

**GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**DESIGN AND TECHNOLOGY**

**A514/01**

**Electronics and Control Systems**

Technical Aspects of Designing and Making  
Electronics

Candidates answer on the question paper.

**OCR supplied materials:**

None

**Other materials required:**

- A calculator may be used

**Wednesday 22 June 2011  
Morning**

**Duration: 1 hour 15 minutes**



Candidate forename		Candidate surname	
--------------------	--	-------------------	--

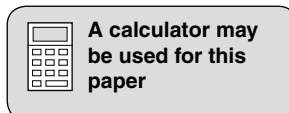
Centre number						Candidate number				
---------------	--	--	--	--	--	------------------	--	--	--	--

**INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Show all your working out for calculations.
- Answer **all** the questions **in Section A and Section B**.
- Do **not** write in the bar codes.

**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 small novelty electronic toy which makes a buzzing insect sound in the dark. The case has been injection moulded from plastics.

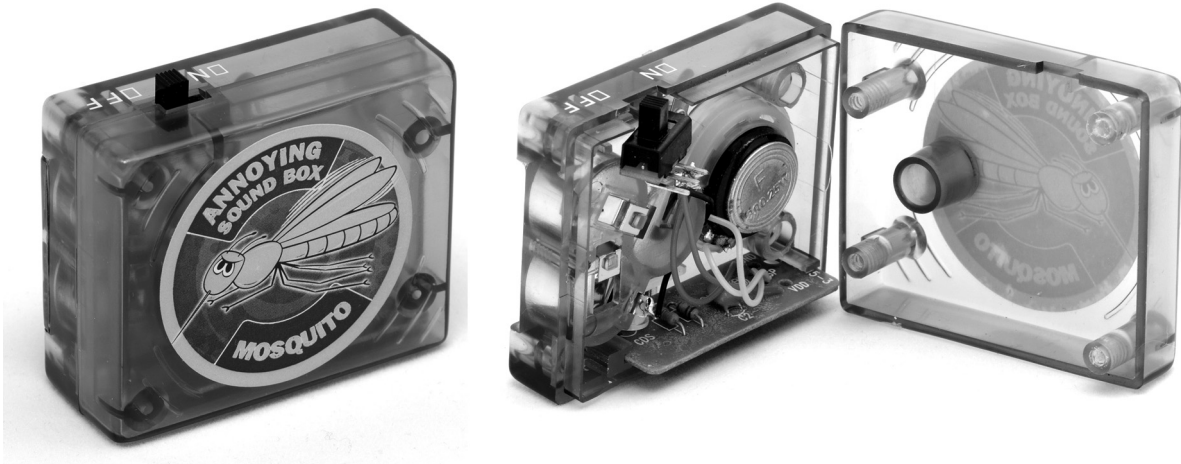


Fig. 1

- (a) (i) Give **one** property of plastics that makes it suitable for injection moulding.  
..... [1]
- (ii) Give **two** benefits to a manufacturer of using injection moulding for product cases.  
1 .....  
2 ..... [2]

(b) The surface of the battery case has information moulded into it as shown in Fig. 2.

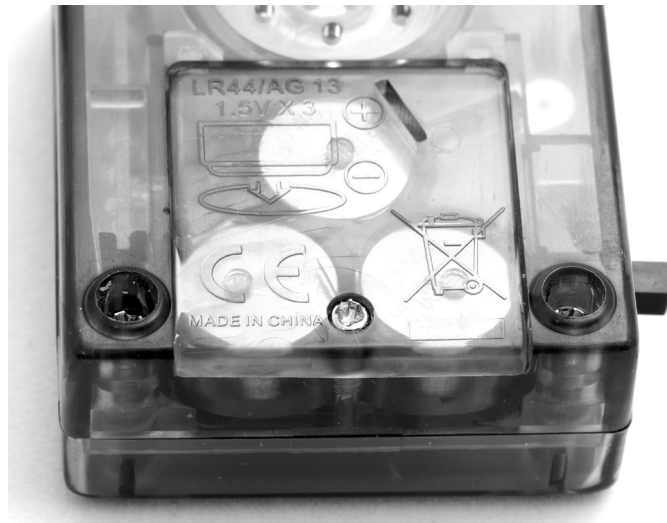


Fig. 2

State **two** items of information on the case that will be of help to the user.

- 1 .....
- 2 ..... [2]

(c) The circuit board for the toy is shown in Fig. 3a.  
A chip on board (COB) integrated circuit is used.  
Explain why this is better for the manufacturer than using either of the other two types of integrated circuit shown in Fig. 3b.



Fig. 3a

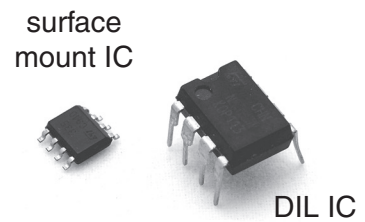


Fig. 3b

.....

.....

.....

.....

[3]

Turn over

(d) The toy will only make a sound in the dark.  
Name **two** components that can be used to detect light level.

1 .....

2 ..... [2]

(e) Ergonomics is used when designing toys.  
Describe how the toy shown in Fig. 1 could be tested for ergonomic suitability.

.....

.....

..... [2]

[Total: 12]

- 2 (a) Fig. 4 shows a soldering iron and wire strippers. State **two** safety checks that should be carried out **before** using the soldering iron.

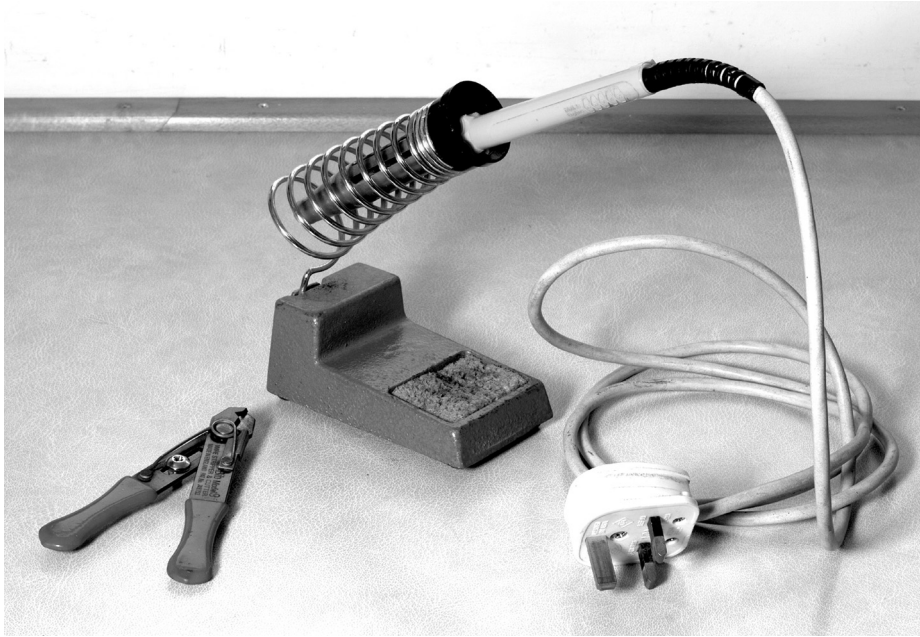


Fig. 4

- 1 .....
- 2 ..... [2]

- (b) Fig. 5 shows a problem that can occur when using wire strippers. Describe how this can be avoided.

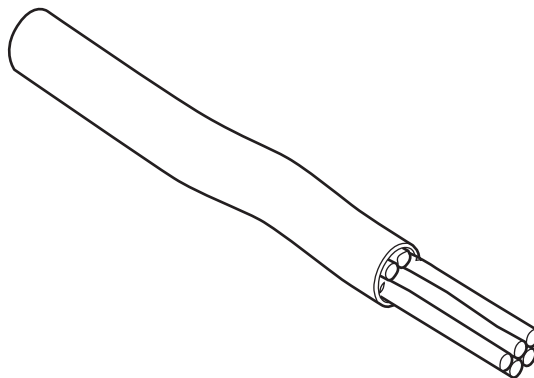


Fig. 5

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

- (c) Accurate measurement is needed when deciding on a drill size to be used for fitting components into a PCB. Fig. 6 shows a digital caliper being used to measure the leg of a diode.



Fig. 6

- (i) State **one** check that should be made before using the digital caliper.  
 ..... [1]
- (ii) Name an alternative tool that could be used to carry out the measurement if a digital caliper is not available.  
 ..... [1]
- (iii) Before fitting the diode into the circuit board the cathode must be identified.  
 Give **one** method of identifying the cathode on the diode shown in Fig. 6.  
 ..... [1]

- (d) Fig. 7 shows a faulty soldered connection. After heating the joint for some time the solder could not be made to flow correctly.

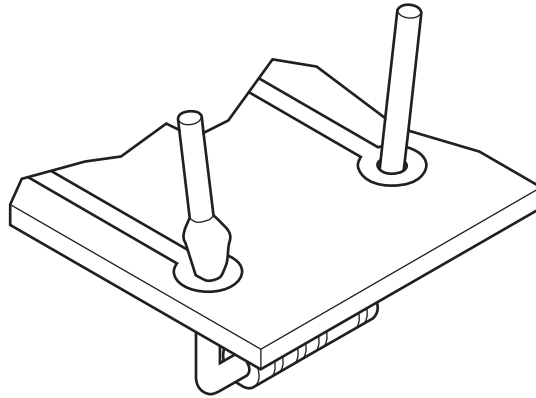


Fig. 7

- (i) Give **one** possible reason why the solder could not be made to flow correctly.

.....  
..... [1]

- (ii) Describe how the fault can be corrected.

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

- (e) Use sketches and notes to show how a multimeter could be used to test a circuit for faulty soldered connections.

[2]

[Total: 12]

Turn over

- 3 (a) Two components are shown in Fig. 8.  
For each component suggest a suitable use in an electronic product.

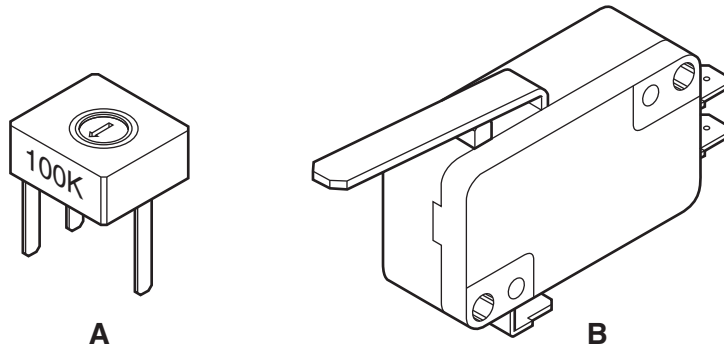


Fig. 8

Use for component A .....

Use for component B ..... [2]

- (b) Fig. 9 shows two types of on/off switch that could be used in a product.

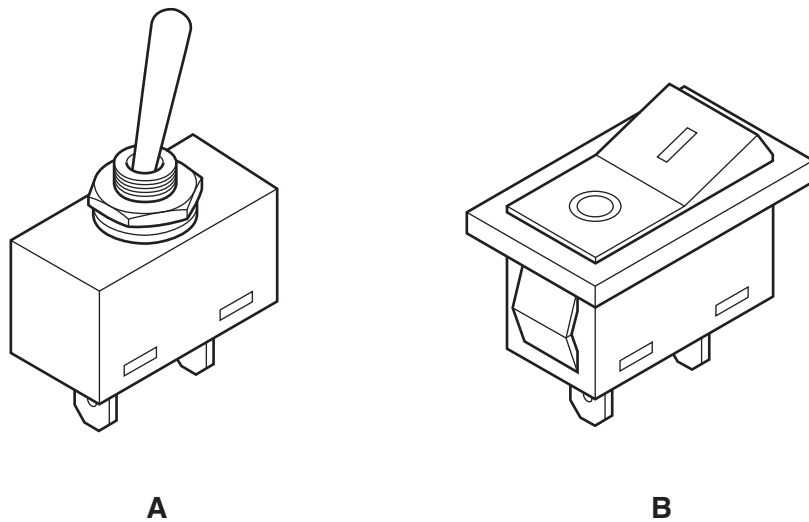


Fig. 9

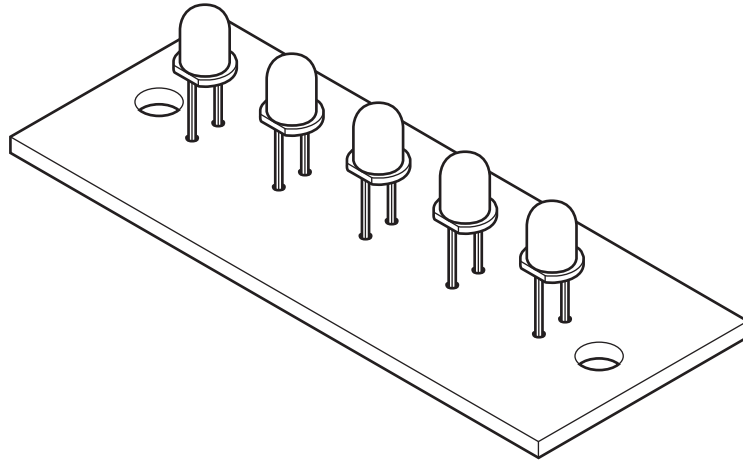
Give **one** benefit for each of the switches.

Switch A .....

Switch B ..... [2]



- (c) Fig. 10 shows five LEDs soldered in position at a set height above a PCB. It can be difficult to solder more than one LED at a set height from a PCB.



**Fig. 10**

Use notes and sketches to show how the problem can be overcome.

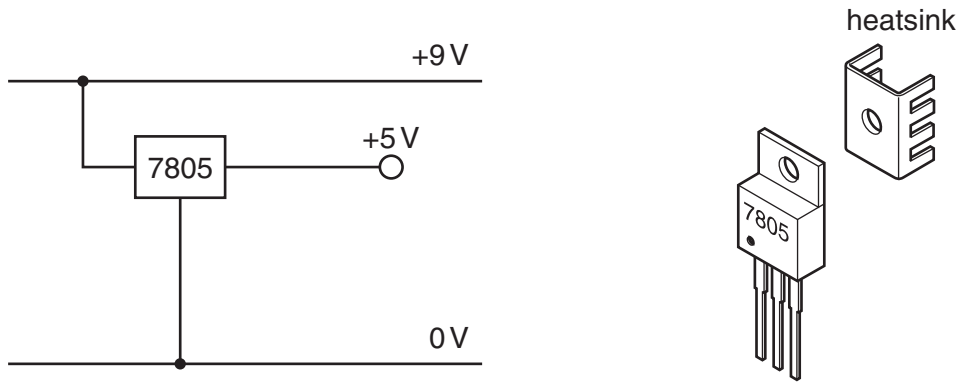
[2]



**Section B**

Answer **all** questions.

- 4 PIC circuits and many logic circuits require a precise voltage supply. Fig. 11 shows part of a circuit being designed to provide a smooth +5V supply. The circuit is based on a 7805 voltage regulator IC.



**Fig. 11**

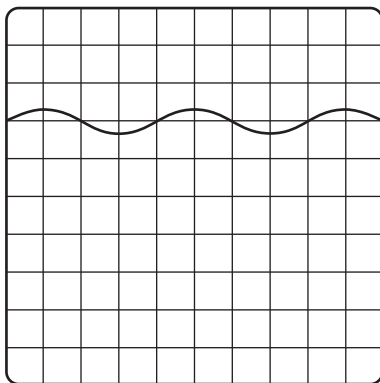
- (a) (i) Give **one** reason why a heatsink may need to be attached to the IC.

..... [1]

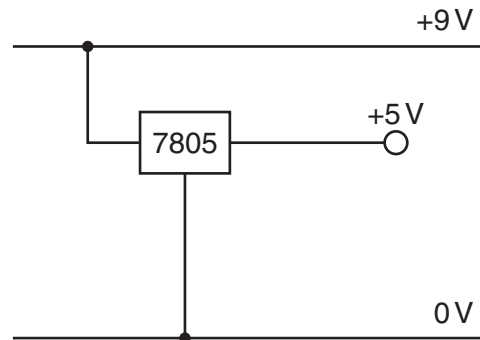
- (ii) Name a suitable material for a heatsink.

..... [1]

- (b) When a 230V AC mains power adaptor is tested using an oscilloscope the output voltage appears as shown in Fig. 12a.



**Fig. 12a**



**Fig. 12b**

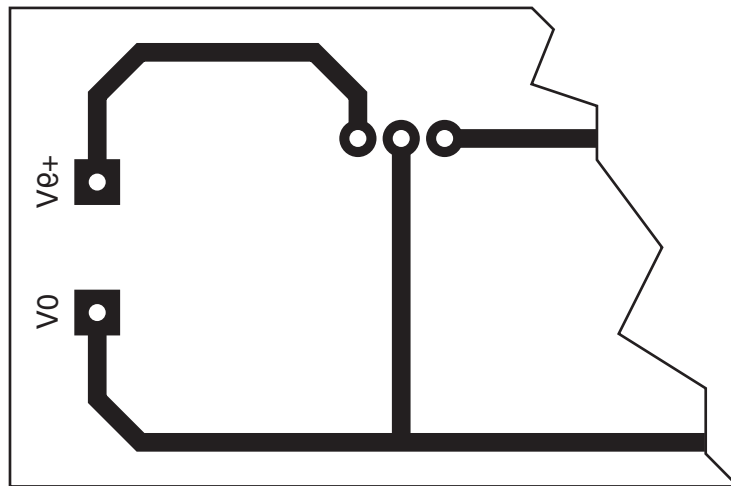
- (i) To remove the ripple from the output the following components are added:
- 47  $\mu\text{F}$  electrolytic capacitor across the input voltage
  - 100 nF capacitor across the output voltage.

Complete Fig. 12b to show the capacitors in place.

[2]

**Turn over**

(ii) Fig. 13 shows part of the PCB layout for the smoothed supply.



**Fig. 13**

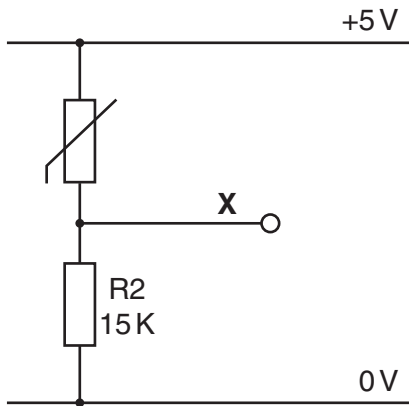
Add the following to the PCB layout:

- pads and tracks for the 47  $\mu\text{F}$  capacitor
- an indication of capacitor polarity.

**[2]**



- 5 Fig. 14 shows part of the sensing circuit for a warning device to indicate when a supermarket fridge temperature is above 4 °C. Values for the thermistor are shown in the table.



°C	kΩ
1	16.18
2	15.35
3	14.56
4	13.82
5	13.12
6	12.46
7	11.84
8	11.25

Fig. 14

- (a) Calculate the voltage at point X when the temperature reaches 4 °C.

Use the formula  $V_{out} = R_2 \times \frac{\text{supply voltage}}{R_1 + R_2}$

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

- (b) The circuit uses a 14 pin PIC IC to convert the temperature signal from an analogue value to a digital value as shown in Fig. 15.

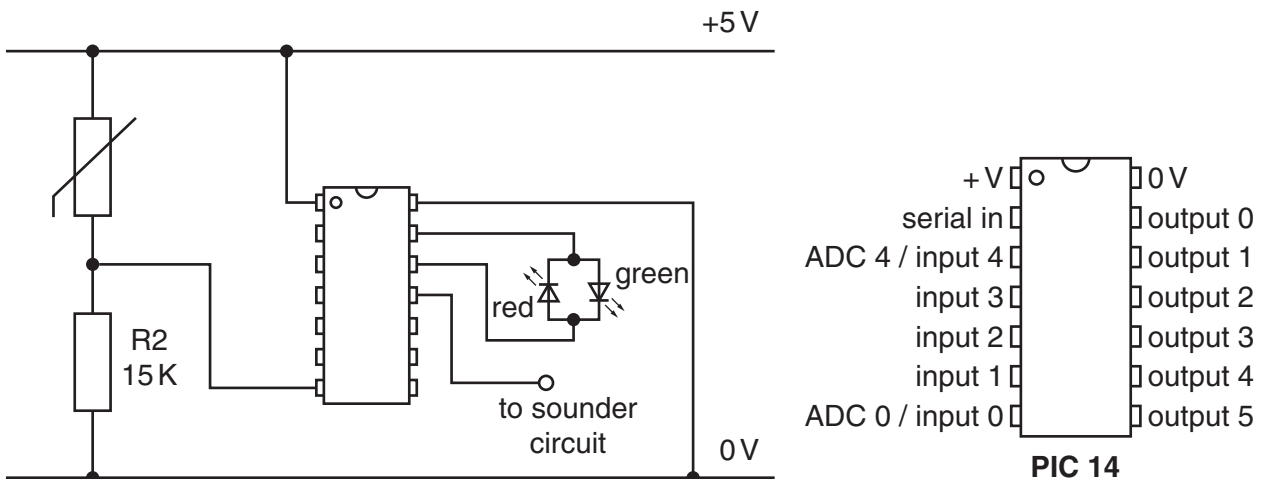


Fig. 15

- (i) Give another method of converting the signal which does not use a PIC IC.

..... [1]

(ii) State the difference between an analogue value and a digital value.

.....  
 ..... [1]

(c) Temperature is displayed using a bicolour LED with the green output on if the temperature is below 4°C.

(i) Use information from Fig. 15 to complete the table below showing the logic level of the outputs that will light each colour of the bicolour LED.

	output 0	output 1
green LED		
red LED		

[2]

(ii) The PIC program uses a delay to ensure that the outputs remain constant for at least three seconds.  
 Explain why this delay is needed.

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

(d) Part of the output circuit for the warning device is shown in Fig. 16.

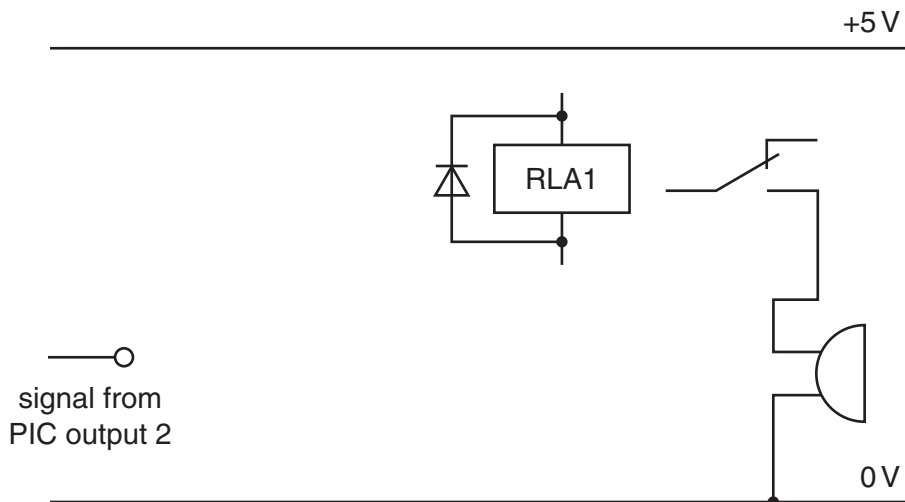


Fig. 16

Add components and connections to operate the sounder when the signal from PIC output 2 is high (logic 1). [3]

[Total: 12]

**PLEASE DO NOT WRITE ON THIS PAGE**



**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.