

Candidate Name \_\_\_\_\_

Centre Number

Candidate  
Number

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**International General Certificate of Secondary Education  
CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**DESIGN AND TECHNOLOGY**

PAPER 4 Technology

**0445/4**

**MAY/JUNE SESSION 2002**

1 hour

Candidates answer on the question paper.  
No additional materials are required.

**TIME** 1 hour

To be taken together with Paper 1 in one session of 2 hours 45 minutes.

**INSTRUCTIONS TO CANDIDATES**

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

Answer any **two** questions.

Write your answers in the spaces provided on the question paper.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets [ ] at the end of each question or part question.

You may use a calculator.

FOR EXAMINER'S USE	
1	
2	
3	
4	
TOTAL	

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**This question paper consists of 20 printed pages.**



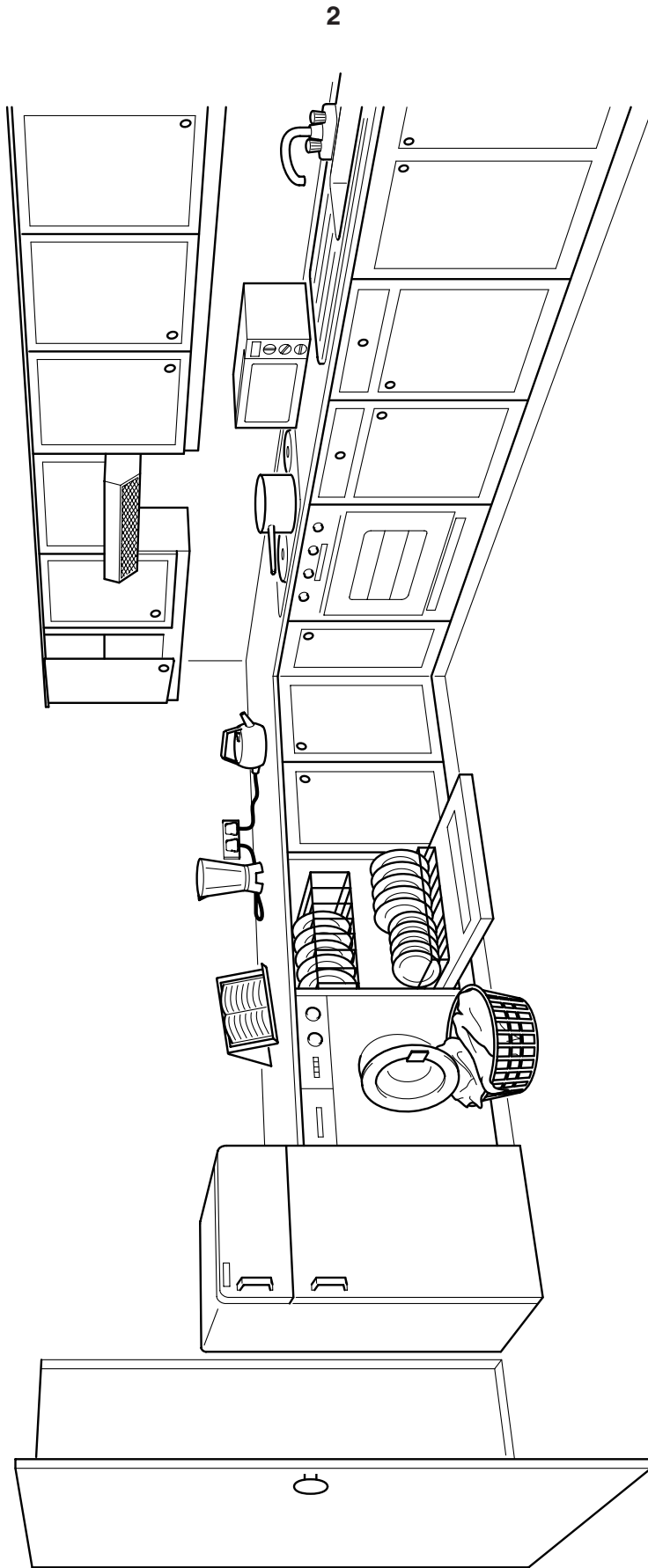
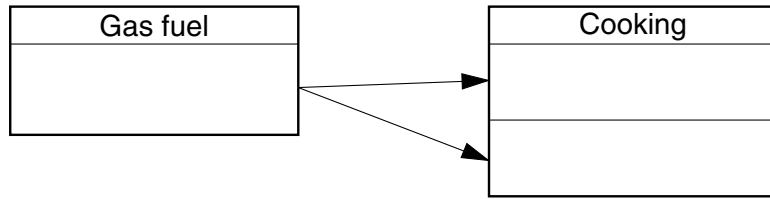


Fig. 1

1 Fig. 1 shows a kitchen.

(a) (i) Complete the diagram below to show the energy conversions taking place when gas is used for cooking.



[3]

(ii) Electricity is another energy source. Explain the difference between a battery and mains electricity as energy sources.

.....

.....

.....[2]

(iii) Suggest **one** way that energy can be conserved when cooking on the gas stove.

.....

.....

.....[2]

(iv) Fossil fuels are used to generate electricity. Give **two** environmental problems caused by using fossil fuels.

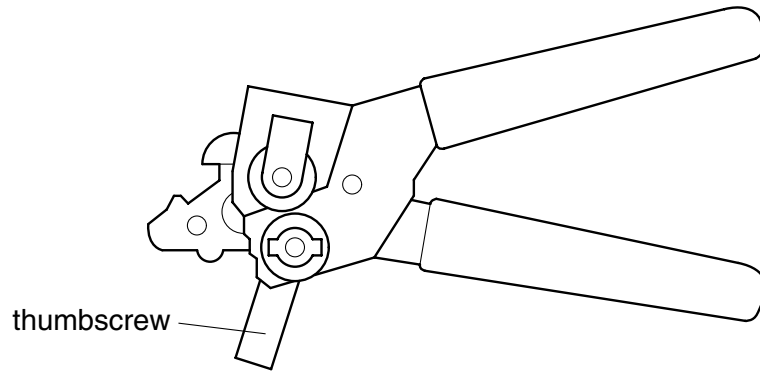
1. ....

2. ....[2]

(v) Name **one** type of renewable energy source.

.....[1]

(b) Fig. 2 shows a tin opener.



**Fig. 2**

(i) The opener uses leverage. Add the following labels to Fig. 2:

Load;      Effort;      Fulcrum. [3]

(ii) Turning the thumbscrew to cut a tin can is difficult. Explain how this action can be made easier for the user.

.....  
.....  
.....[2]

(iii) Operation of the opener involves moments of force. Explain the term moment.

.....  
.....  
.....[2]

(iv) Fig. 3 shows a schematic diagram of the opener.

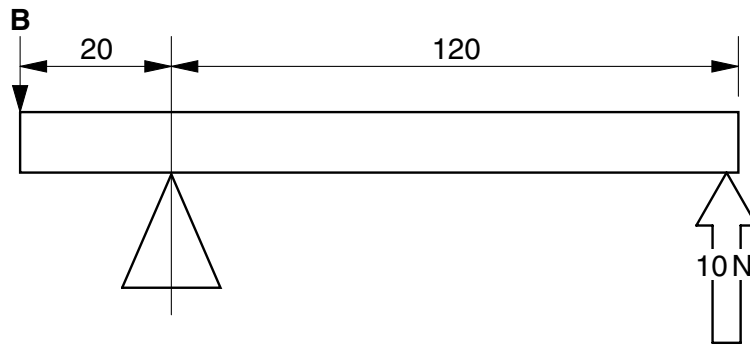
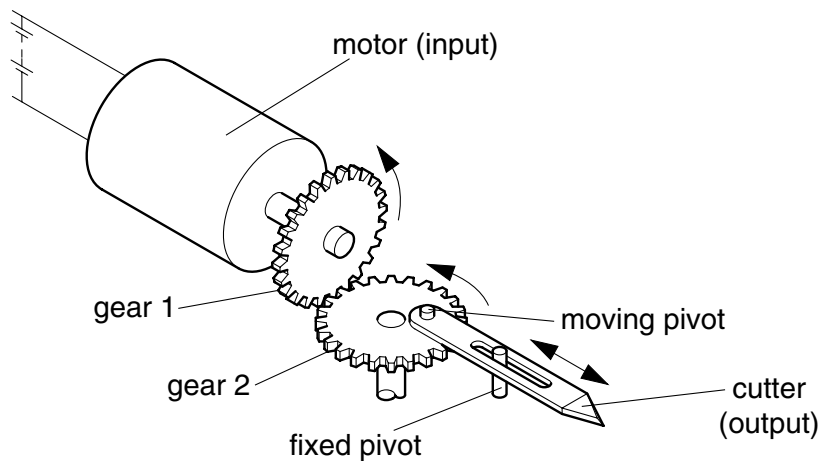


Fig. 3

Calculate the force at B.

[3]

(c) A designer wishes to produce a mechanical tin opener using an electric motor and battery. A schematic diagram is shown below.



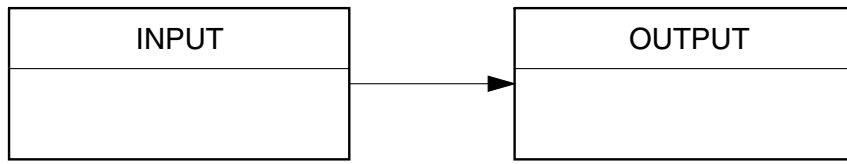
(i) Describe a suitable way of modelling this system during the design stages.

.....

.....

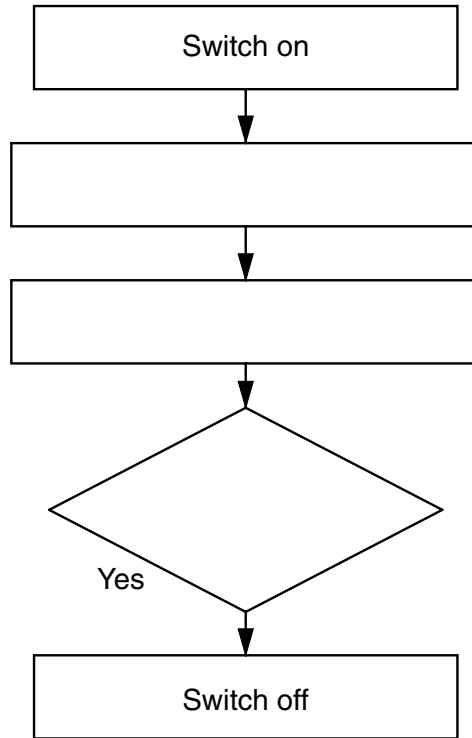
.....[2]

(ii) Complete the block diagram below to show the motion conversion for the system.



[2]

(iii) Complete the flow chart showing the cycle of operation for the system.



[5]

(iv) Name a suitable switch that could control the motor so that it was activated when a tin can was placed in the correct position for cutting.

.....[1]

2 (a) In the construction of kitchen cupboards both frames and carcasses are used.

(i) Explain the difference between a frame and a carcass.

.....  
.....  
.....  
.....[2]

(ii) Fig. 4 shows detail of a cupboard door and handle.

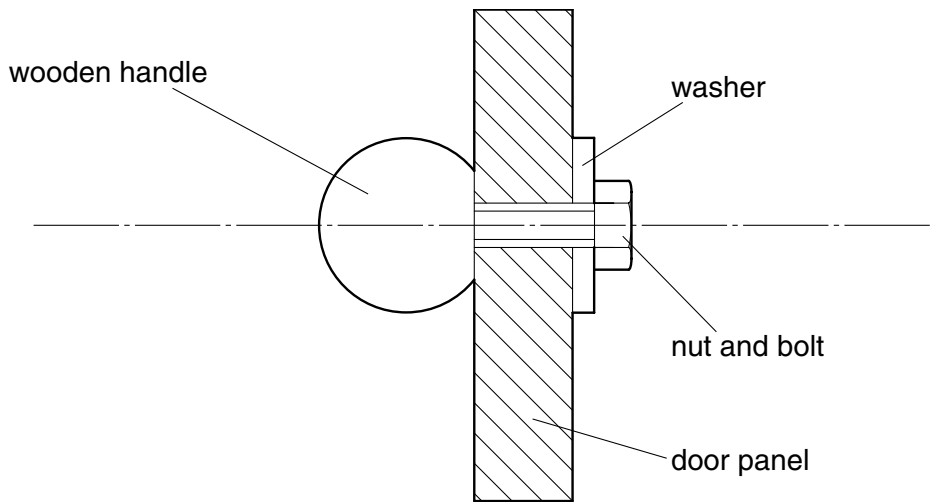


Fig. 4

Explain the purpose of the washer.

.....  
.....  
.....[3]

(iii) Explain why it is better to use a wood screw to secure the handle to the panel.

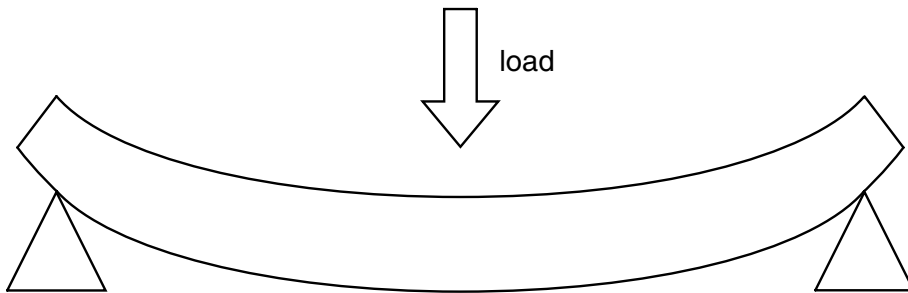
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.....  
.....[2]





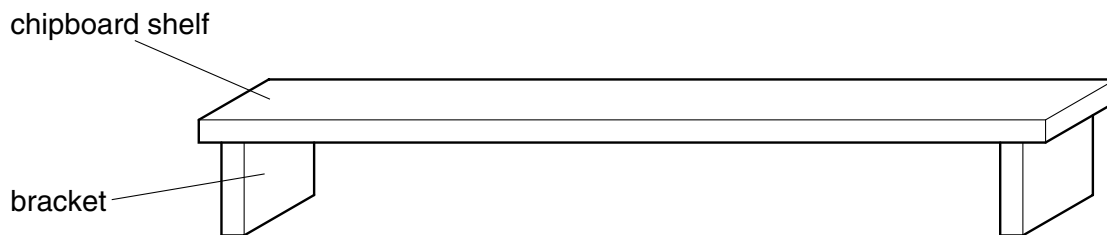
(iii) Complete the diagram below using the following words:

tension;      compression;      neutral axis.



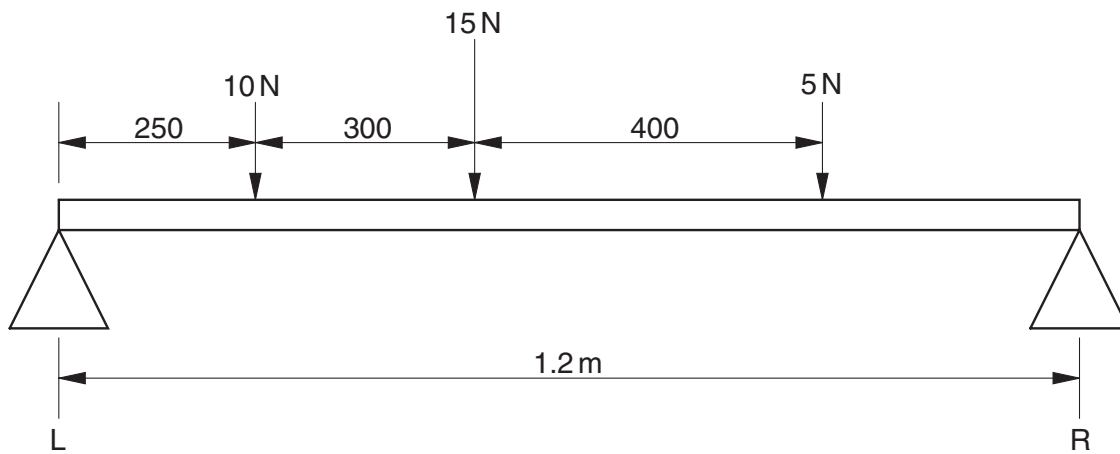
[3]

(iv) Add sketches and notes to the diagram below to show how a chipboard cupboard shelf can be modified to reduce sagging. Explain how your modification works.



[3]

(c) Fig. 6 shows a schematic diagram of a kitchen shelf loaded as shown.



**Fig. 6**

(i) Calculate the values of the reactions at L and R.

[4]

(ii) Draw a shear force diagram for the shelf.

[3]

(iii) Draw a bending moment diagram for the kitchen shelf.

[3]

(iv) Explain the term equilibrium.

.....

.....

.....[2]

3 (a) Fig. 7 shows a diagram of a kitchen pedal bin.

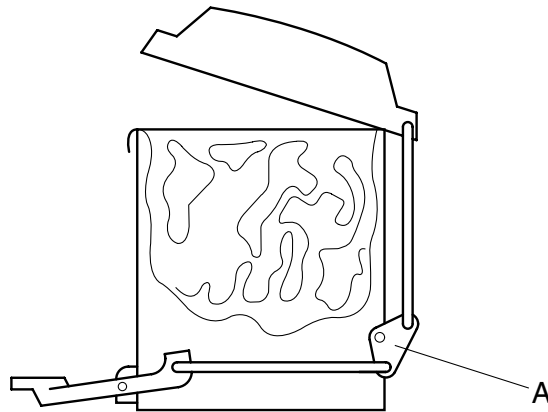


Fig. 7

(i) Add arrows to Fig. 7 to show the transmission of motion and indicate the input and output for the linkage shown. [3]

(ii) Describe the difference between a fixed pivot and a moving pivot.

.....  
.....[2]

(iii) Explain the purpose of part A.

.....  
.....  
.....[2]

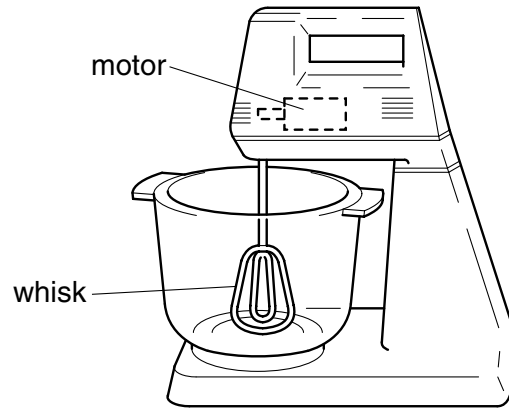
(iv) Explain what is meant by the term linkage.

.....  
.....  
.....[2]

(v) Give another example of a linkage.

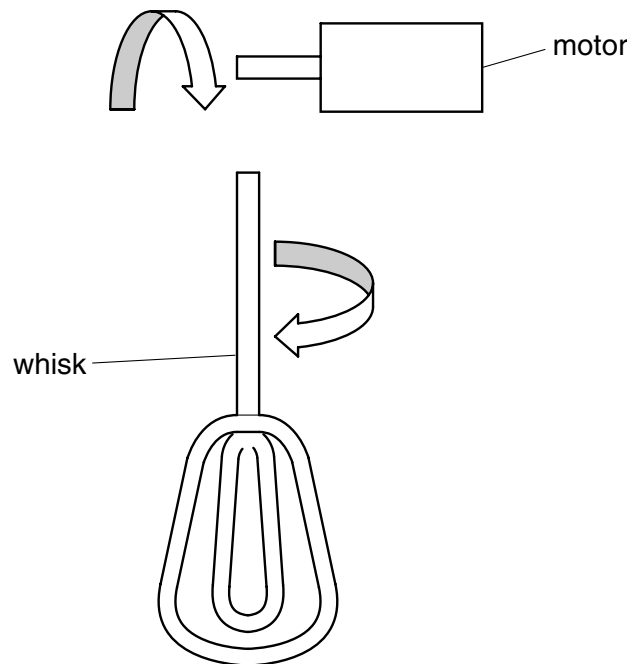
.....  
.....[1]

- (b) Fig. 8 shows a food mixer. The motion of the motor is converted from horizontal to vertical rotation to power the whisks.



**Fig. 8**

- (i) Complete the sketches below to show how the motion of the motor is converted from the horizontal direction to the vertical direction using gears. [3]



(ii) Draw a **black box** diagram showing the motion conversion for the food mixer.

[2]

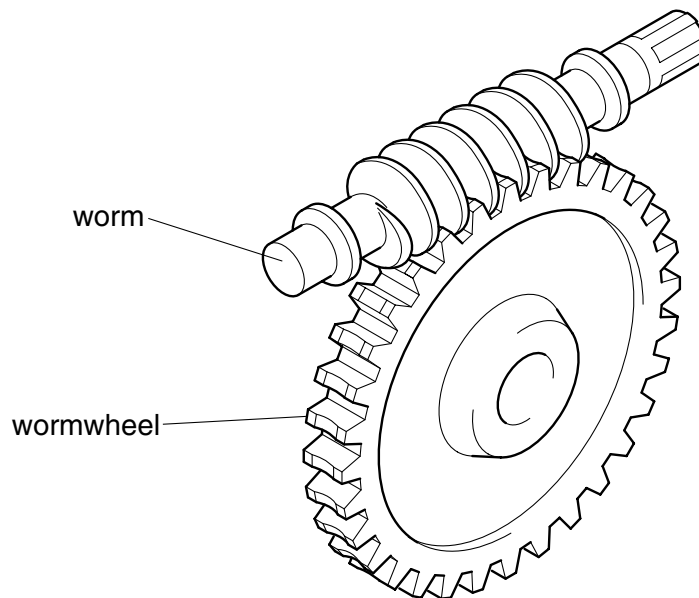
(iii) State a suitable specific material for gear wheels in the mixer. Give **one** reason for your choice.

Material: .....

Reason: .....

.....[2]

(c) Fig. 9 shows a worm and wormwheel system.



**Fig. 9**

(i) Give **one** benefit of using this system.

.....

.....

.....[1]

(ii) If the wormwheel has 40 teeth state the gear ratio of the system.

.....[1]

(iii) If the speed of the worm is 200 rpm calculate the output speed from the wormwheel.

[3]

(d) Fig. 10 shows another type of gear wheel.

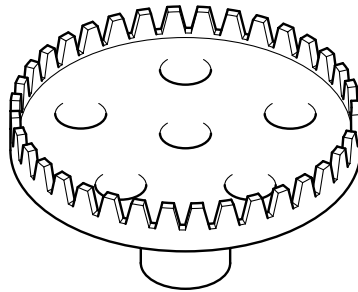


Fig. 10

(i) Name this type of gear wheel.

.....[1]

(ii) Give a suitable use for this type of gear wheel.

.....

.....

.....[2]

(iii) Use labelled sketches to show how this gear wheel could be fixed to a shaft when used in a construction kit.

[3]

(iv) Explain why holes have been made in the surface of the gear wheel.

.....

.....

.....[2]



4 Fig. 11 shows a design for a kitchen timer.

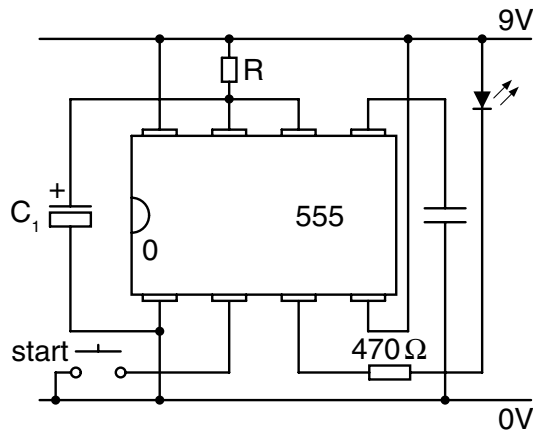


Fig. 11

(a) (i) Give **one** benefit of using the 555 IC in this application.

.....  
 .....[1]

(ii) State the type of switch shown in Fig. 11.

.....[1]

(iii) Complete the pin numbering on the 555 IC in Fig. 11.

[2]

(iv) Explain how the time interval is controlled in this circuit.

.....  
 .....[2]

(v) Describe how the circuit could be modified to allow the user to adjust the time interval.

.....  
 .....  
 .....[2]

(vi) Name the output device shown in this circuit.

.....[1]

(vii) IC's are sensitive to heat. Describe how an IC can be protected from heat damage when soldering is taking place.

.....  
.....  
.....[2]

(viii) Give another application of the 555 IC.

.....[1]

(b) A 9 V battery powers the circuit.

(i) If the protecting resistor for the LED is  $470\ \Omega$  calculate the current flowing through the LED.

[3]

(ii) Give **two** ways of identifying the negative connection on an LED.

1. ....  
2. ....[2]

(iii) Give **one** benefit of using an LED compared to a bulb.

.....  
.....[1]

(c) The timer circuit is made using a PCB and discrete components.

(i) List **six main stages** in producing a PCB before components are soldered to it.

- 1. ....
- 2. ....
- 3. ....
- 4. ....
- 5. ....
- 6. ....[6]

(ii) Give **one** potential safety hazard when producing a PCB.

.....  
.....[1]

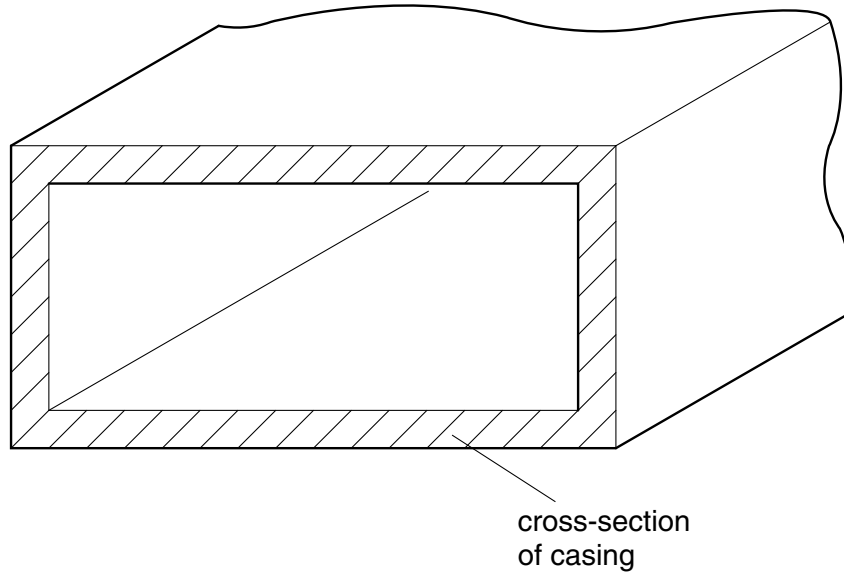
(iii) Give **one** benefit of using PCB circuit construction.

.....  
.....[1]

(iv) Give **one** drawback of using PCB's.

.....  
.....[1]

- (v) Use sketches and notes to show how the timer PCB could be secured inside the timer casing.



[3]