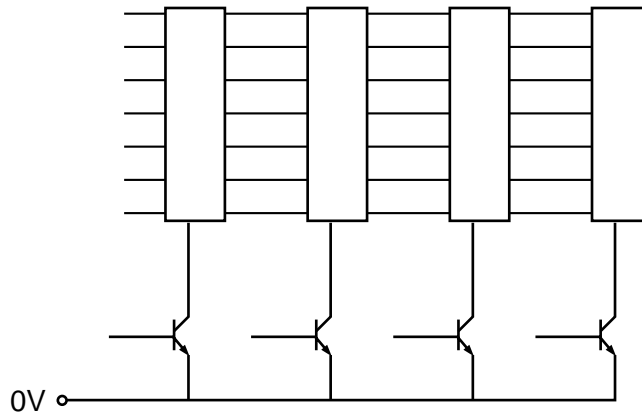


**Fig. 2**

**(ii)** State one advantage of this type of display over LCD displays.

\_\_\_\_\_ [1]

Matrix displays are often positioned side by side. Multiple matrix displays can be multiplexed together as shown by Fig. 3.



**Fig. 3**

**(iii)** Describe what is meant by the term 'multiplexing'.

\_\_\_\_\_ [1]

**(iv)** Name a suitable single IC that could provide the four transistor drivers required.

\_\_\_\_\_ [1]

**(d)** A microcontroller is often used to provide the control for a multiplexer circuit. State two reasons why a microcontroller is suitable for use in this type of application.

1 \_\_\_\_\_ [1]

2 \_\_\_\_\_ [1]

- 2 (a) Fig. 4 shows a diagram of a toggle switch. The switch is to be mounted on a front panel made from sheet aluminium. The shape of the panel cutout required for the switch is also shown.

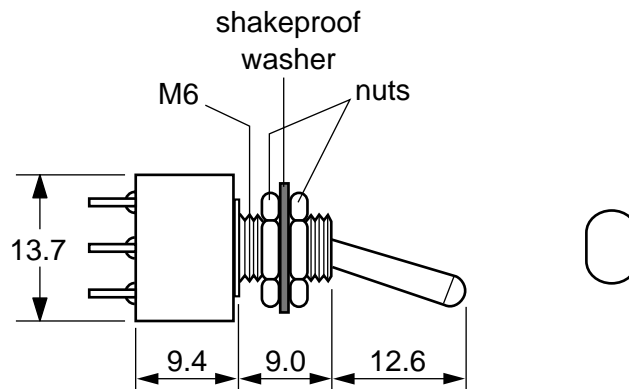


Fig. 4

- (i) State the maximum thickness of sheet aluminium that the switch could be securely mounted onto.

\_\_\_\_\_ [1]

Ten identical prototype front panels are to be produced for market testing of the product.

- (ii) Name this type of production method.

\_\_\_\_\_ [1]

- (iii) Explain how CAD and CAM could be used to design and manufacture the prototype panels.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

[4]

**(b)** To avoid the cost of designing and printing a separate self-adhesive sticker for the prototype panels, the switch labels and instructions are to be engraved directly onto the aluminium panel.

**(i)** Describe how the engraving could be made more attractive and visible.

\_\_\_\_\_ [2]  
\_\_\_\_\_

**(ii)** State two environmental reasons why it is preferable to manufacture prototype panels out of aluminium rather than steel.

1 \_\_\_\_\_ [1]

2 \_\_\_\_\_ [1]

- 3** The cold store in a supermarket is entered via a doorway at the rear of the building. To prevent the public entering the cold store the door is secured with an electronic lock.

To allow the supermarket staff to enter the cold store an easy to use electronic control system must be designed.

One possible solution is to use a stainless steel keypad, so the staff must enter a code to open the lock.

- (a) (i)** As the lock is to be used in an environment that may contain moisture or fluid from spilt food, the keypad must be 'environmentally sealed'.

Explain the term 'environmentally sealed'.

\_\_\_\_\_ [2]

- (ii)** Name two other design specifications that must be considered when developing a keypad control system.

1 \_\_\_\_\_ [1]

2 \_\_\_\_\_ [1]

- (b)** The door lock mechanism is to be developed using a commercial 12V dc solenoid.

- (i)** Describe the operation of a solenoid.

\_\_\_\_\_ [2]

The solenoid could be interfaced to be the control circuit by use of a relay or a field effect transistor (FET).

- (ii)** Describe two advantages, other than cost, of using a FET rather than a relay.

1 \_\_\_\_\_ [1]

2 \_\_\_\_\_ [1]

Once a prototype system had been made it was found that the electronic control system acted erratically when the solenoid moved in and out. This problem was identified to electrical noise generated via the solenoid.

**(iii)** Describe what is meant by 'electrical noise'.

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**[1]**

**(iv)** Describe one solution that would reduce the electrical noise generated by the solenoid.

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**[1]**

4 The air conditioning unit in a supermarket uses an airflow sensor to detect whether an extraction fan is operating correctly. If the signal from the airflow sensor is high when the fan is operating, a buzzer should sound.

(a) Fig. 5 shows the symbol for a logic gate to be used with this circuit. Complete the truth table for this logic gate.

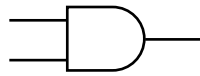


Fig. 5

FAN	SENSOR	BUZZER
0	0	
1	0	
0	1	
1	1	

[1]

(b) Fig. 6 shows a PCB track layout for a logic circuit, drawn with a CAD software package.

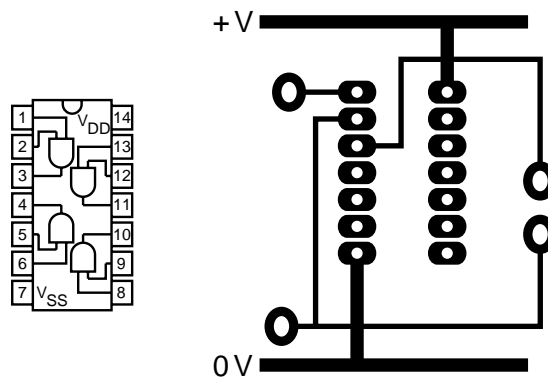


Fig. 6

(i) State one reason why this is an unsuitable layout.

[1]



- (ii) Complete Fig. 7 to show a suitable layout. Tracks may be taken through the centre of the IC, but not between adjacent IC pads.

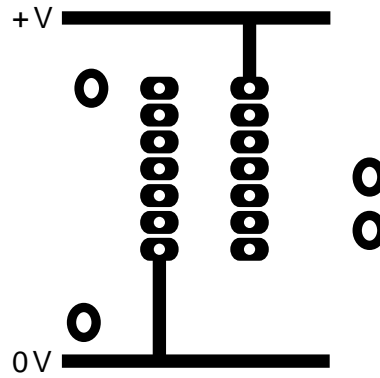


Fig. 7

[3]

- (c) After testing, it was found that the alarm sometimes stopped before it was heard by the maintenance engineers.

- (i) Explain why the alarm may stop before it was heard.

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[2]

- (ii) Describe how the circuit could be modified so that the alarm, once activated, continued until it was switched off by the maintenance engineer.

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[3]

- 5 Fig. 8 shows incomplete details of an operational amplifier connected as an inverting amplifier. It is used to amplify the small voltage generated by a microphone in a supermarket public address system.

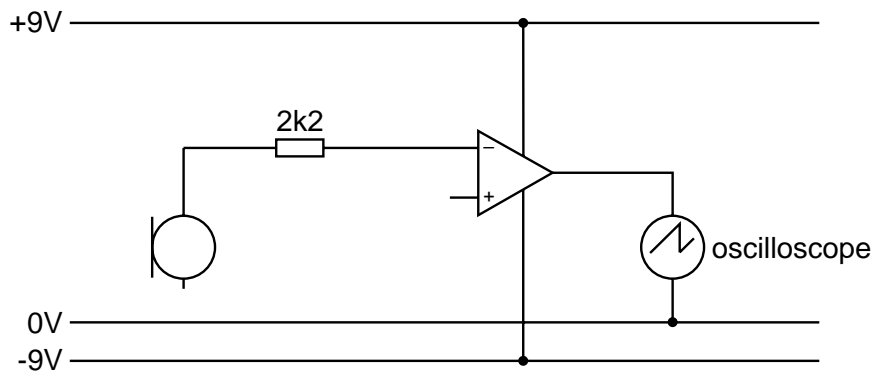


Fig. 8

- (a) (i) Complete the circuit diagram to include a feedback resistor and any other connections and components necessary. [3]

- (ii) Calculate the value of the feedback resistor if the gain of the amplifier is to be  $-10$ .

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[1]

- (iii) The oscilloscope is used to observe the output voltage waveform from the amplifier. The triangular waveform shown in Fig. 9 is used as a test input signal. On the same axes draw the output waveform displayed when the gain of the inverting amplifier is  $-10$ .

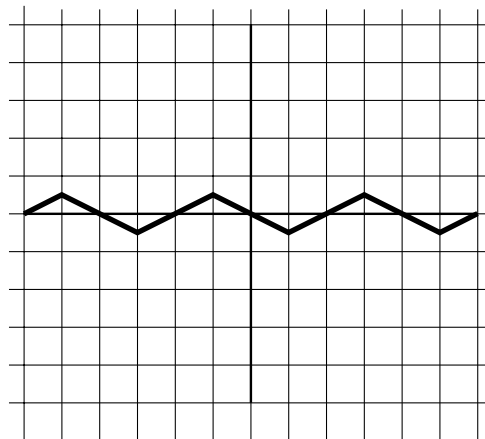
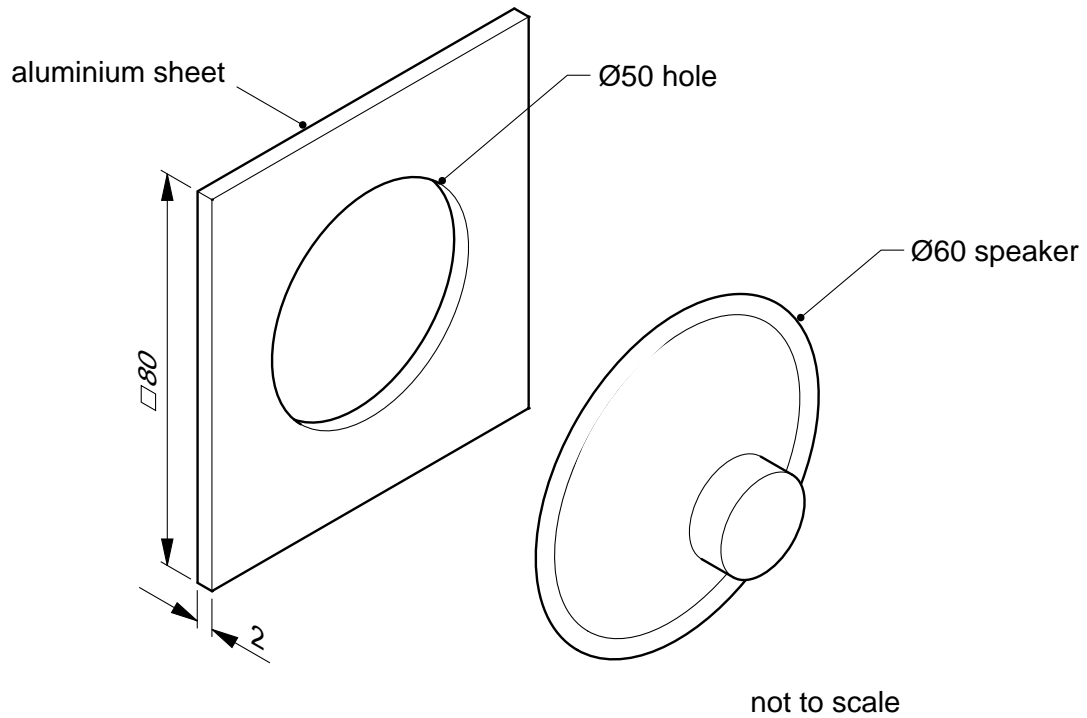


Fig. 9

[2]

- (b) The microphone signal goes through further amplification stages before being fed into a loudspeaker. The loudspeaker and mounting panel dimensions are given in Fig. 10.



**Fig. 10**

Use notes and sketches to show a method of attaching the loudspeaker to the mounting panel. Your design must ensure that:

- holes are not needed in the loudspeaker
- the speaker can be removed for easy maintenance
- fixings cannot vibrate loose.

[4]

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**1953/4**

**PAPER 4 HIGHER TIER**

**MARK SCHEME**

**Specimen Paper 2003**

- 1 (a) (i) Light dependent resistor or LDR. [1]
- (ii) Arrangement (a) is better because less chance of stray light entering [1]
- (b) Any two from
- 1 keeps a record of stock
  - 2 records replacement needs
  - 3 records cash flow
- 1 mark each. [2]
- (c) (i) Liquid Crystal Display [1]
- (ii) Visible in dark, large size possible [1]
- (iii) Is a method of reducing the number of connections (wires)  
Replacing a lot of outputs by combining signals [1]
- (iv) ULN 2003 A/ULN 2803 A [1]
- (d) 1 Easily re-programmed to display new numbers
- 2 Enough input/output pins to control all lines
- 1 mark each [2]

[Total marks : 10]

- 2 (a) (i) 5mm [1]
- (ii) batch [1]
- (iii) CAD would be used to design the shape and dimensions of the cutouts, as well as enabling the designer to easily change design (e.g. with a CNC punch or milling machine) [4]
- (b) (i) The engraving could be linked to provide a higher contrast between the letters and surrounding metal [2]
- (ii) 1 aluminium is easily melted down and recycled
- 2 easily worked and so reduce wear on machines and power machines and power required for machining [2]

[Total marks : 10]

- 3 (a) (i)** This means that no fluid or dust can enter the device  
(this could damage the components)
- e.g. IP ratings are used to show components are suitable [2]
- (ii)** Any two from
- 1 size of buttons
  - 2 the numbers of numbers in the pin that the staff must remember
  - 3 the size and positioning (height) of the key pad
- 1 mark each [2]
- (b) (i)** A "bolt" is pushed to the normally out position by a spring.  
When energised an electromagnet coil attracts the bolt,  
moving it inwards. [2]
- (ii)** 1 solid state rather mechanical so more reliable
- 2 smaller size
- 1 mark each [2]
- (iii)** 'Electrical noise'.
- The back emf of the solenoid is putting "power spikes"  
onto the 12 V supply [1]
- (iv)** Suppress the solenoid using a capacitor [1]

**[Total marks : 10]**

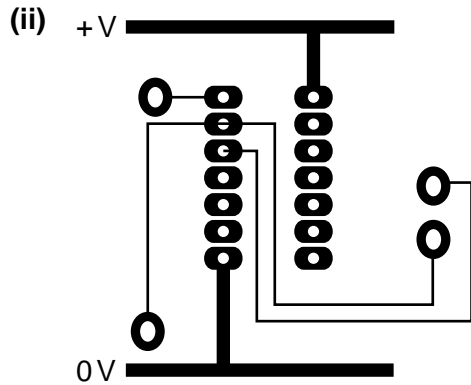
4 (a) BUZZER

0  
0  
1  
1

[1]

(b) (i) Tracks crossing

[1]



[3]

(c) (i) As soon as the signal changes the alarm will stop – not latched

[2]

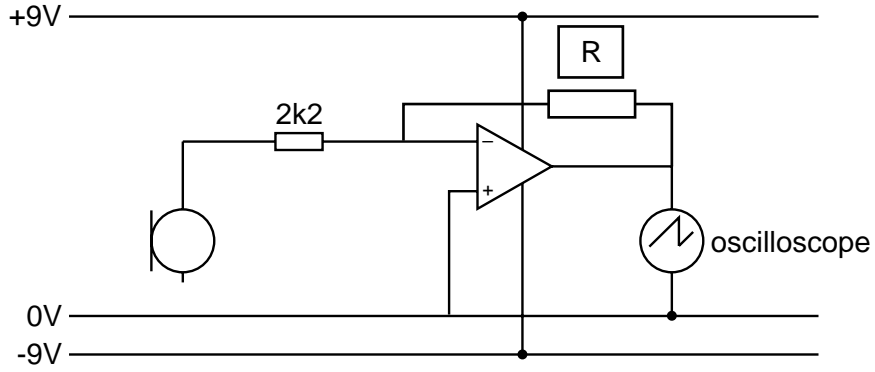
(ii) Add a latching circuit with a reset switch.  
As soon as the signal is achieved the buzzer will stay on  
until the engineer presses the reset switch

[3]

[Total marks : 10]



5 (a) (i)



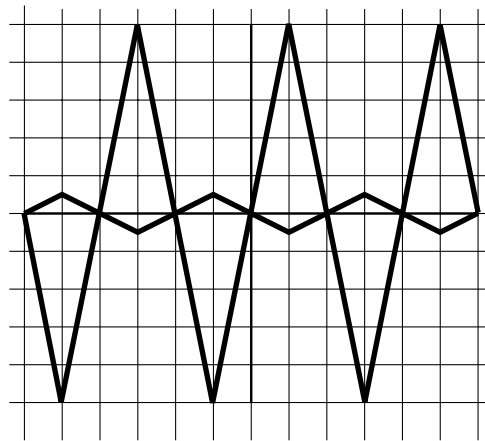
[3]

(ii) gain =  $-R_f/R_{in}$

$$R_f = -\text{gain} \times R_{in} = -(-10) \times 2k2 = 22K$$

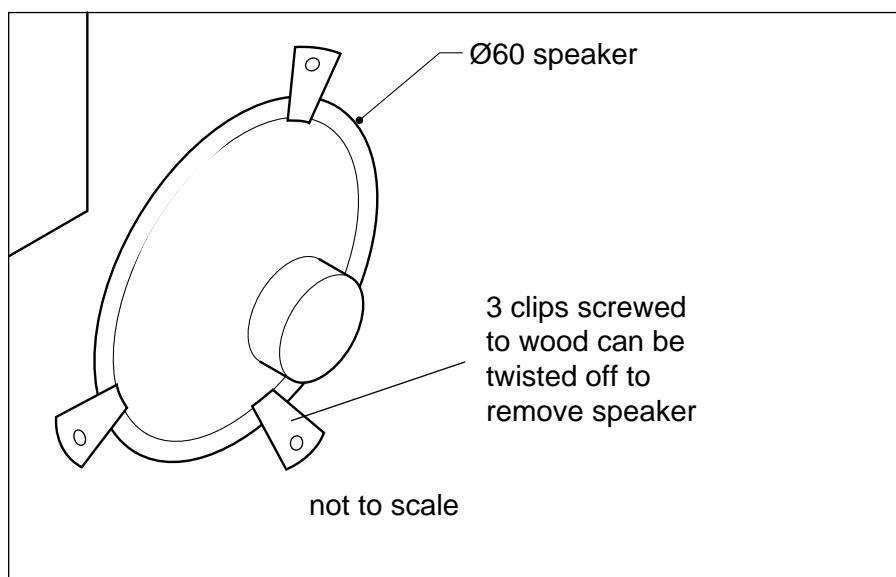
[1]

(iii)



[2]

(b)



[4]

[Total marks : 10]

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