Mock examination based on 2016 AQA Preliminary material

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This paper should only be used for revision and exam preparation.

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	
MAX	120

Section A

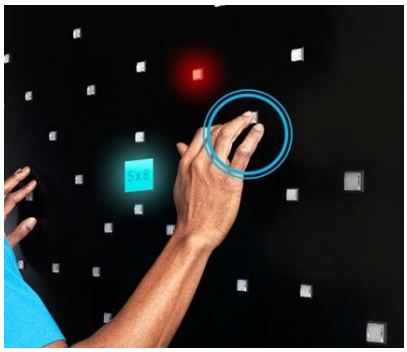
Answer this question in the space provided.

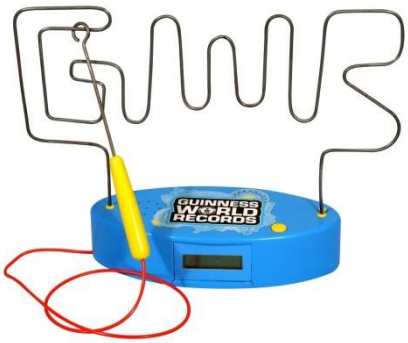
You are advised to spend about 35 minutes on this question.

1. This question is about designing products to help improve hand and eye coordination.

Design brief

You are asked to design a product that will help improve people's hand-eye coordination. Here are some images that might help you.





The product must meet the following specification points. The product must:

- give light and sound outputs
- be fun and engaging
- be safe for use
- use a microcontroller-based circuit capable of controlling sound and light outputs

1 (a) Give **four** more design requirements for the product.

Two design requirements should be for the casing.

Two design requirements should be for the circuit.

An example is given below.

The case will be made from tough and durable material.

[4 marks]

Design requirements for product casing:

1 ……

……

2 ……

……

Design requirements for product circuit:

1 ……

……

2 ……

……

1 (b) Using the information given in the design brief and requirements on page 4, and your four design requirements above, sketch **two** different ideas for the product.

You should sketch your ideas on the next page.

Marks will be awarded for:

- Features to make the product engaging
- The location of sound and light components
- Creative ideas
- Quality of communication

[8 marks]

Idea 1

Idea 2

1 (c) Choose one of your ideas from part (b).

Use notes and sketches to produce a detailed design for the case of the product to meet the design brief and your design requirements.

Marks will be awarded for:

- Case construction details **[2 marks]**
- Materials to be used **[2 marks]**
- Details of how input switches/sensors are triggered and held in place **[3 marks]**
- Quality of communication **[3 marks]**

1 (d) The circuit must give a sound and light output.

1 (d) (i) Describe how a microcontroller can be used to make the product fun and engaging for the user.

[2 marks]

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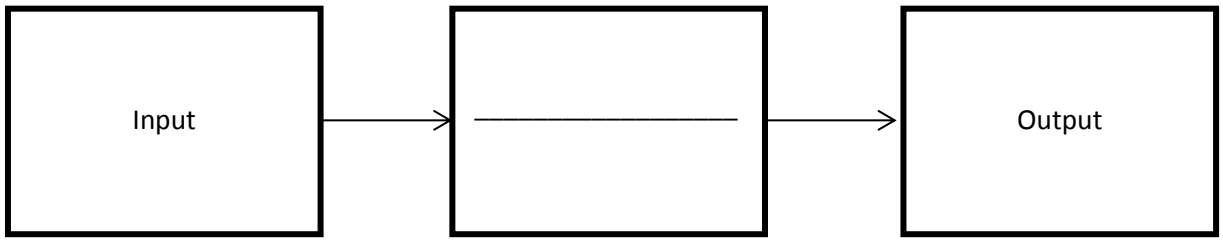
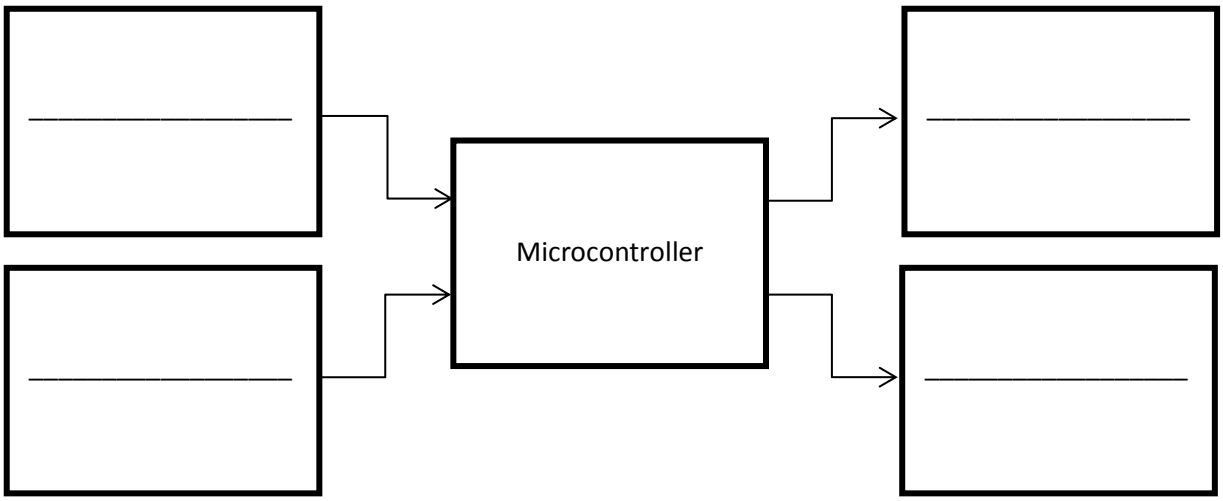
1 (d) (ii) Complete the system diagrams below by first completing the system block diagram and then naming two input components and two output components for the product.



[1 marks]



[4 marks]

1 (e) Use notes and a circuit diagram to show how the input and output components are connected to the microcontroller.

[4 marks]

1 (f) Explain one design feature that would allow for easy maintenance by the user.

[2 marks]

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Section B

Answer this question in the space provided.

2 This question is about microcontrollers.

2 (a) (i) Give an example of a product in which a microcontroller might be used, which is different from the product in section A.

Product ……

[1 mark]

2 (a) (ii) Suggest **three** advantages of using microcontrollers to control products

Advantage 1..……..……

……

Advantage 2...……..……

……

Advantage 3....……

……

[3 marks]

2 (b) (i) State a suitable voltage for powering microcontrollers.

……

……

[1 mark]

2 (b) (ii) A 9 volt power supply is to be used with a circuit containing a microcontroller. Name a component that could be used in the circuit to make it suitable for the microcontroller.

……

……

[1 mark]

2 (c) In the space below, use a programming system to write a program for a steady hand game, so that:

- During play, when the wand hits the wire a light emitting diode (LED) flashes for three seconds with a frequency of 2 Hertz

[7 marks]

13

3 This question is about timing circuits.

3 (a) Complete the table below by describing the outputs produced by each subsystem.

	Subsystem	Description of output
(i)	Astable	
(ii)	Monostable	
(iii)	Bistable	

[3 marks]

3 (b) A 555 timer IC is housed in an 8-pin DIL package.

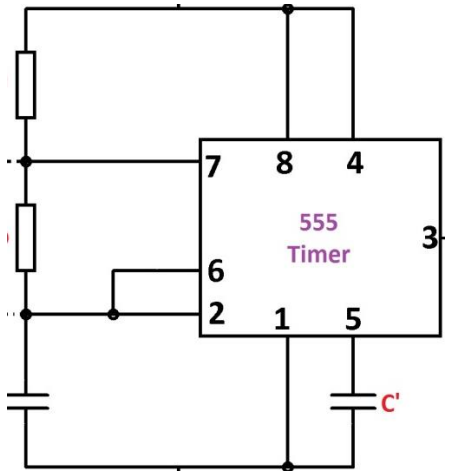
What do the abbreviations **IC** and **DIL** mean?

IC ……

DIL ……

[2 marks]

3 (c) The following circuit diagram is for an astable circuit.



3 (c)(i) Add the following to the diagram:

- Two LEDs that will flash alternately
- Positive power rail
- 0V supply rail

[6 marks]

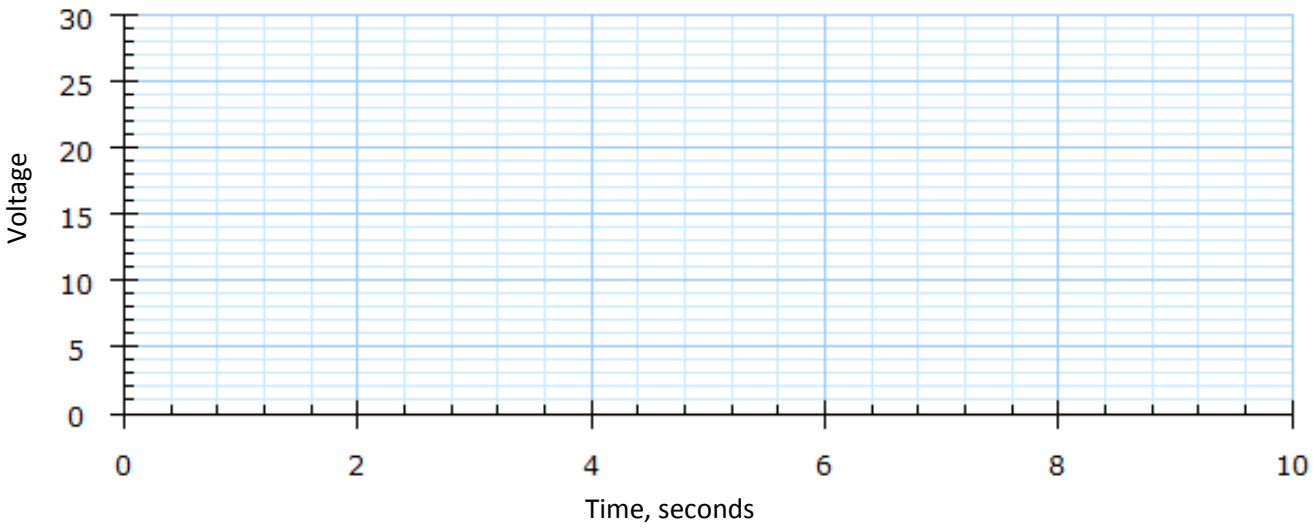
3 (c)(ii) What type of output signal is produced by this circuit?

…… **[1 mark]**

3 (d) In the space below draw a graph to represent the output from the circuit. Include the following:

- A period of 1 second
- Equal mark-space ratio
- Mark labelled
- Space labelled

[4 marks]



16

4 This question is about printed circuit boards (PCBs).

4 (a) Circuits can be designed and developed using CAD (computer aided design) or traditional methods such as breadboarding.
Give **one** advantage and **one** disadvantage of using CAD and breadboarding for designing circuits.

	Advantage	**Disadvantage**
CAD		
Breadboard		

[4 marks]

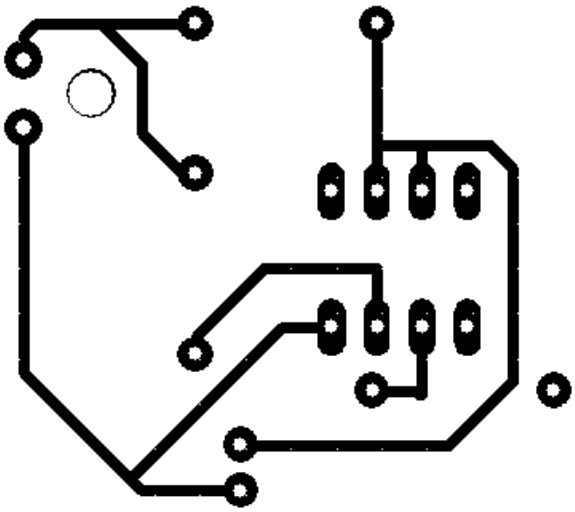
4 (b) Complete the table below to outline the stages involved in the production of a PCB using either the photo-etch method or CNC.

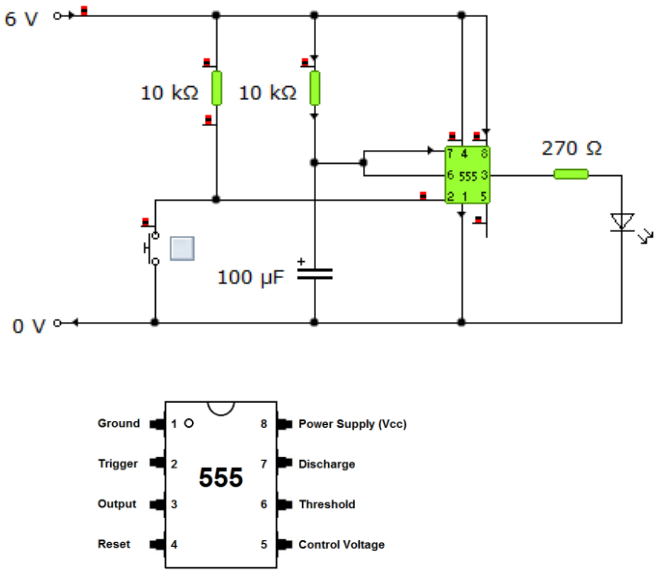
Chosen method ……

Stage	**Description**
1	
2	
3	
4	
5	
6	

[6 marks]

4 (c) A PCB layout for a timer circuit containing a 555 IC is shown below.





4 (c)(i) Explain **two** quality control checks that can be carried out on the PCB before it is populated.

Check 1. ……..

……

……

Check 2. ……..

……

……

[4 marks]

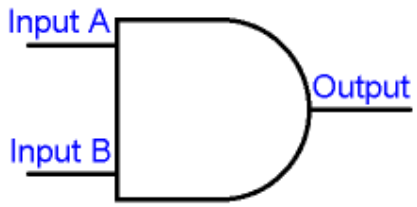
4 (c)(ii) The PCB is incomplete. Use the information provided to complete the PCB design by adding pads and tracks for the following:

- A positive supply rail to the IC
- A PTM switch to trigger the timer
- A timing capacitor
- A light emitting diode between the output of the IC and the 0 volt rail

[4 marks]

5 This question is about logic and logic gates.

5 (a)(i) Name the logic gate shown below.



……

[1 mark]

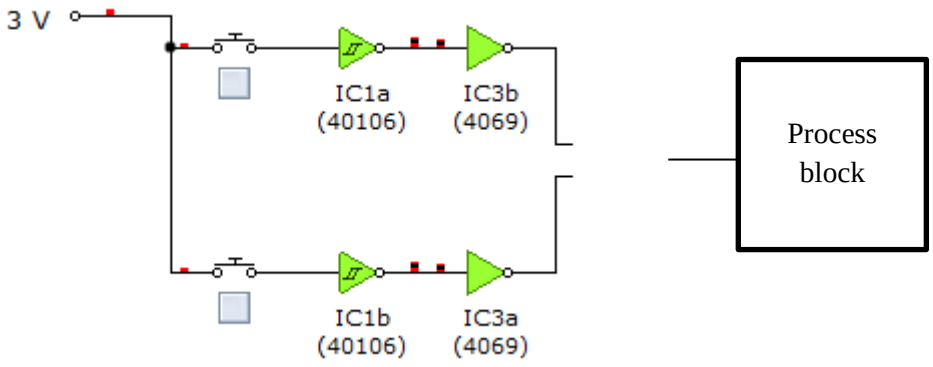
5 (a)(ii) Complete the truth table for the logic gate above.

Input B	Input A	Output
0	0	
0	1	
		0
1	1	

[4 marks]

5 (b) A reaction game like those seen in Section A has two input sensors. Contact with either sensor will trigger the system.

5 (b)(i) Complete the circuit diagram below by inserting a suitable logic gate.



[1 mark]

5 (b)(ii) Name the logic gate you have added.

…… **[1 mark]**

6 This question is about manufacturing.

6 (a) A manufacturer will be producing a large number of plastic cases for a game and has chosen **injection moulding** as the method of manufacture.

Explain why injection moulding is suitable for high volume production.

……...

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[3 marks]

6 (b) A student is using vacuum forming as a method of creating a plastic case for a prototype for a steady hand game.

Explain why vacuum forming is suitable for creating prototypes.

……...

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……...

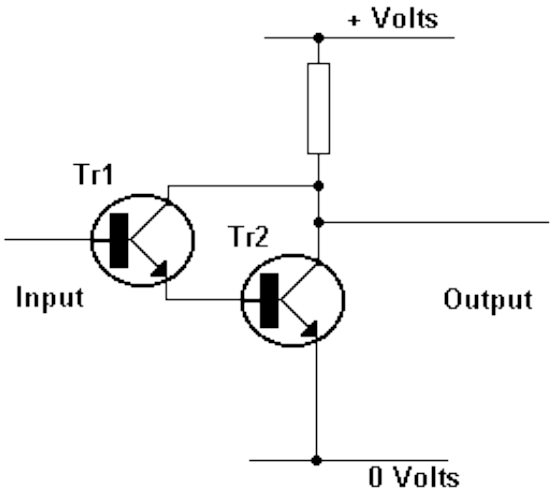
[3 marks]

6 (c) In the space below draw an example of a suitable former that could be used to create a simple vacuum formed product casing. Label the drawing to highlight features of the former.

[3 marks]

7 This question is about transistors.

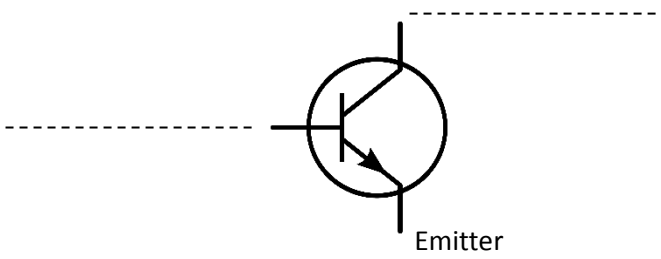
A sensing circuit uses bipolar transistors in the arrangement shown below.



7 (a)(i) What is the name given to this arrangement of transistors?

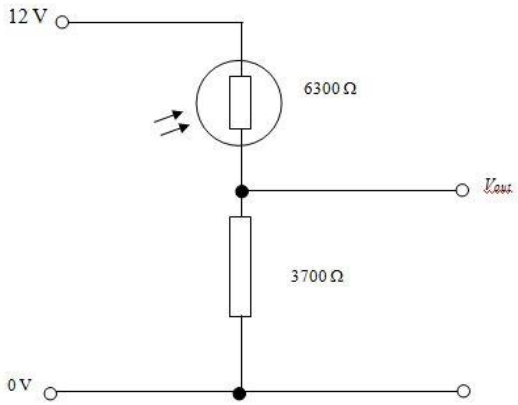
…….. **[1 mark]**

7 (a)(ii) Label each leg of the transistor below.



[2 marks]

7 (b) The input block of the system uses a potential divider as shown below.



Use the potential divider formula to calculate V_{out} that would be used to forward bias the transistor arrangement.

Formula ……

Working ……

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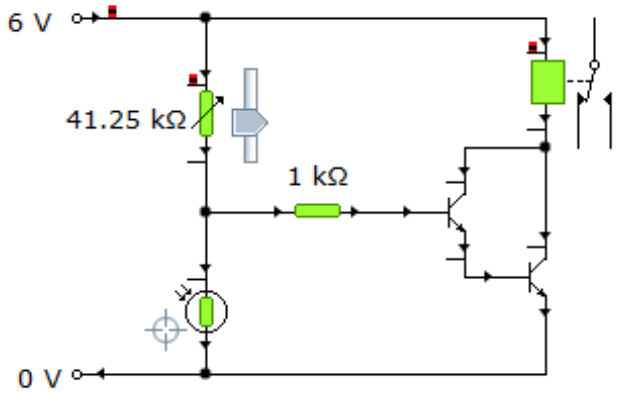
Answer …… **[3 marks]**

7 (c) The output from the system is used to switch a relay.



7 (c)(i) Add a component to prevent back e.m.f. from the relay coil causing damage to the transistors. **[2 marks]**

7 (c)(ii) Name the component you have added to the circuit. **[1 mark]**

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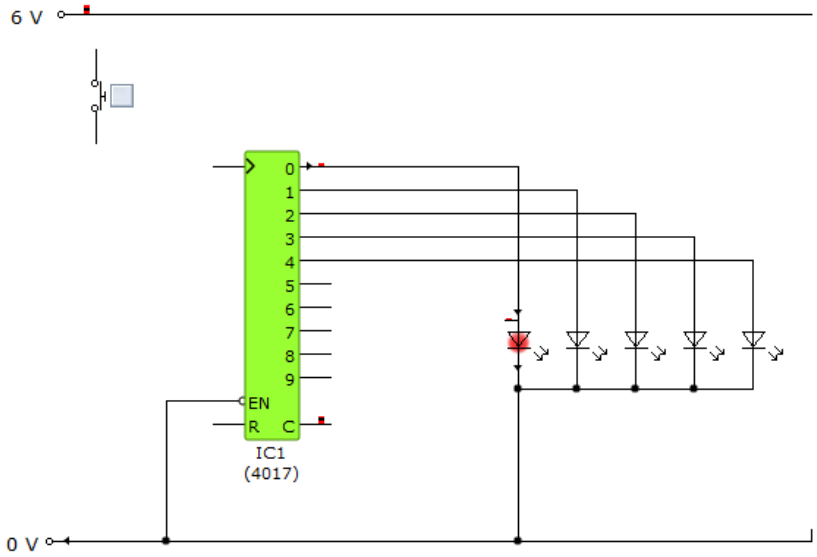
9

8 This question is about counting circuits.
The circuit below uses a 4017 decade counter to display a sequence of five LEDs in turn when a signal is received at the input.



8 (a) Complete the circuit diagram by:

- Adding a pull down resistor between the switch and 0 volt rail
- Connecting the switch to create a count input for the IC
- Creating a connection to reset the counter after the fifth LED has lit **[3 marks]**

8 (b) When the circuit was tested the input was affected by switch bounce.

Explain what is meant by switch bounce.

……

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……

[2 marks]

5

9 This question is about sustainability.

During the life cycle of an electronic product many sustainability issues are likely to be considered.

Discuss these issues using an example product to help illustrate your answer.

You will be tested on the Quality of Written Communication in this question.

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[8 marks]

End of questions