Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

AQA

General Certificate of Secondary Education
Specimen Paper

Design and Technology: Electronic Products XXXX/W

Unit 1: Written Paper

Date: Time

For this paper you must have:
- a pen, a pencil, a ruler, an eraser and a pencil sharpener.
- You may use a calculator.

Time allowed:
- 2 hours

Instructions
- Use black ink or black ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show the working of your calculations.

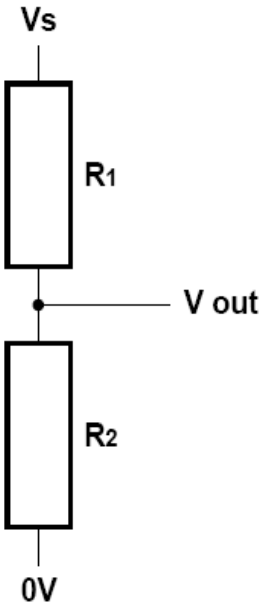
Information
- The maximum mark for this paper is 120.
- The marks for questions are shown in brackets.
- The questions in Section A relate to the context referred to in the preparation sheet that was previously issued.
- A list of formulae and other information, which you may wish to use in your answers, is provided on pages 2 and 3.
- You are reminded of the need for good English and clear presentation in your answers. Quality of Written Communication is assessed in question 4 and question 7(b).

You may need to use one or more of the following formulae when answering questions which includes calculations.

Potential Difference — Potential Difference = Current × Resistance ($V = I \times R$)

Series Resistors — $R_{total} = R1 + R2 + R3$ etc

Potential Divider



$$V\ out = \frac{R2}{R1 + R2} \times Vs$$

where V out = signal value

Vs = supply voltage

R1 and R2 are resistance values

Time Constant — Time Constant ≏ Resistance × Capacitance ($T \doteq R \times C$)

Astable Frequency for 555

$$f = \frac{1.44}{(R1 + 2R2) \times C}$$

Mark Space Ratio

$$= \frac{\text{Time high}}{\text{Time low}}$$

Time High = 0.693 x (R1 + R2) x C

Time Low = 0.693 x R2 x C

Inverting Op.Amps — Gain = $\frac{-Rf}{Rin}$ Where Rf = feedback resistor value; Where Rin = input resistor value

You may need to use the following information when answering some of the questions.

The figure shown below and their decade multiples or submultiples are the series of preferred values in accordance with BS: 2488

E12 Resistors series 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82

E24 Resistor series 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91

Capacitor series 10, 22, 47

Resistor colour code

Colour	Band 1	Band 2	Band 3 (no. of 0s)	Band 4 (tolerance)
Black	0	0	None	
Brown	1	1	0	
Red	2	2	00	
Orange	3	3	000	
Yellow	4	4	0000	
Green	5	5	00000	
Blue	6	6	000000	
Violet	7	7	-	
Grey	8	8	-	
White	9	9	-	
				Gold = 5%
				Silver = 10%

Turn over for the first question

SECTION A

You should answers **all** questions in this Section

This design task is to design a flashing light to be fitted to the rear of a bicycle.

1 Your design must satisfy the following specification points:

- the bicycle light is powered by a battery
- the bicycle light has an on / off switch
- the bicycle light has four LEDs which flash
- the bicycle light will switch on automatically when it gets dark
- the bicycle light needs a method of attachment to the bicycle frame.

1 (a) Give **two** advantages of using AA size batteries rather than AAA size batteries in the light.

……

……

……

(2 marks)

Table 2 shows the details of LEDs which could be used for the bicycle rear light.

Table 2

LED	Size (Diameter in mm)	Colour	Cost
A	3	blue	£1.00
B	5	red	£0.10
C	5	white	£0.35
D	10	green	£0.10

1 (b) Identify the most suitable LED for the bicycle rear light from **Table 2**. Give a reason to support your choice.

……

……

……

(2 marks)

1 (c) Suggest two different ways of making the LEDs flash on and off automatically.

An example is given below:

Use a flashing LED in series with other LEDs.

1...……

……

2...……

……

(2 marks)

1 (d) Name a component which can be used as an input device to switch the LEDs on automatically when it gets dark.

……

……

(1 mark)

1 (e) Explain how your chosen device reacts to changes in light levels.

……

……

……

……

(2 marks)

1 (f) Name two different types of Integrated Circuits (ICs) which can react to an analogue sensor.

……

……

……

……

(2 marks)

11

Question 2 is about designing the case for a rear light for a bicycle.

2 The rear light for a bicycle is battery powered, has an On / Off switch and four LEDs.

Using notes and sketches, on the page opposite develop a design for the case for the rear light which shows the following features:

- the name of a suitable specific material for the case

(2 marks)

- the position of the four LEDs

(2 marks)

- a secure way of holding the LEDs in the case

(2 marks)

- the position of the On/Off switch

(1 mark)

- how access to the inside of the case is achieved

(2 marks)

- the main dimensions of the case

(3 mark)

- a secure method of attachment to the bicycle frame.

(4 marks)

Quality of Communication (3 marks)

Areas outside the box will not be scanned for marking

19

SECTION B

Answer **all** questions is this section

Question 3 is about identifying components.

3 (a) Name the components shown in **Table 3**.

An example has been completed for you.

Table 3

	Component	Component Name
e.g.		Push to Make switch
A		
B		
C		
D		
E		

(5 marks)

3 (b) Name an electronic component which best fits each of the descriptions given below:

(i) It emits light when a current flows from the anode to the cathode.

……..

(1 mark)

(ii) Its resistance decreases as the temperature increases.

……

(1 mark)

(iii) It has two connections and stops a current flowing when it is pressed.

……

(1 mark)

(iv) It has three connections called Anode, Cathode and Gate.

……

(1 mark)

3 (c) Name a smart material which can be easily formed at low temperatures for shaped parts such as handles.

…….

(1 mark)

10

Turn over for the next question

Question 4 is about producing a circuit board.

4 Describe the main stages of making a circuit board using the photo-etching (acid) method. At each identified stage describe and evaluate any Quality Control and Health and Safety issues which might occur.

……

……..……..

……

……

……

……

……

……

……..……..

……

……

……

……

……

……..……..

……

……

(10 marks)

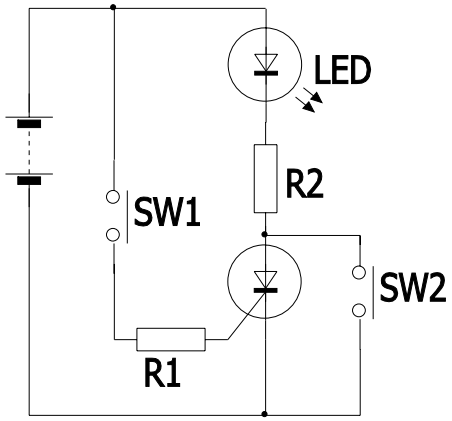
10

Question 5 is about designing a circuit.

5 An advertising company has asked you to design a small electronic torch as a promotional gift.

5 (a) One possible solution is a circuit using a Thyristor and an LED as shown in **Figure 1.**

Figure 1



Explain what happens when the following actions are carried out in the order shown in the above the circuit.

5 (a) (i) SW1 is pressed and then released.……

……..

……..

……..

(2 marks)

5 (a) (ii) SW2 is pressed and then released.…….

……

……

……

(2 marks)

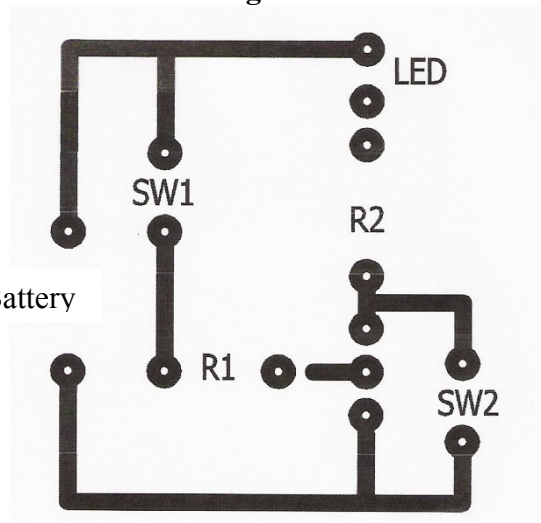
5 (b) The PCB layout of the circuit in **Figure 1** is shown in **Figure 2.**

When the circuit was built it did not work.

On **Figure 2,** identify **two** mistakes which could be the cause of the problem by drawing a circle around each mistake.

(2 marks)

Figure 2



5 (c) Explain the advantages for a designer of using Computer Aided Design for producing the Printed Circuit layout.

In your answer evaluate this method of working compared with the alternative method of building circuits on stripboard (Veroboard) or prototyping board and then with manually drawing the PCB layout.

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

(5 marks)

11

Question 6 is about a monostable circuit.

6 A student is designing a small light and has decided to include a feature which would automatically switch off the light after an amount of time.

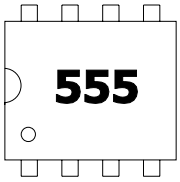
A 555 IC operating as a monostable, can provide a time delay.

The 555 IC is in an 8 pin package.

6 (a) On the plan view in **Figure 3**:

- Clearly label pin 2 with a **2**
- Clearly label pin 7 with a **7**

Figure 3



(2 marks)

6 (b) **Figure 4** shows an incomplete circuit diagram for the monostable circuit.

Complete **Figure 4** to work as a monostable by connecting:

6 (b) (i) a timing potential divider

(3 marks)

6 (b) (ii) a trigger input showing the appropriate value of components

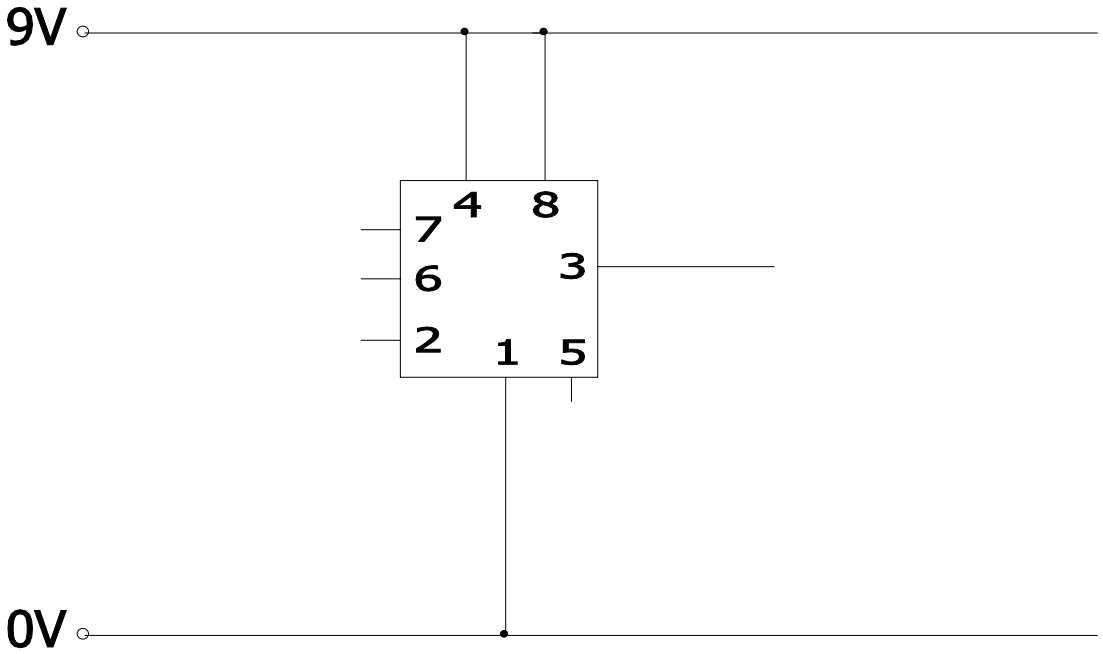
(4 marks)

6 (b) (iii) a suitable transducer driver, a lamp and any other necessary components to the output, pin 3, so that it will light when pin 3 goes high.

(3 marks)

Quality of drawing (2 marks)

Figure 4



6 (c) (i) Name the Transducer driver you have chosen in part (b) (iii) above.

……..

(1 mark)

6 (c) (ii) Suggest an alternative component that could also be used as a Transducer driver in part (b) (iii) above.

……..

(1 mark)

6 (c) (iii) Evaluate the need to add devices such as transducer drivers by stating how circuit performance is improved by such devices.
Ensure you explain what would happen if they were not used.

.

……..

……..

...……

……

……..

……..

...……

……..

……..

...……

(3 marks)

6 (d) Calculate the time constant for the monostable if the resistor is 470K and the capacitor is 100 µF.

Formula: ……..……

Working:

……

……

……

Answer with units: ……..……

(4 marks)

23

Question 7 is about social and environmental issues.

7 Electronic products have a product lifecycle.

7 (a) Explain what is meant by the term product lifecycle.

……

……

……

……

……

(3 marks)

7 (b) Evaluate how the lifecycle of a product affects the consumer and the environment.

……

……

……

……

……

……

……

……

……

……

……

……

(6 marks)

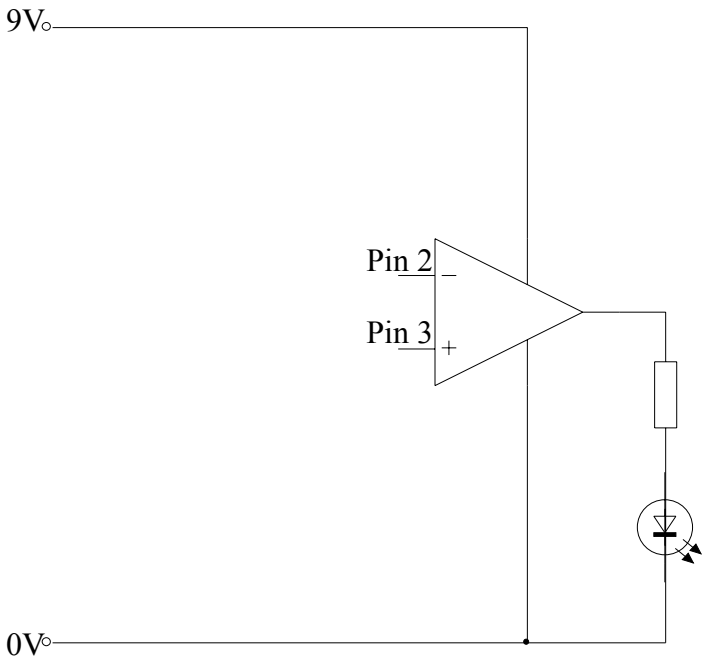
9

Question 8 is about using an operational amplifier as a comparator.

8 A student is developing a circuit using a comparator to warn gardeners that the temperature is dropping and that plants might be at risk.

8 (a) **Figure 5** shows an incomplete circuit diagram for a comparator.

Figure 5



Complete **Figure 5** by adding:

8 (a) (i) a fixed potential divider to provide a reference voltage of 4.5V to pin 2

(4 marks)

8 (a) (ii) a temperature sensing potential divider to pin 3 to make the output go high when the temperature falls. The potential divider must have the ability to adjust the threshold voltage at pin 3.

(4 marks)

8 (b) Calculate the voltage at pin 3 when the thermistor has a value of 15K and the resistor value is 5K.

Formula ……

Working……

……..

……..

……..

……..

Answer……..

(4 marks)

12

Barcode

Areas outside the box will not be scanned for marking

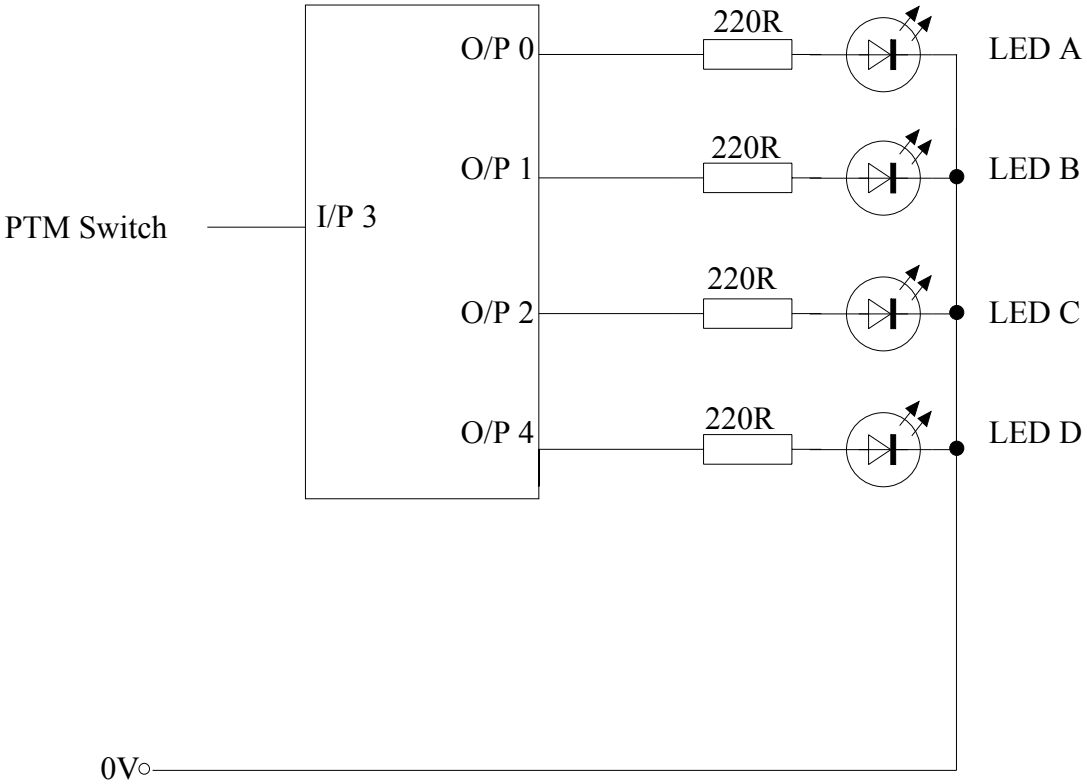
There are no questions printed on this page

Turn over for the next question

Question 9 is about microcontrollers.

9 A student designs a warning light with four LEDs, which are controlled by an 8 pin microcontroller as shown in **Figure 6**.

Figure 6



Using a programming system you are familiar with, write a sequence of commands for the input and outputs for the microcontroller shown in **Figure 8** so that the LEDs come on as detailed below.

After the PTM switch is pushed, all four LEDs come on for 2 seconds and then flash in the sequence A, B, C and D for 15 times, each coming on for 0.25 seconds. This should continue until the PTM switch is pushed again.

Show your answers on the page opposite.

(15 marks)

Areas outside the box will not be scanned for marking

15

END OF QUESTIONS

Additional Sample Question

"The term *nanotechnology* is generally defined as utilizing technology less than 100nm in size"
Describe how nanotechnology has changed electronic products and the impact this has on society.

……

……

……

……

……..

.....……

……

……

……

……

(5 marks)