

- 1 Fig. 1 shows a sunshade which has an adjustable support made from two tubes, A and B, which slide together and are fixed using a clamping mechanism.

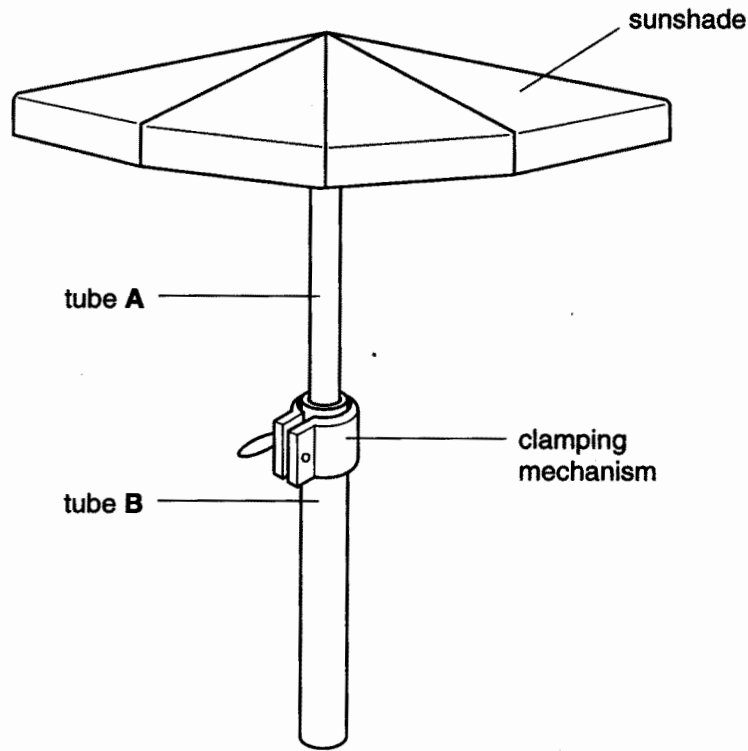


Fig. 1

Fig. 2 shows details of the clamping mechanism. The lever is shown in the open position. When it is locked the mechanism clamps onto tube B causing it to tighten on tube A.

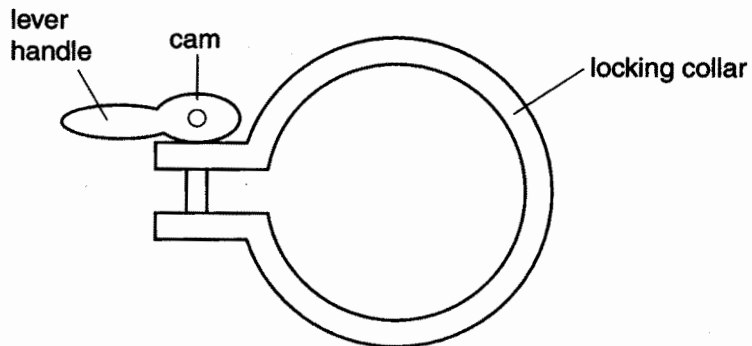


Fig. 2

The designer of the clamping mechanism used a CAD system to produce a suitable design.

- (a) Give **two** benefits to the designer of using a CAD system for designing the clamping mechanism compared to using hand drawing techniques.

Benefit 1 \_\_\_\_\_

[1]

Benefit 2 \_\_\_\_\_

[1]

The lever handle is commercially manufactured using a CNC milling machine.

(b) Explain why this machine would be most suitable for producing the part.

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[2]

It is important that the customer is satisfied with the sunshade and the adjustable support.

(c) Describe **two** quality control checks which will ensure the customer is satisfied with the sunshade and the adjustable support.

Quality control check 1 \_\_\_\_\_ [1]

Reason \_\_\_\_\_ [1]

Quality control check 2 \_\_\_\_\_ [1]

Reason \_\_\_\_\_ [1]

Fig. 3 shows a mark which is to be found on the sunshade.

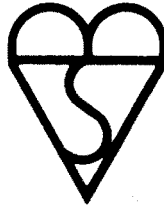


Fig. 3

(d) Give **two** benefits to the manufacturer of having this mark.

Benefit 1 \_\_\_\_\_ [1]

Benefit 2 \_\_\_\_\_ [1]

2 Fig. 4 below shows the parts of a garden lighting system.

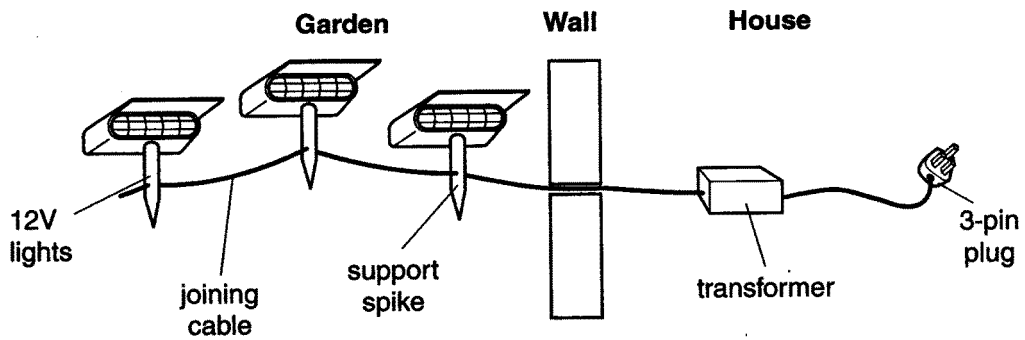


Fig. 4

The system is powered from the transformer which is placed inside where it is plugged into the mains electricity supply.

(a) Give one reason why the system is designed to use 12 V bulbs.

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[1]

(b) Add two further design specification points for the system.

- the system is designed to use 12 V bulbs;
- the lights must be attractive to the intended users;
- \_\_\_\_\_ [1]
- \_\_\_\_\_ [1]

Fig. 5 shows the head unit of a garden light.

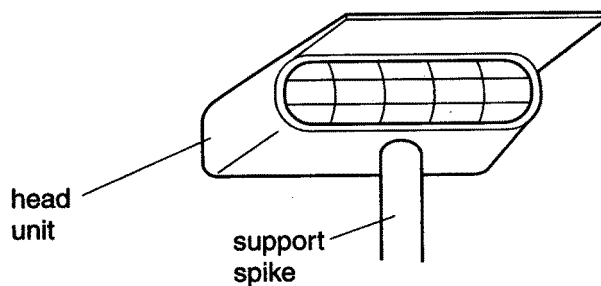


Fig. 5

- (c) In the space below, use sketches and notes, to show a development which would allow the angle of the head unit to be tilted.

[4]

Fig. 6 shows a different design for a garden light, It uses small solar cells as a source of power.

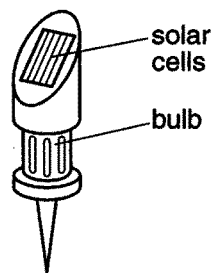


Fig. 6

- (d) Give **one** environmental advantage of using solar cells, compared to mains power for garden lights.

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[1]

- (e) Solar cells use a simple SMART material which responds to a change in the level of external light. Shape memory alloy (SMA) is another type of SMART material.

(i) State the external change to which SMA responds. \_\_\_\_\_

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[1]

(ii) Give **one** application for SMA. \_\_\_\_\_

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[1]

- 3 When cooking, the centre of food has to be heated to at least 75 °C.  
 Fig. 7 shows the circuit for an electronic thermometer.

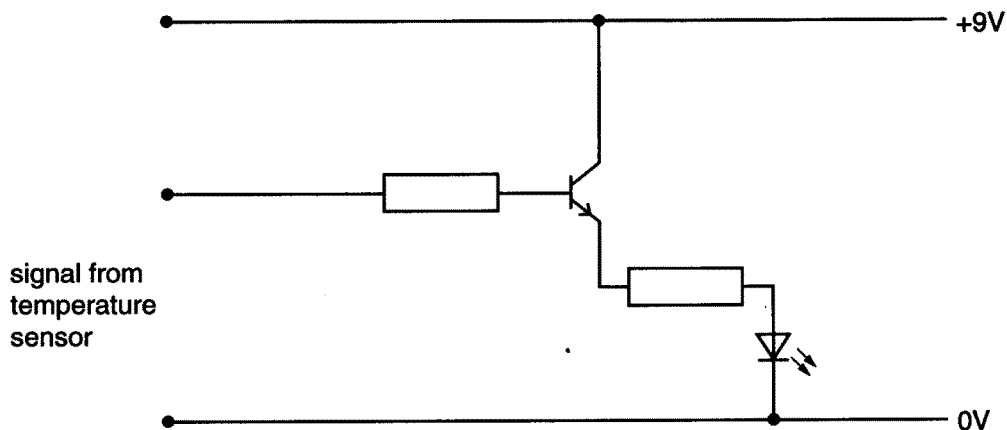


Fig. 7

- (a) State a component that could be used to sense change in temperature.

\_\_\_\_\_ [1]

- (b) The circuit does not switch on the LED at the correct temperature. Explain how the circuit could be modified to make the temperature sensing adjustable.

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 \_\_\_\_\_  
 \_\_\_\_\_ [2]

- (c) In the circuit in Fig. 7, explain the reason for using the resistor in series with the LED.

\_\_\_\_\_  
 \_\_\_\_\_ [2]

The chart in Fig. 8 gives the technical specification for an LED.

Technical specification							
	$I_F$	$V_F$	$V_F$	$V_R$	Lum.int.(mcd)	View angle	Wave length
	max.	typ.	max.	max.	$\odot I_F(20\text{mA})$		
55-0132	30 mA	1.85 V	2.5 V	5 V	200	60°	660

**Fig. 8**

- (d) Calculate the maximum power used by the LED. Show all your working out.

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[2]

- (e) A battery is used to power this circuit.

Describe the energy conversions that take place when the altered circuit detects the required temperature.

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[3]

- 4 Fig. 9 shows a folding chair. Parts of the chair frame are made from tubing, and are joined and strengthened with a gusset plate at X, details of which are shown in Fig. 10.

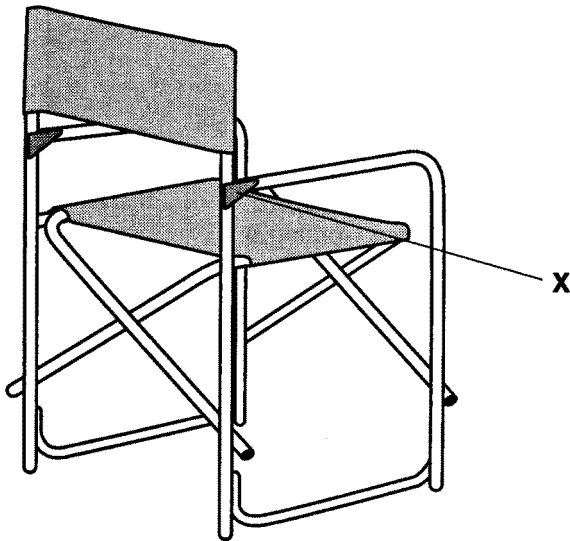


Fig. 9

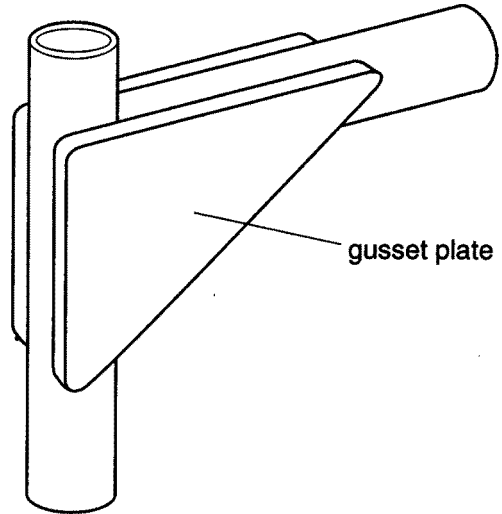


Fig. 10

- (a) Give **two** reasons why tubing is appropriate for the frame of the chair.

Reason 1 \_\_\_\_\_ [1]

Reason 2 \_\_\_\_\_ [1]

- (b) State a method of attaching the gusset plate to the frame which is suitable for repetitive flow production.

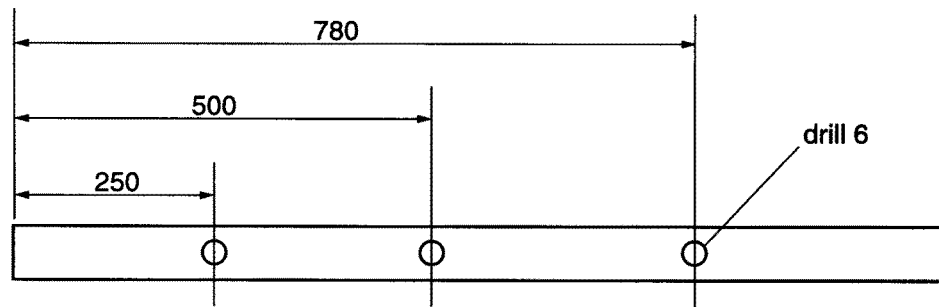
\_\_\_\_\_ [1]

- (c) Give **two** reasons why a jig would be used for this task.

Reason 1 \_\_\_\_\_ [1]

Reason 2 \_\_\_\_\_ [1]

Fig. 11 shows a tube from the chair.



**Fig. 11**

- (d) In the space below use sketches and notes to design a suitable drilling jig for this component.

5 Fig. 12 shows an outline drawing for a portable barbecue trolley used for cooking.

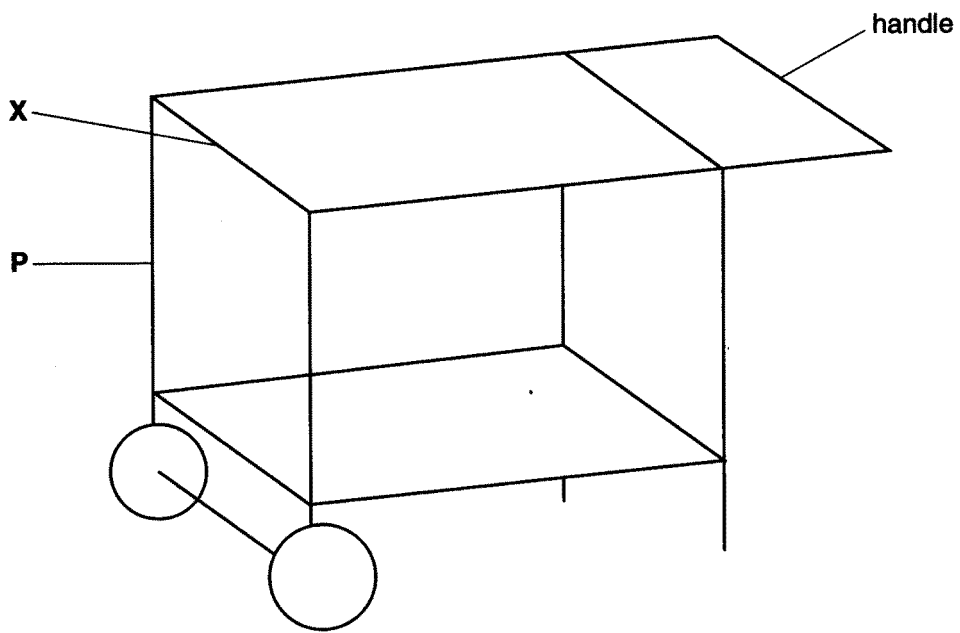


Fig. 12

(a) State the force acting in part P, when the trolley is in use.

[1]

(b) Fig. 13 shows the barbecue loaded.

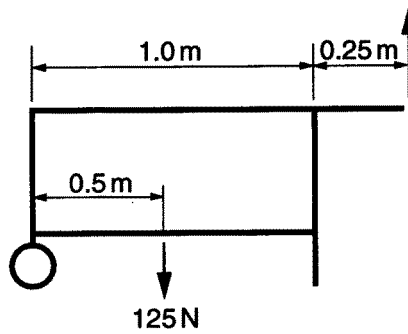


Fig. 13

Calculate force F needed to lift the trolley at the handle.

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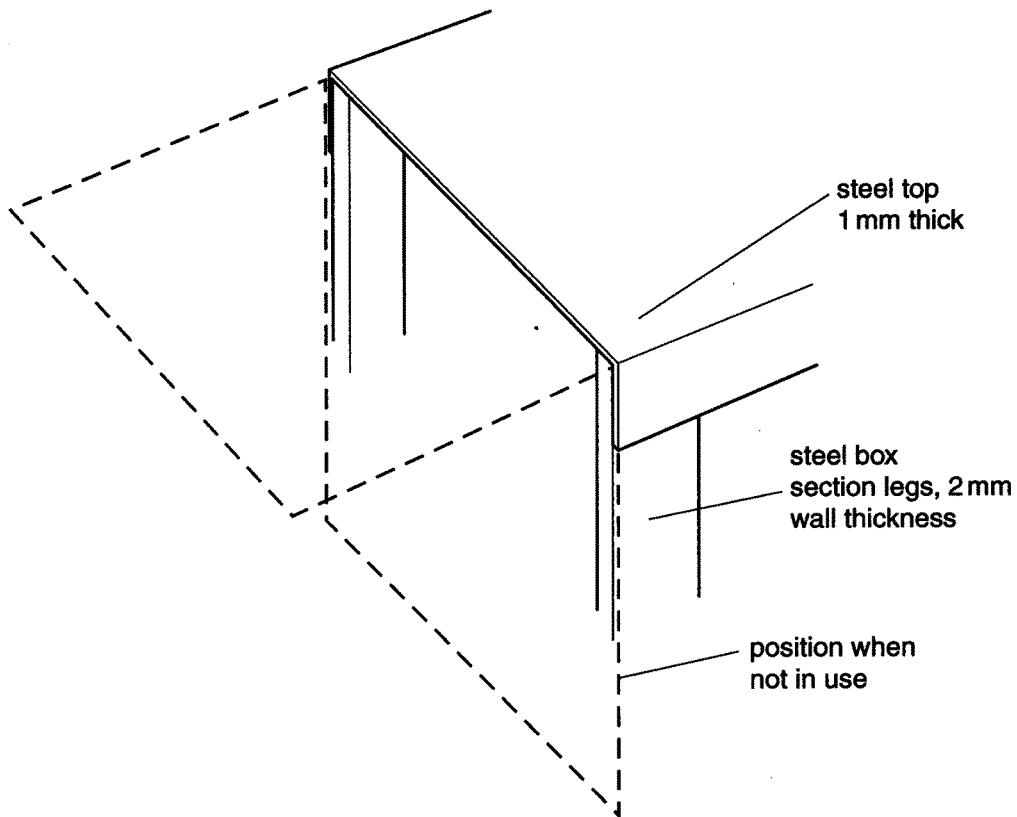
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[3]

- (c) A folding side shelf is to be added to the side of the barbecue at X. It must cover the area indicated by the dashed line in Fig. 14 below. The shelf is to be used to hold plates while the user puts food on to them.



**Fig. 14**

On the following page use sketches and notes to show a design for a folding shelf which will hold at least four plates when food is being served. Marks will be awarded for:

- a note stating a suitable material(s) chosen [1]  
and detail showing how the shelf will:
- fold down when not in use; [1]
- remain attached to the frame; [1]
- retain rigidity in use; [1]
- lock in a horizontal position. [2]