

Surname	Centre Number	Candidate Number
First name(s)		2



GCE A LEVEL

1601U30-1



THURSDAY, 9 JUNE 2022 – AFTERNOON

DESIGN AND TECHNOLOGY – A2 unit 3 Engineering Design

2 hours 30 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	12	
3.	12	
4.	8	
5.	8	
6.	8	
7.	12	
8.	10	
9.	10	
10.	12	
Total	100	

ADDITIONAL MATERIALS

A calculator, ruler, pencil and coloured pencils.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Answer **all** questions.

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

Write your answers in the spaces provided in this booklet. If you run out of space, use the continuation page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question. You are advised to divide your time accordingly.

The total number of marks available is 100.

You are reminded of the need for good English and orderly, clear presentation in your answers. The quality of your written communication, including appropriate use of punctuation and grammar, will be assessed in your answer to question **9**.

1. Before designing a new torch, a student decides to undertake 'reverse engineering' using the two existing torches shown below.



- (a) Describe how the student would carry out 'reverse engineering' on the two existing torches. [3]

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- (b) Explain the benefits of carrying out 'reverse engineering' on the two torches prior to designing, and the impact this will have on the new torch. [5]

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2. Details of a handheld electronic can opener are shown below.



- The can opener is powered by 4 x 1.5v AA batteries.
- Place can opener onto can and press the start button.
- Automatically rotates and cuts the can through 360 degrees.
- Uses a magnet to retain the lid on the can.
- Made from injection moulded ABS.

(a) Explain **two** important anthropometric values that would need to be considered before designing the can opener. 2 x [2]

Value 1:

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Value 2:

.....

(b) Explain **two** safety issues that would need to be considered when designing the can opener.

Issue 1:

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..... [2]

Issue 2:

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..... [2]

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- (c) Compare the environmental footprint of the new can opener in comparison to the traditional mechanical can opener shown below.

[4]

Examiner
only



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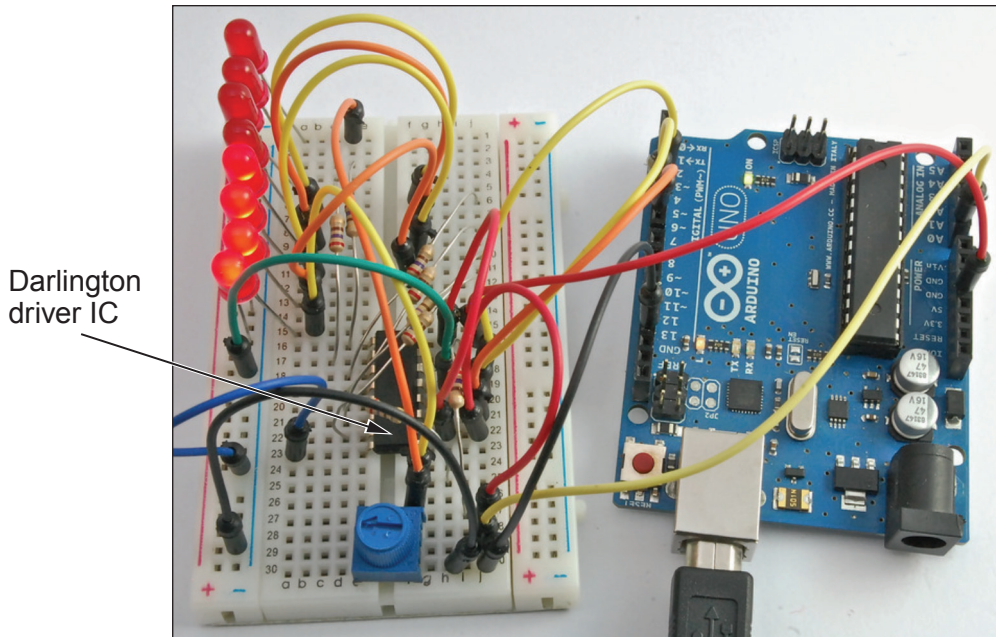
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3. The model below has been constructed during the development of a programmable electronic control system.



- (a) (i) State the name of the method of modelling used in the image, and explain how this method works.

Name: [1]

Explanation:

..... [2]

- (ii) Describe **two** advantages to this designer of modelling using this technique.

Advantage 1:

..... [2]

Advantage 2:

..... [2]

(b) When modelling the control system, the designer opted to use a standard bought-in printed circuit board (PCB) to interface with the model.

(i) Explain, in detail, the benefit of using the standard bought-in PCB to the designer. [3]

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(ii) Explain why the Darlington driver integrated circuit (IC) is needed to power the LEDs. [2]

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4. A robot vacuum cleaner has been launched to automatically remove dust and debris from multiple floor coverings without the user being present.



Features:

- 5 cleaning modes
- Disinfecting UV lamp
- Self-charging base, with return to base function
- HEPA filters trap allergens
- Mop cleaning as well as vacuuming
- Comes with a remote control and app feature



- (a) Describe how both ‘technology push’ and ‘market pull’ forces have influenced the development of the robot vacuum cleaner.

Technology push:

..... [2]

Market pull:

..... [2]

(b) Explain how research on current technological trends would suggest that the robot vacuum cleaner is popular with the target market.

[4]

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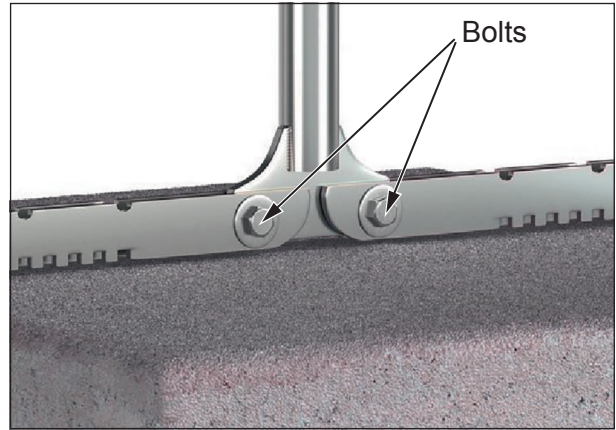
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5. The mechanical lifting aid below is designed to allow users to easily lift, move and position patio slabs.



- (a) State the name of the simple mechanical system used in the lifting aid, and explain how a patio slab can be lifted when the user applies an effort force to the handle.

Name: [1]

Explanation:

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..... [3]

- (b) In the space below, use notes and sketches to explain how a shear force occurs in the bolts when a patio slab is lifted. [4]

6. A timer to automatically water plants is shown below at different stages of its development.



Physical testing



CAD modelling



Final prototype

(a) Describe the importance of physical testing during the development of the timer.

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..... [2]

(b) Identify **one** benefit and **one** limitation to the designer of using CAD modelling when developing the timer.

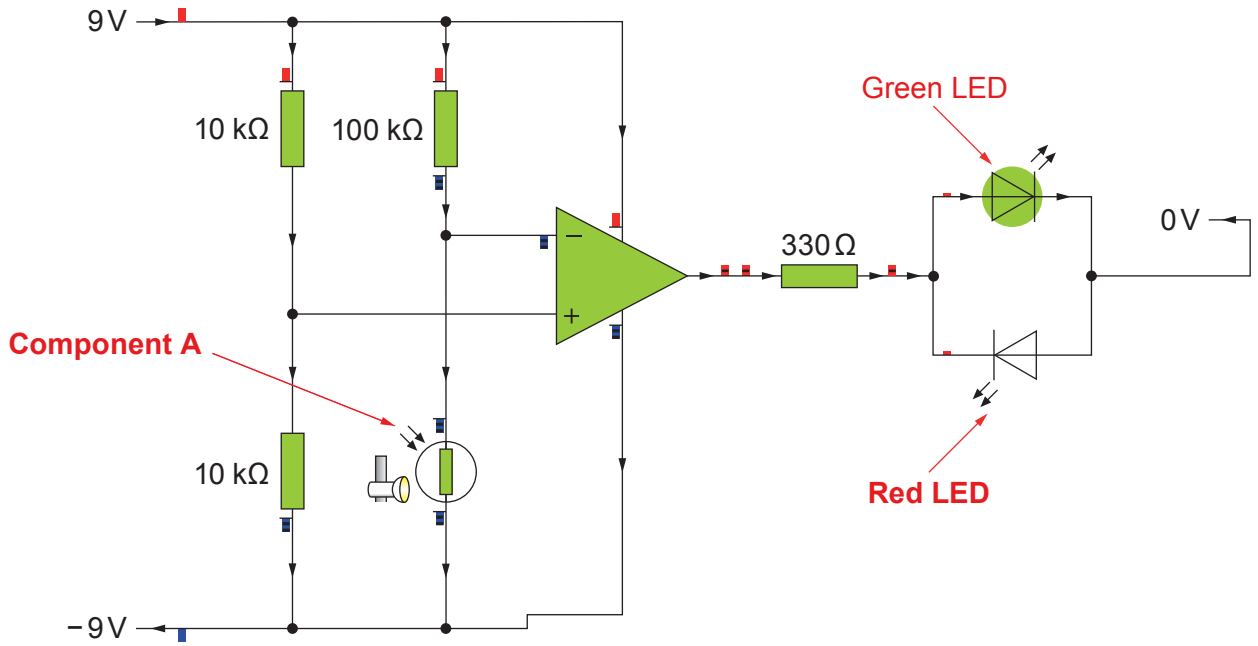
Benefit:
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..... [2]

Limitation:
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..... [2]

(c) Explain why it is critical to produce a fully functioning final prototype during the development of the timer.

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..... [2]

7. Study the electronic circuit below.



(a) (i) State the name of **Component A** and describe how this component functions.

Name: [1]

Function:

..... [2]

(ii) Describe in detail what has to happen in the circuit for the **Red LED** to illuminate. [3]

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(iii) Explain the need for the component marked 330Ω .

[2]

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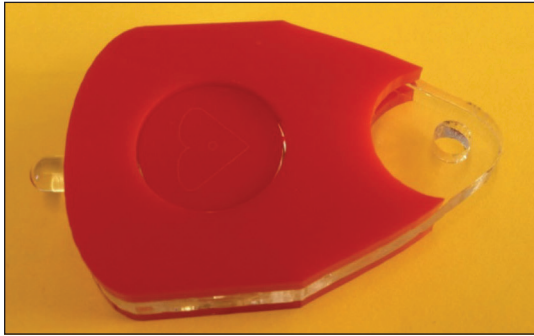
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(b) In the space below, show how two 9V batteries are connected to achieve the power supply shown in the circuit.

[4]

8. A laser cut keyfob light has been designed to illuminate one 3 Volt LED when a button is pressed.



(a) (i) Describe the properties of this material that make it suitable for laser cutting.

Name of thermoplastic: [1]

Properties:

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..... [2]

(ii) The middle layer is made from 6 mm thick sheet, and the outer layers from 3 mm thick sheet. Explain how this will impact on the process of laser cutting. [3]

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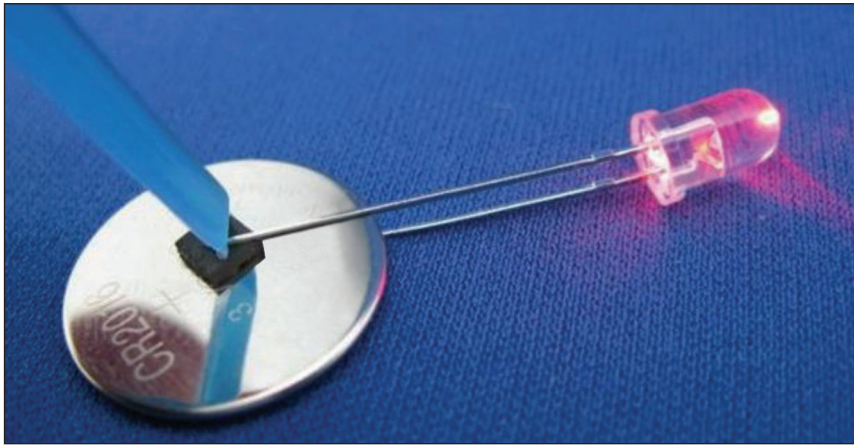
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- (b) After testing the keyfob light, the next iteration shown below includes a smart material which improves the function of the keyfob light.



- (i) State the name of the smart material shown. [1]
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- (ii) Explain in detail how the addition of this smart material will affect the performance of the keyfob light. [3]
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10. Evaluate the importance of the designer knowing the needs, wants and values of the user, and how this is critical to the eventual success of a product. [12]

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