OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

DESIGN AND TECHNOLOGY

Electronic Products **1953/02**

Electronic Products (Short Course) **1053/02**

Paper 2 (Higher Tier)

Systems & Control Technology (Electronics Option) **1957/04**

Paper 4 (Higher Tier)

MONDAY 2 JUNE 2008

Morning

Time: 1 hour 15 minutes

Candidates answer on the question paper

Additional materials: No additional materials are required

CUP/T41138

Candidate Forename		Candidate Surname	
Centre Number		Candidate Number	

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or 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.
- Show all working for calculations.
- All necessary formulae are provided within the questions. No extra formulae sheet is required.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **50**.
- Marks will be awarded for the use of correct conventions.
- Dimensions are in mm unless stated otherwise.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
TOTAL	

This document consists of **15** printed pages and **1** blank page.

[Turn over

1 Electronic products are often used in personal transport systems.
Some examples are shown in Fig. 1.

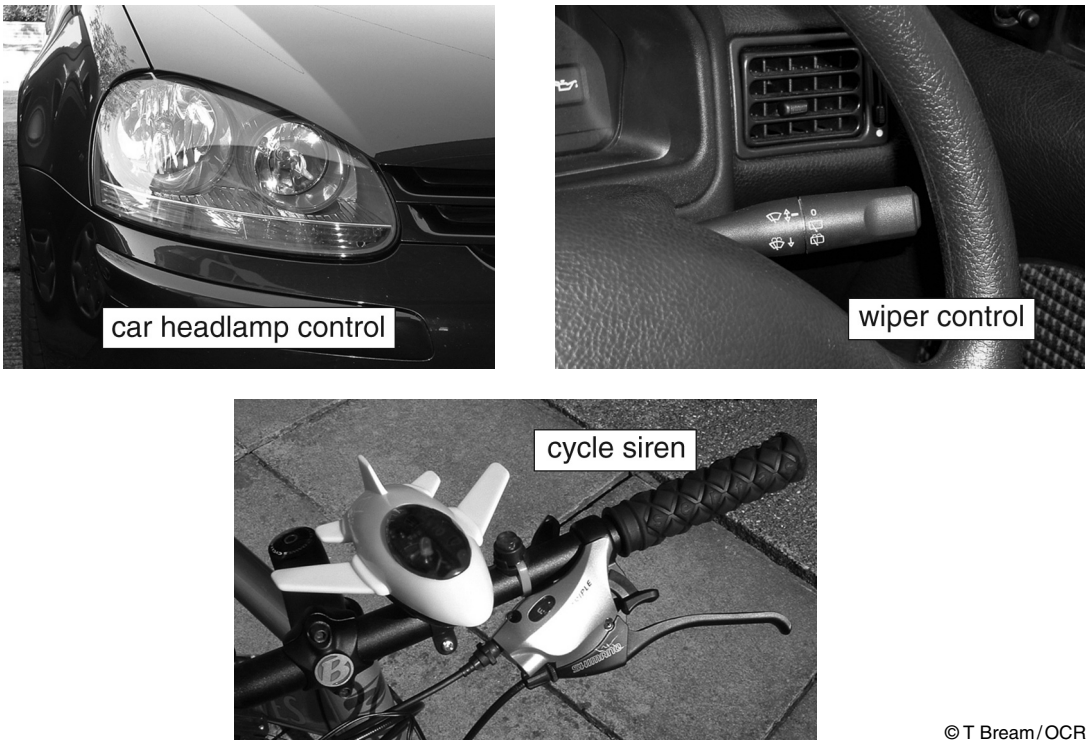


Fig. 1

(a) PCB layouts are often designed using CAD software.
Part of a layout is shown in Fig. 2.

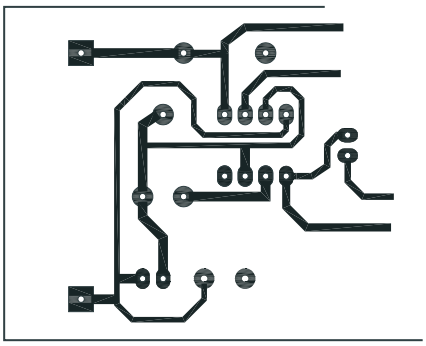


Fig. 2

(i) State **two** features that can be changed without altering the basic layout of the circuit.

1 .....[1]

2 .....[1]

(ii) PCBs will often be designed using an auto-routed layout.
Give **one** important stage in the production of an auto-routed layout.

.....

.....[1]

(iii) Auto-routing will sometimes leave the last part of the circuit to be completed manually.
Fig. 3a shows the position of two unrouted tracks and component outlines.
Complete the layout on Fig. 3b to show a suitable route for each track which uses no links.

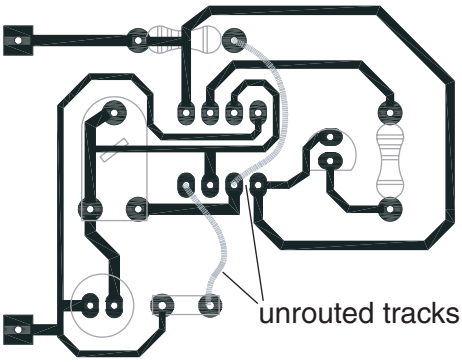


Fig. 3a

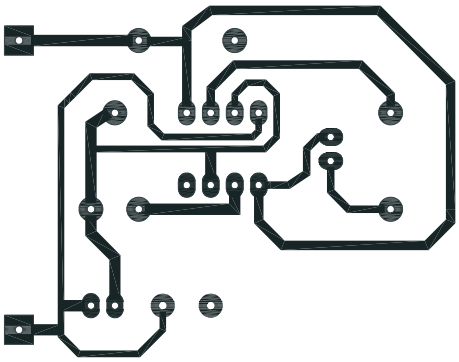


Fig. 3b

[2]

(b) Fig. 4 shows final details added to a board layout before manufacture.

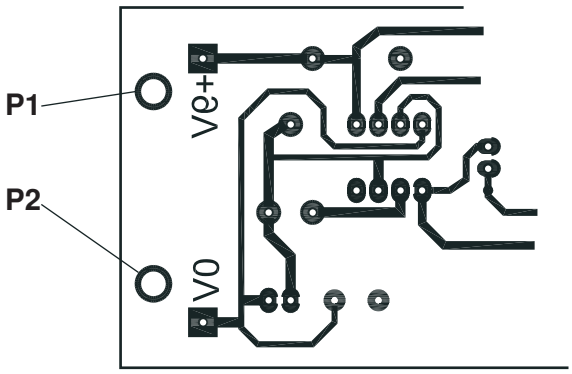


Fig. 4

State the purpose of pads **P1** and **P2**.

.....[1]

(c) Fig. 5 shows a completed block of circuit boards from a commercial manufacturer.

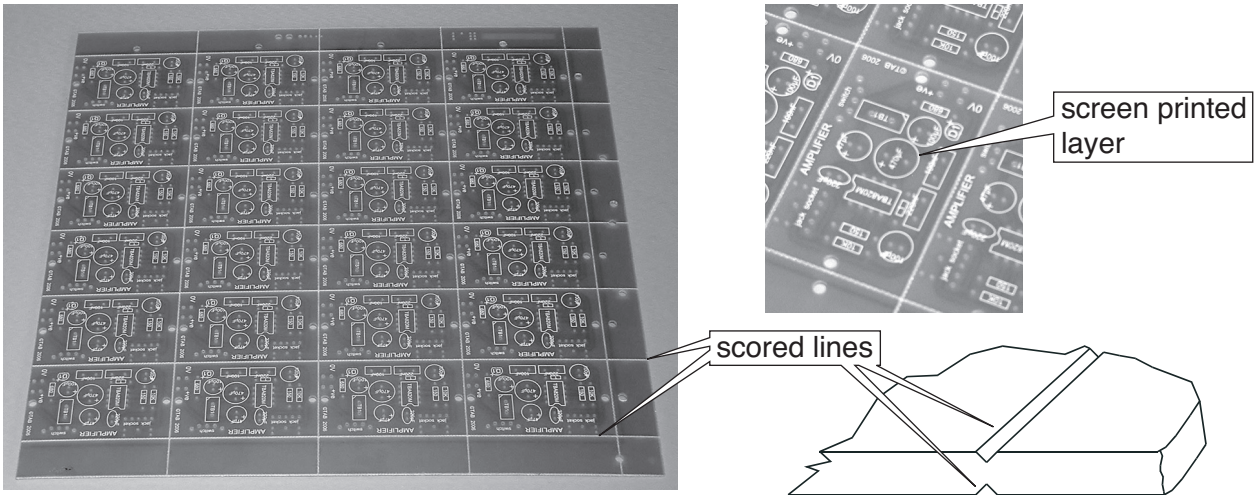


Fig. 5

(i) Give **two** benefits to the manufacturer of blocking circuits.

Benefit 1 .....[1]

Benefit 2 .....[1]

(ii) CAD/CAM equipment is used to provide the two features labelled in Fig. 5.
Give **one** reason for the inclusion of each feature.

Scored lines .....[1]

Screen printed layer .....[1]

[Total: 10]

2 **(a)** Fig. 6 shows a novelty siren for use on a cycle. The siren has eight sounds available which can be selected with a rotary switch. It also has three LEDs which light when the siren is operated.

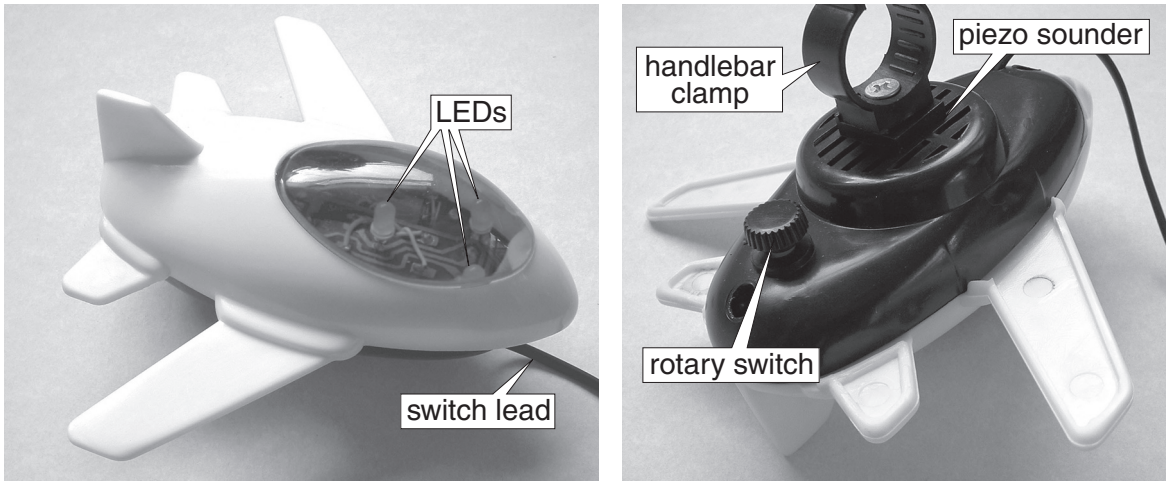


Fig. 6

(i) State the most likely method of manufacture for the plastic casing of the siren.

.....[1]

(ii) Once tools for the casing are prepared for manufacture any changes are likely to be expensive.
Give **one** change that can be made with little cost to the manufacturer.

.....[1]

(b) The circuit board for the siren is shown in Fig. 7.
The circuit uses an IC which is permanently bonded to the PCB, known as Chip on Board (COB) technology.

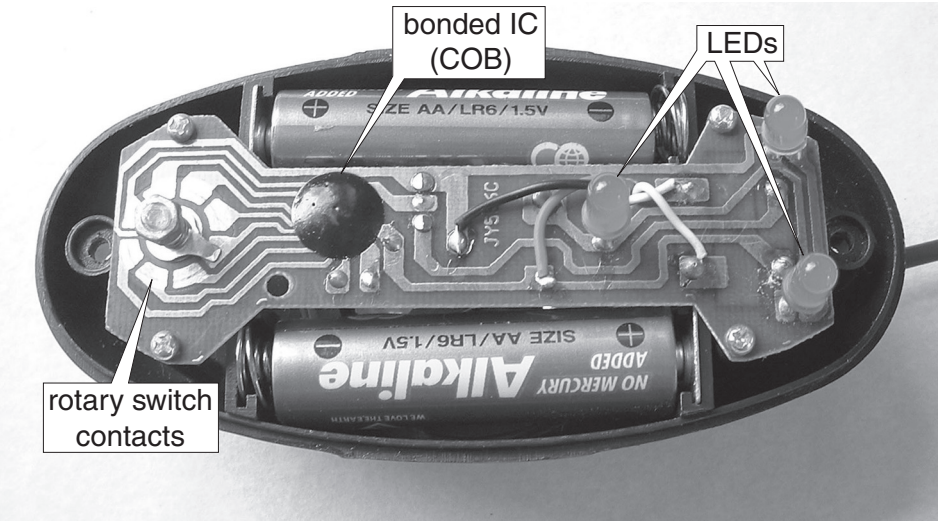


Fig. 7

Give **two** benefits of having a board with the IC permanently bonded to the PCB.

Benefit 1 .....

.....[1]

Benefit 2 .....

.....[1]

(c) The construction of the rotary switch is shown in Fig. 8.

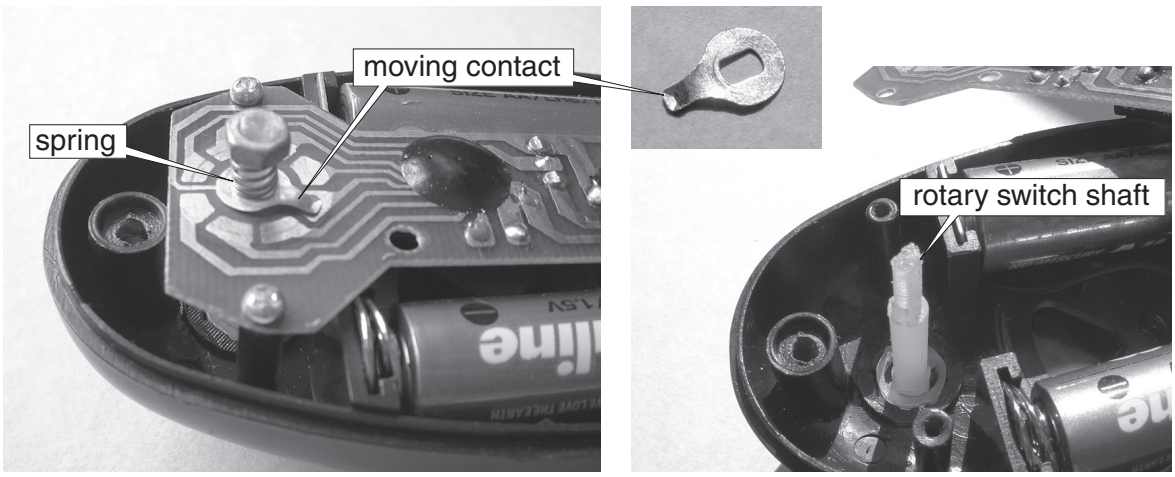


Fig. 8

(i) Describe the purpose of the spring.

.....[1]

(ii) Give the reason for using a shaped mounting hole for the moving contact to locate on the rotary switch shaft.

.....[1]

(d) The novelty siren is a low cost item that is not intended to last for a long time.
Describe **two** ways in which the manufacturer could help to avoid damage to the environment when the product is disposed of.

1 .....

.....[1]

2 .....

.....[1]

(e) The novelty siren is powered by 2 × 1.5V (AA) batteries.
The circuit for the three LEDs is shown in Fig. 9.

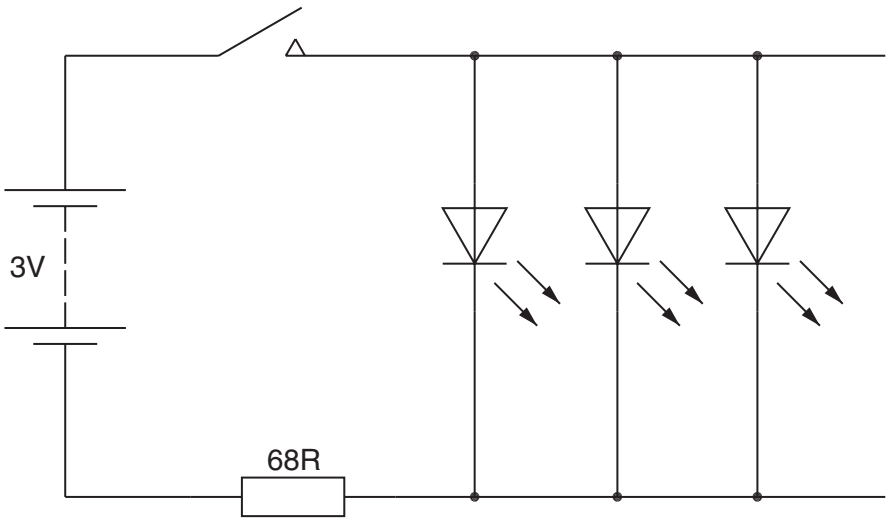


Fig. 9

Calculate the current flow through each LED when the circuit is operated.
Assume a 1.7V drop across an LED.

Use the formula V = I × R.

.....

.....[2]

[Total: 10]

3 Vehicle cooling systems have been electronically controlled for many years.
Fig. 10 shows a flow diagram of a typical system.
The temperature of the coolant should not exceed 110 °C.

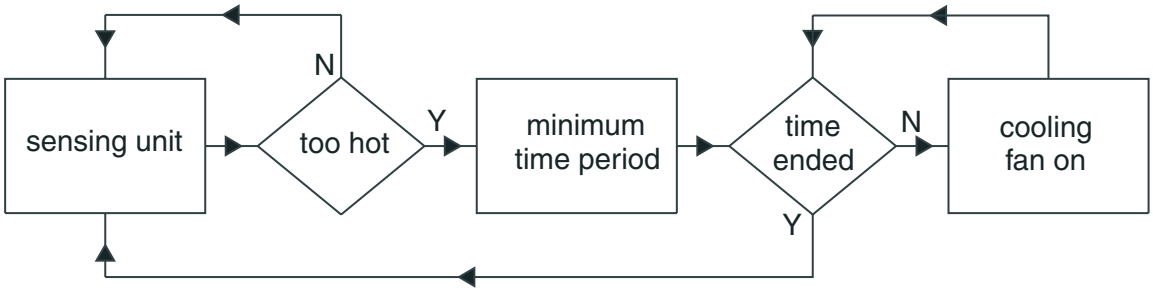


Fig. 10

(a) One functional specification point is that the cooling fan should stay on for a minimum time of 11 seconds.

(i) Give **two** further **functional** specification points that the designer of the system may have to follow.

1 .....

.....[1]

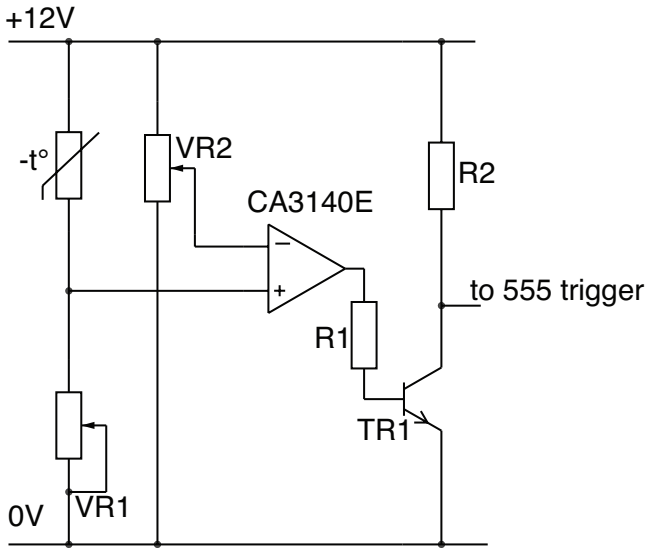
2 .....

.....[1]

(ii) The minimum time period for the cooling fan is an important part of the design.
Give the likely reason for having this minimum time of operation.

.....[1]

(b) (i) Fig. 11 shows the sensing section of the circuit and a table of thermistors.



Code	Tolerance	Res. at 25°C	Res. at 100°C	Temp. range
0012	10%	300R	24R	-30°C to +125°C
0014	10%	1K	90R	-30°C to +125°C
0016	1%	1K		-50°C to +90°C
0018	1%	100K	5K	-30°C to +125°C

Fig. 11

The thermistor code 0018 has been chosen from the selection in the table.
Give **two** reasons for this choice.

1 .....

.....[1]

2 .....

.....[1]

(ii) The thermistor fits in a housing in the radiator and is encased with epoxy resin.
Give **one** property of epoxy resin that makes it suitable for this job.

.....

.....[1]

(c) Fig. 12 shows the completed circuit.
Calculate the **maximum** time period using these components.
Use the formula $t=1.1R_1C$

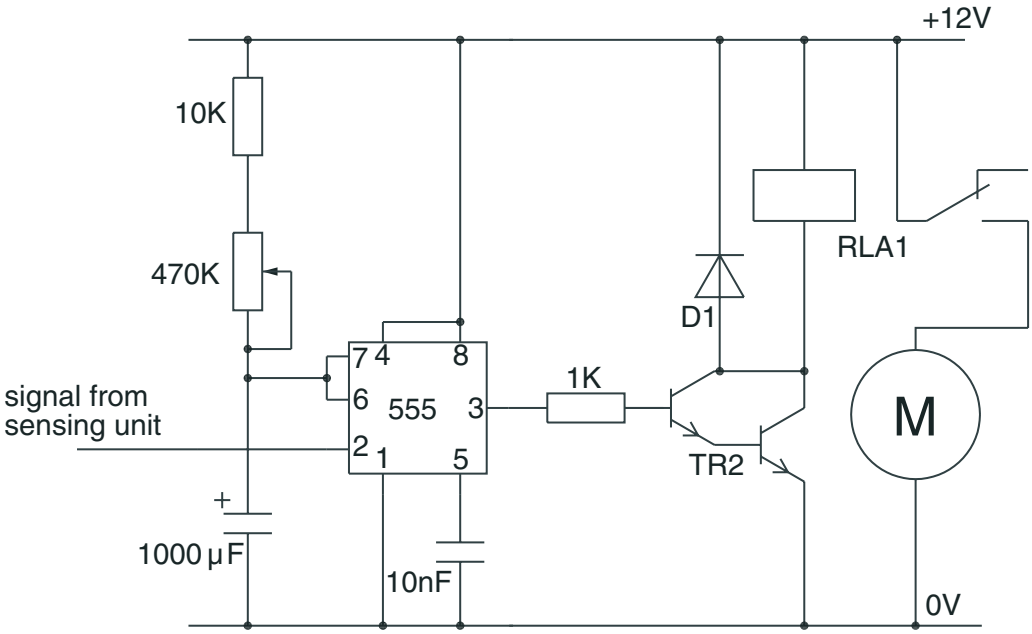


Fig. 12

.....

.....

.....[2]

(d) Newer vehicles will use microcontrollers in preference to the comparator and timer.
Give **two** functional advantages of using a PIC based system for vehicle electronics.
Do **not** include size of circuit or cost in your answer.

1 .....

.....[1]

2 .....

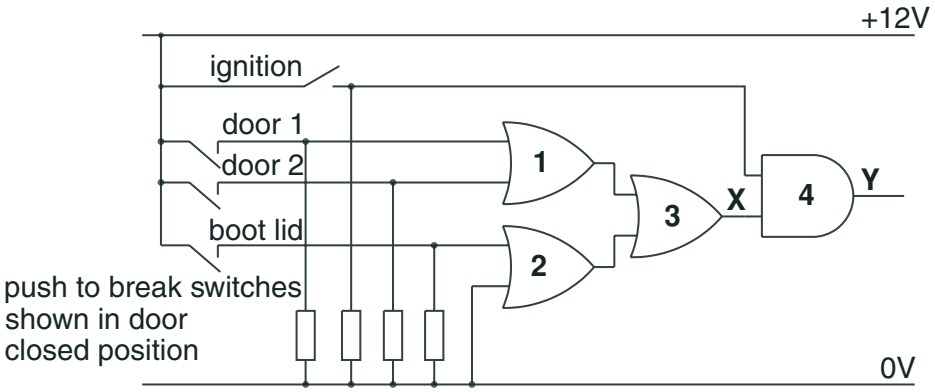
.....[1]

[Total: 10]

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

4 **(a)** Modern vehicles may give a warning signal when car doors are left open.
The system must only give a warning when the car ignition is switched on.
Input from the doors is taken from push to break switches.
Fig. 13 shows the logic for the circuit.



door 1	door 2	boot lid	ignition	output at **X**	output at **Y**
0	0	0	0		
0	0	1	0		
0	1	0	0		
1	0	0	0		
0	0	1	1		
0	1	0	1		
1	0	0	1		

Fig. 13

(i) Complete the truth table to show the logic level at points **X** and **Y**. [2]

(ii) State the purpose of the **AND** gate in the system.

.....[1]

(iii) Logic gate **2** has one input permanently connected to 0V.
Give the reason for this connection.

.....

.....[1]

(b) Fig. 14 shows a breadboard with the logic IC for gates **1**, **2**, and **3**.
There is a capacitor connected across the supply pins.

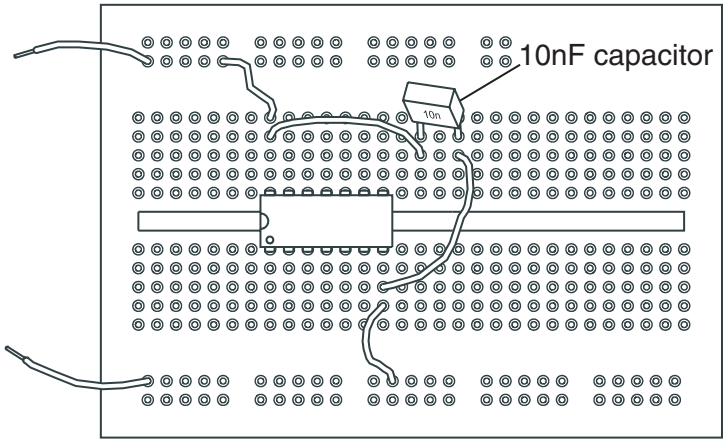


Fig. 14

State the purpose of the capacitor.

.....[1]

(c) Fig. 15 shows two ways of indicating logic level when quality control testing is carried out.

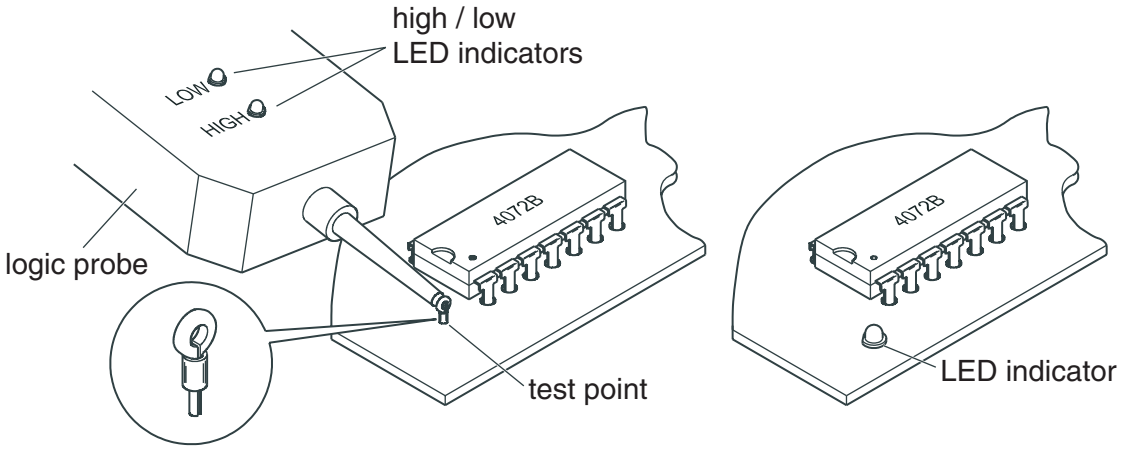


Fig. 15

(i) Give **one** benefit of using test points in a circuit.

.....[1]

(ii) Give **one** benefit of using LEDs to indicate logic level.

.....[1]

(d) The output display must show exactly which of the doors are open.
Fig. 16 shows part of the output stage of the circuit.
When the output of gate 4 is high a transistor is needed to switch enough current to operate all LEDs together.

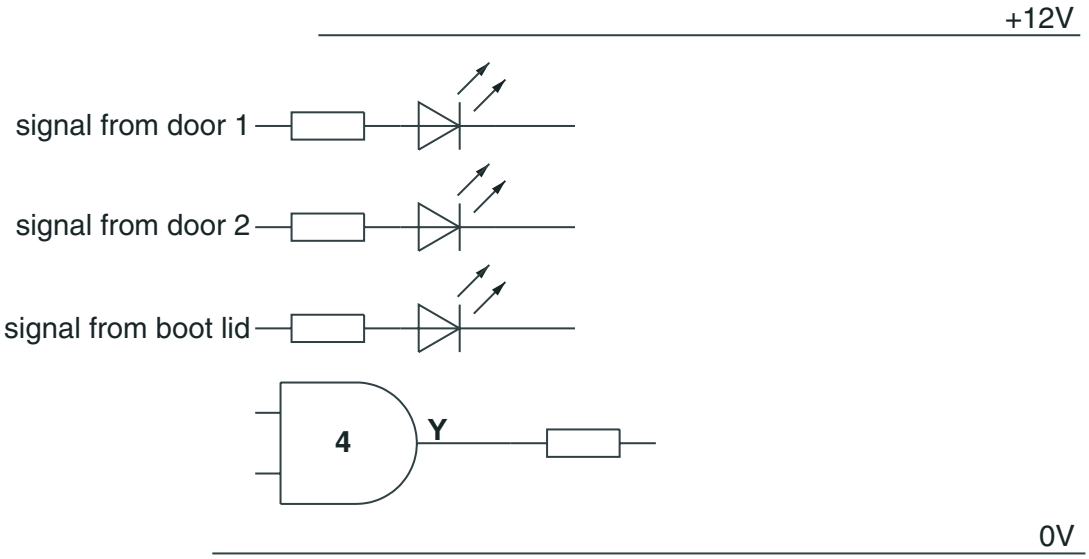


Fig. 16

Add an NPN transistor to the circuit.
All connections must be completed with the collector connected to all LED cathodes. [3]

[Total: 10]

5 A circuit is being developed for a device to measure the speed of rotation of a crank on a cycle.
Fig. 17 shows a cycle with a reed switch sensor fitted.
The signal from the sensor needs to be clean before it can be used for a count.

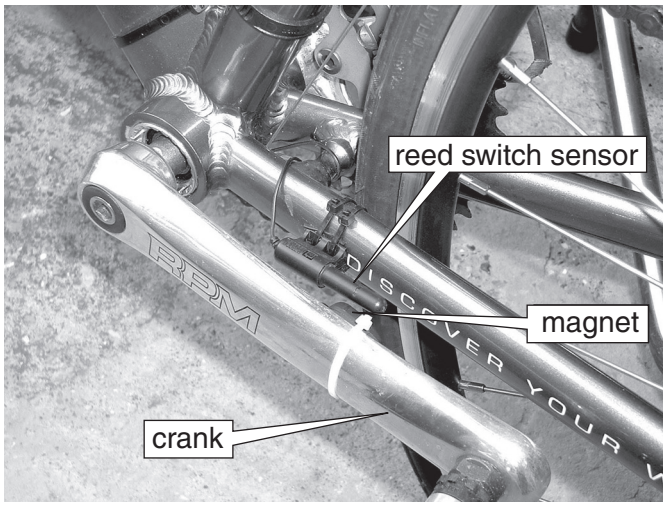


Fig. 17

(a) Fig. 18 shows the initial signal from the rotating crank followed by the cleaned signal.
Use notes or sketches to show how the cleaned signal can be produced.

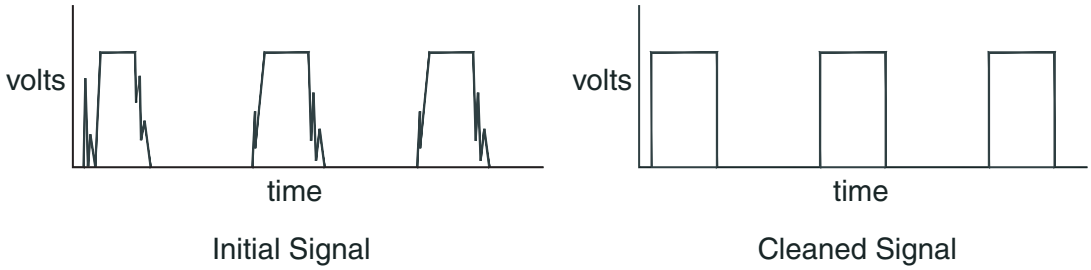


Fig. 18

.....

.....

.....

.....[2]

(b) The maximum figure for the count is expected to be no more than 120 r.p.m.
The counters will reset after each minute before beginning the next count.
Fig. 19 shows the two counter ICs that will provide the count.

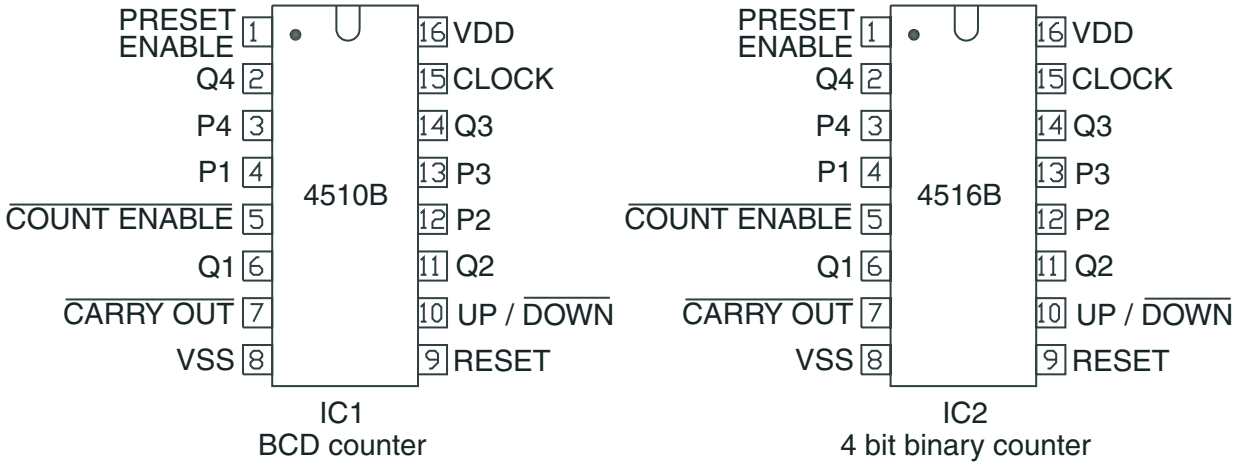


Fig. 19

(i) The bar above pins 5, 7 and 10 indicates that they are active low.
Describe what this means when connecting pin 10.

.....[1]

(ii) IC1 is a BCD counter and IC2 is a 4 bit binary counter.
Give the highest decimal number that each IC will record before resetting.

BCD counter ..... 4 bit binary counter ..... [2]

(iii) Fig. 20 shows the clock connection for both ICs.
The carry out from IC1 sends a pulse each time the maximum count is reached.
This pin is connected to the clock input of IC2.

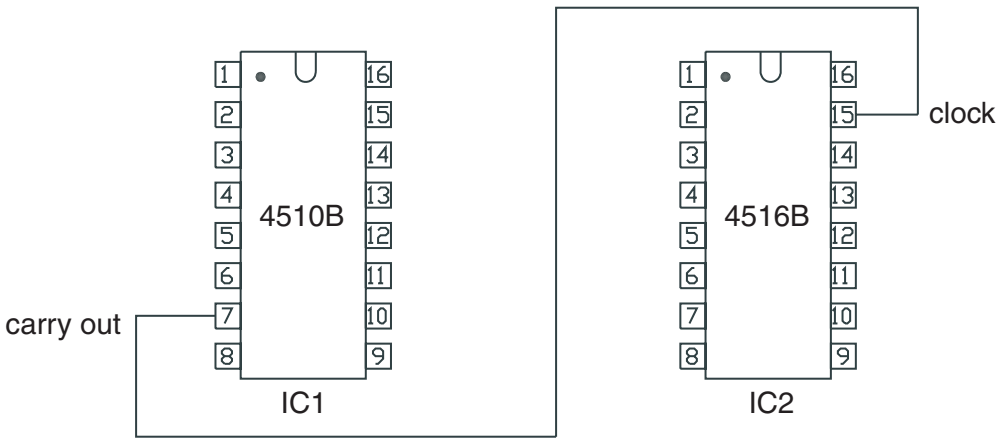


Fig. 20

State the **maximum** count of input pulses that is now possible before both counters return to zero.

.....[1]

(c) Fig. 21 shows the circuit arrangement that will stop the count for a short time after each minute and reset the counters before the next count begins.
Explain the reason for connecting the reset pins to gate **A**.

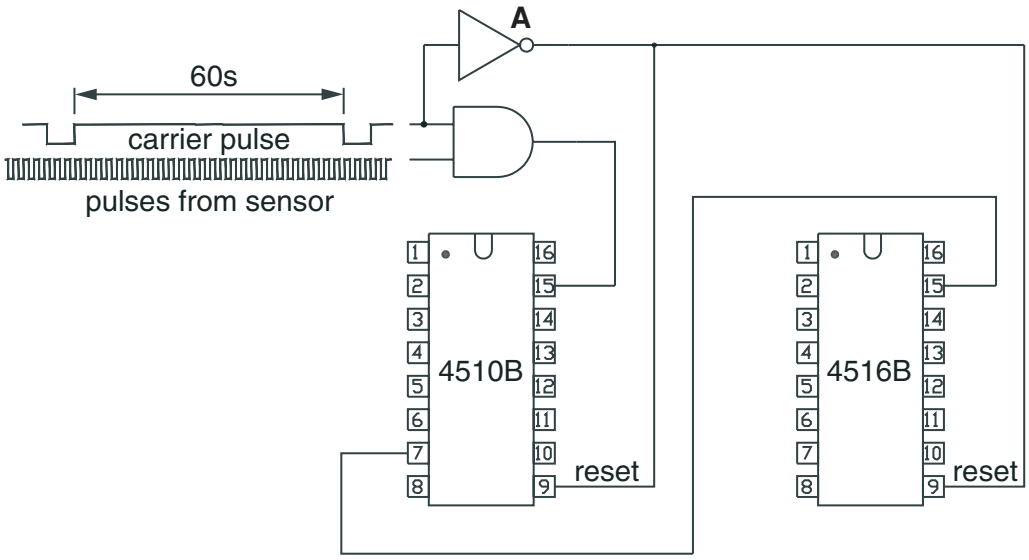


Fig. 21

.....

.....

.....[2]

(d) The circuit is tested using LEDs for the display.
Some modification to the display will be needed before it can be successfully marketed.
Describe **one** important modification and give a reason for the change.

Modification required .....[1]

Reason for the change .....[1]

[Total: 10]