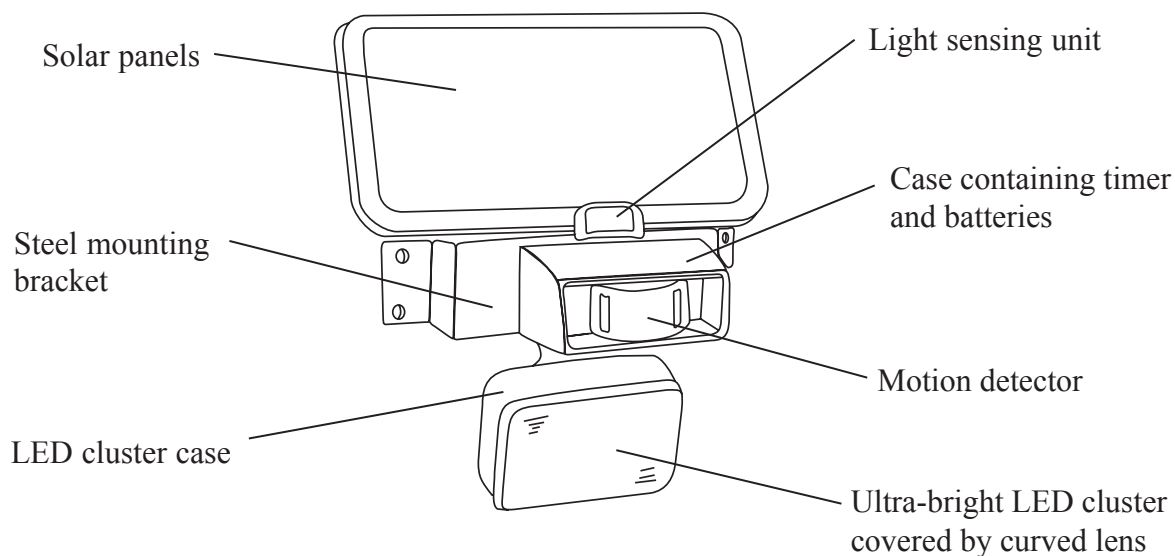


Answer ALL the questions. Write your answers in the spaces provided.

1. The drawing below shows details of a solar powered security light.



(a) Two specification points for the solar powered security light are that it must:

- light a large area
- be powered without mains electricity.

Under each of the following headings, give **one** more point that should be included in the specification for the solar powered security light.

For each point, give **one** reason why it should be included.

(i) The needs of the user.

Point

Reason

.....

(2)

(ii) Environmental considerations.

Point

Reason

.....

(2)



(iii) Quality.

Point

Reason

.....

.....

(2)

(b) The mounting bracket is made from steel.
One reason for using steel is that it can be bent to shape.

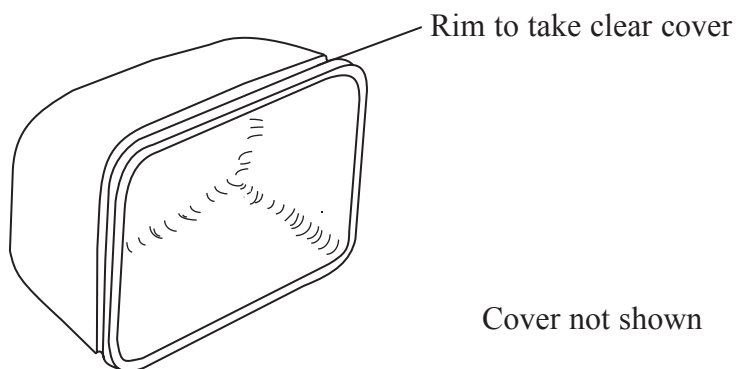
Give **two** other reasons why steel is a suitable material from which to make the mounting bracket for the solar powered security light.

1

2

(2)

(c) The ultra-bright LED cluster case is shown below. It is manufactured using injection moulding.



Give **two** reasons why injection moulding is a suitable process for manufacturing the ultra-bright LED cluster case.

1

2

(2)



- (d) The connections between the solar panels and the batteries of the security light are made from copper.

Give **two** properties of copper that make it suitable for the connections between the solar panels and the batteries.

For each property give **one** reason why it makes copper suitable for the connections between the solar panels and the batteries.

Property 1

Reason

Property 2

Reason

(4)

- (e) Quality control checks are carried out at important stages during the manufacture of the solar powered security light.

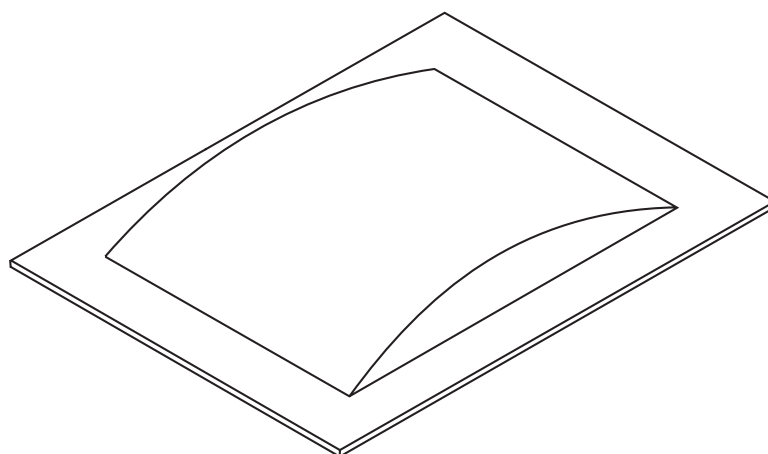
Name **two** important electronic quality control checks, other than safety, that should be made during the manufacture of the solar powered security light.

1

2

(2)

- (f) The thermoplastic cover for the motion detector is shown below. It is made in batches using the vacuum forming process.



Describe **one** way in which the shape of the thermoplastic cover for the motion detector makes it suitable to be made in batches using the vacuum forming process.

.....

.....

(2)



(g) Two purposes of the solar powered security light are that it must:

- light a large area
- be powered without mains electricity.

Explain, under the following headings, how the solar powered security light achieves these purposes.

(i) Lights a large area.

.....
.....
.....

(2)

(ii) Be powered without mains electricity.

.....
.....
.....

(2)

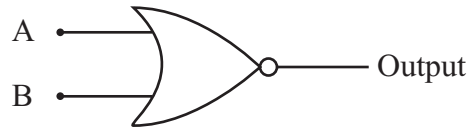
Q1

(Total 22 marks)

| | |
|--|--|
| | |
|--|--|



2. (a) The logic diagram of a NOR gate is shown below.



(i) Complete the truth table for the NOR gate. The first and last lines have been done for you.

| Input A | Input B | Output |
|---------|---------|--------|
| 0 | 0 | 1 |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | 0 |

(2)

(ii) The NOR gate needs digital signal inputs.

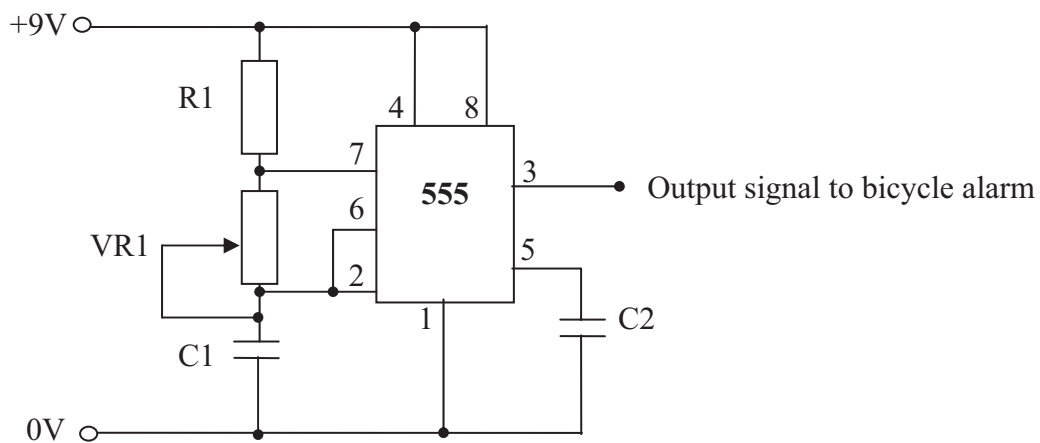
Complete the graph of input A below.



(2)

(b) Part of a bicycle alarm circuit is shown below.

A 555 Astable is used to generate the pulses for the bicycle alarm circuit.



(i) Name the **three** components that control the frequency of the output signal.

- 1
- 2
- 3

(3)



(ii) Describe **one** way in which the frequency of the output signal can be adjusted.

.....
.....

(2)

(c) A prototype Printed Circuit Board (PCB) for the bicycle alarm needs to be designed.

CAD can be used when designing a prototype PCB.

Describe **one** way that CAD can be used when designing a prototype PCB.

.....
.....

(2)

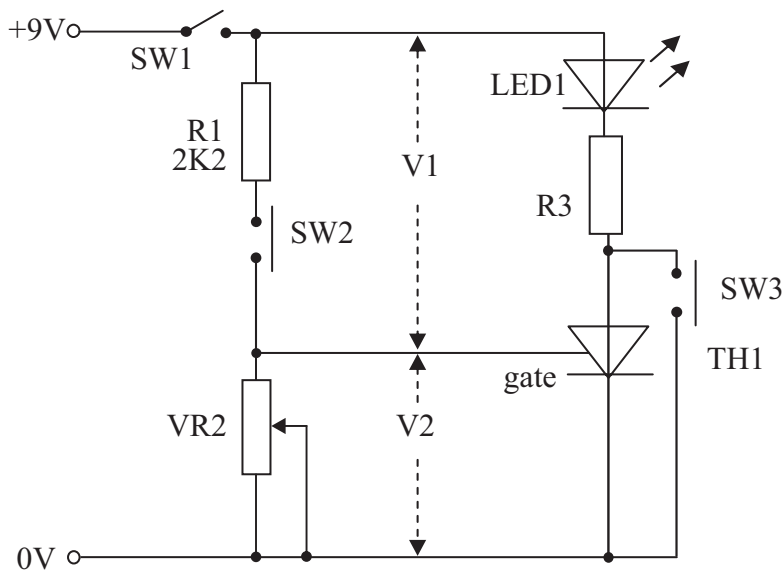
Q2

(Total 11 marks)

| | |
|--|--|
| | |
|--|--|



3. (a) A circuit diagram for a simple latch indicator is shown below.



Switch SW1 is closed to turn on the circuit.

(i) Describe the action of the thyristor (TH1) in the circuit when SW2 is pushed briefly.

.....

(2)

(ii) Explain **one** reason for including SW3 in the circuit.

.....

(2)

(iii) Calculate the value of VR2 if the voltage on the gate of the thyristor (TH1) is 3V when SW2 is pushed.

Use the formula $VR2=R1 \times \frac{V2}{V1}$

Show your working.

..... K
 (2)



(iv) R3 is a protection resistor for LED1. The specification for LED1 is that it emits light at 1.5V with a current of 10mA.

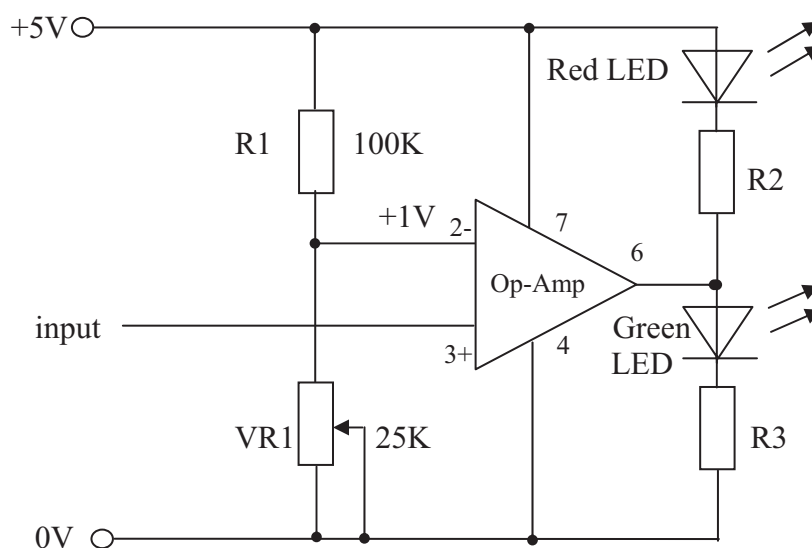
Calculate the value of the resistor used to protect the LED.

Use the formula $R = V/I$

.....

(2)

(b) A circuit diagram for an operational amplifier (Op-Amp) connected as a comparator is shown below.



(i) The output of the Op-Amp in the circuit above is either at +5V or 0V.

From the list below, mark with a cross (☒) the LED or LEDs that will light when the output of the Op-Amp is 0V.

Red Green Both Neither

(1)

(ii) Explain **one** action of the circuit when the input voltage is just greater than +1V.

.....

(2)

(Total 11 marks)

TOTAL FOR PAPER: 44 MARKS

END

Q4



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