



General Certificate of Secondary Education  
2009

## Technology and Design

Foundation Tier

[G9501]

THURSDAY 21 MAY, MORNING



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Centre Number

71	
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Candidate Number

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### TIME

1 hour 45 minutes.

### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.  
Write your answers in the spaces provided in this question paper.  
Answer all **fifteen** questions.

### INFORMATION FOR CANDIDATES

The total mark for this paper is 126, including a maximum of 6 marks for quality of written communication.  
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
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QWC	
<b>Total Marks</b>	

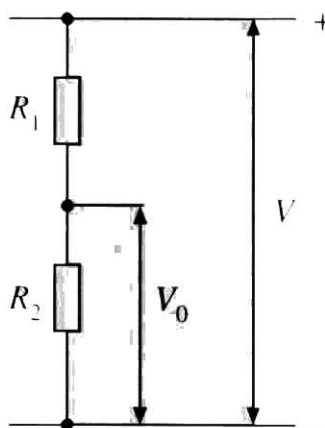
## Formulae for GCSE Technology and Design

You should use, where appropriate, the formulae given below when answering questions which include calculations.

1 Work done = force  $\times$  distance moved in the direction of the force ( $W = f \times d$ )

2 Potential Difference = current  $\times$  resistance ( $V = IR$ )

3 For potential divider  $V_0 = \frac{R_2}{R_1 + R_2} \times V$



4 Series Resistors  $R_{\text{Total}} = R_1 + R_2 + R_3$  etc

Parallel Resistors  $\frac{1}{R_{\text{Total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$  etc

5 Gear ratio of a simple gear train =  $\frac{\text{number of teeth on driven gear}}{\text{number of teeth on driver gear}}$   
(NB for a compound gear train)

Total Gear ratio = the product of the gear ratios of all the subsystems

i.e.  $G.R_T = G.R_1 \times G.R_2 \times G.R_3 \dots$

6 Mechanical Advantage =  $\frac{\text{Load}}{\text{Effort}}$

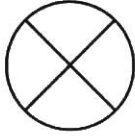


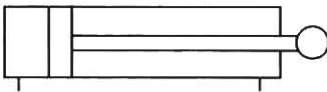

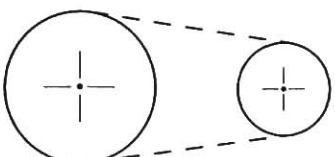
7 Velocity Ratio =  $\frac{\text{Distance moved by effort}}{\text{Distance moved by load}}$

8 Pneumatics Force = Pressure  $\times$  Area ( $F = P \times A$ )

1 **Table 1** shows a number of different symbols. Using the first row as a guide, complete the table.

Examiner Only	
Marks	Remark

**Table 1**

Sketch of Symbol	Type of Symbol	Name of Symbol
	Electronic Control	Lamp
	Electronic Control	Motor
	Mechanical Control	
	Warning Sign	
	Pneumatic Control	
		Diode
		
		

[10]

- 2 Complete **Table 2** below by ticking (✓) the one correct box which relates to each material.

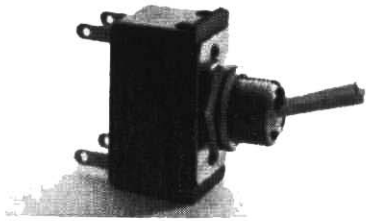
**Table 2**

<b>Material</b>	<b>Hardwood</b>	<b>Plastic</b>	<b>Ferrous metal</b>	<b>Manufactured board</b>	<b>Softwood</b>	<b>Non-ferrous metal</b>
Pine						
Mild Steel						
Chipboard						
Acrylic						
Aluminium						
Mahogany						

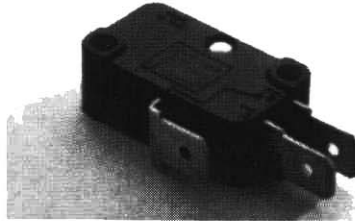
[6]

<b>Examiner Only</b>	
<b>Marks</b>	<b>Remark</b>

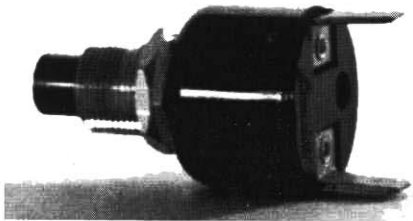
3 Four switches labelled (a), (b), (c) and (d) are shown in Fig. 1. Name each of the switches shown.



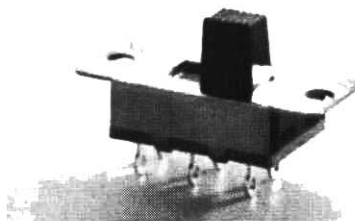
(a)



(b)



(c)



(d)

© Design and Technology by James Garrett, published by Cambridge University Press, 1991, ISBN 052136969X

Fig. 1

Switch (a) \_\_\_\_\_

Switch (b) \_\_\_\_\_

Switch (c) \_\_\_\_\_

Switch (d) \_\_\_\_\_ [4]

Examiner Only	
Marks	Remark



5 A piece of 3 mm acrylic is shown in Fig. 2. Two 6 mm holes are marked out for drilling using a vertical drilling machine.

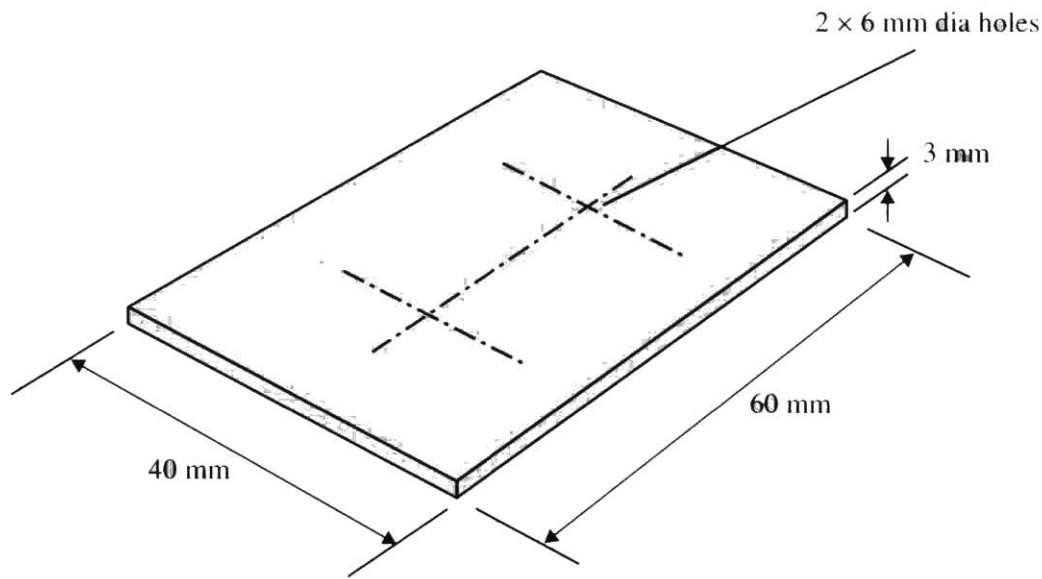


Fig. 2

(a) Suggest **two** specific safety precautions that must be considered when drilling the holes in the acrylic.

(i) \_\_\_\_\_ [1]

(ii) \_\_\_\_\_ [1]

(b) Name a tool or piece of equipment for holding the acrylic for drilling.

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

(c) State **one** factor that must be considered during the drilling process of the acrylic.


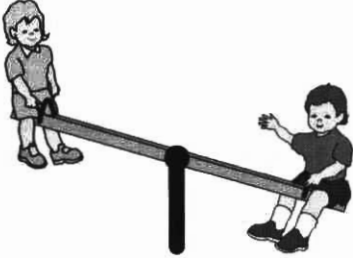

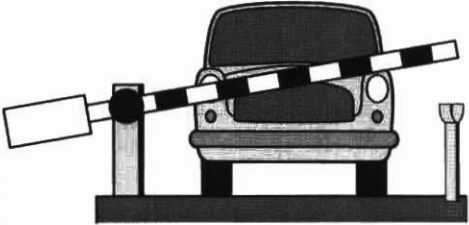
\_\_\_\_\_ [2]

Examiner Only	
Marks	Remark

6 There are **three** classes of levers. Complete **Table 3** by identifying the class of lever used in the following products.

Examiner Only  
Marks Remark

**Table 3**



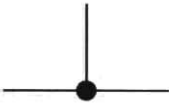
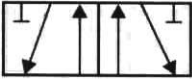
Name	Picture of product	Class
Wheelbarrow		
See-saw		
Tweezers		
Car park barrier		

[4]



7 (a) **Table 4** shows a number of pneumatic symbols.

**Table 4**

Symbol	Name of symbol
	
	
	
	

Complete **Table 4** by inserting the correct name for each symbol from **Table 5**.

**Table 5**

5/2 valve
Shuttle valve
Pipeline junction
3/2 valve
Pressure source

[4]

Examiner Only

Marks Remark

(b) Fig. 3 shows a pneumatic circuit which is used to clamp parts during a bonding process.

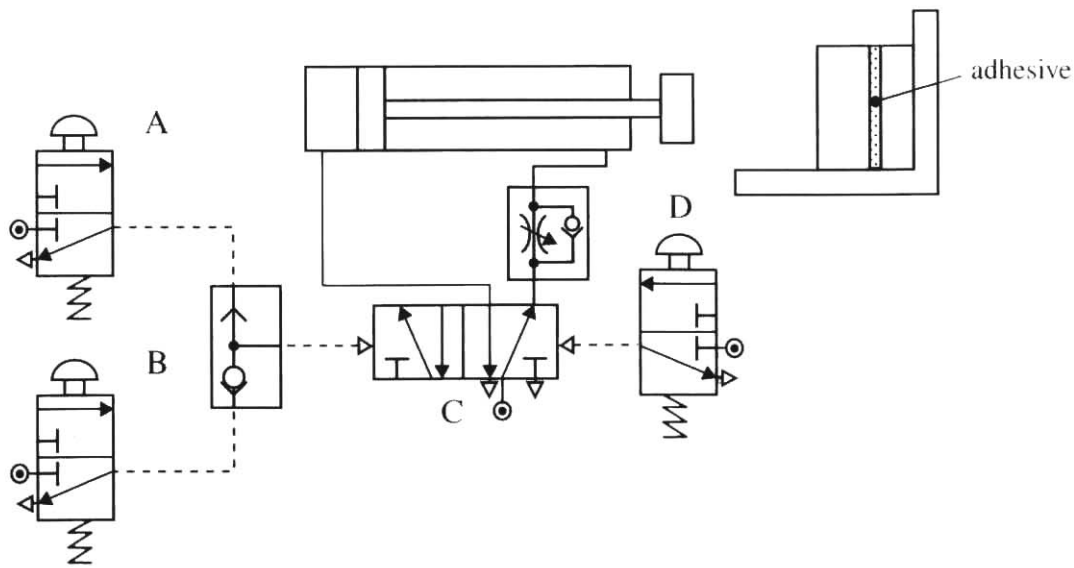


Fig. 3

Tick (✓) the correct box in each of the following cases:

(i) The parts are clamped by pushing:

Button A and B

Button A or B

(ii) The clamp is released:

Automatically

By pressing button D

(iii) The clamping speed is controlled

The speed of release is controlled

(iv) Valve C is:

Button actuated and button reset

Pilot air actuated and pilot air reset




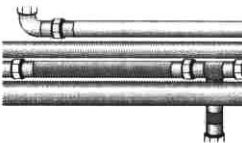
[4]

Examiner Only	
Marks	Remark

- 8 Four examples of the use of **metals** are shown in **Table 6** below. Complete **Table 6** by naming a suitable metal for each product giving a reason, other than cost, for your answer.

A different metal should be selected for each example.

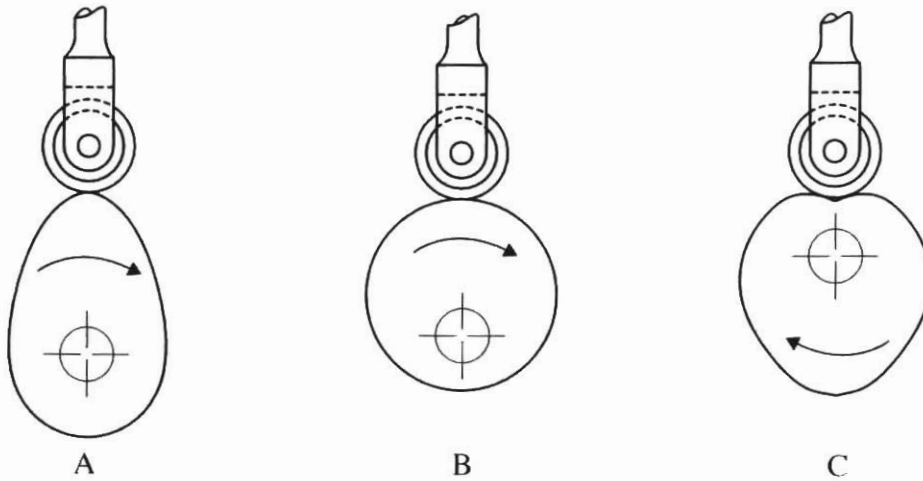
**Table 6**

Example of product	Name	Metal	Reason for choice
	Car body		
	Saucepan		
	Nameplate		
	Water pipes		

[8]

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Marks	Remark

- 9 (a) Cams are used to change one type of motion into another. **Fig. 4** shows the front view of three types of cam.



**Fig. 4**

- (i) Select the correct names for the cams from the list given below.

**Eccentric**  
**Pear-shaped**  
**Heart-shaped**

A \_\_\_\_\_  
 B \_\_\_\_\_  
 C \_\_\_\_\_ [3]

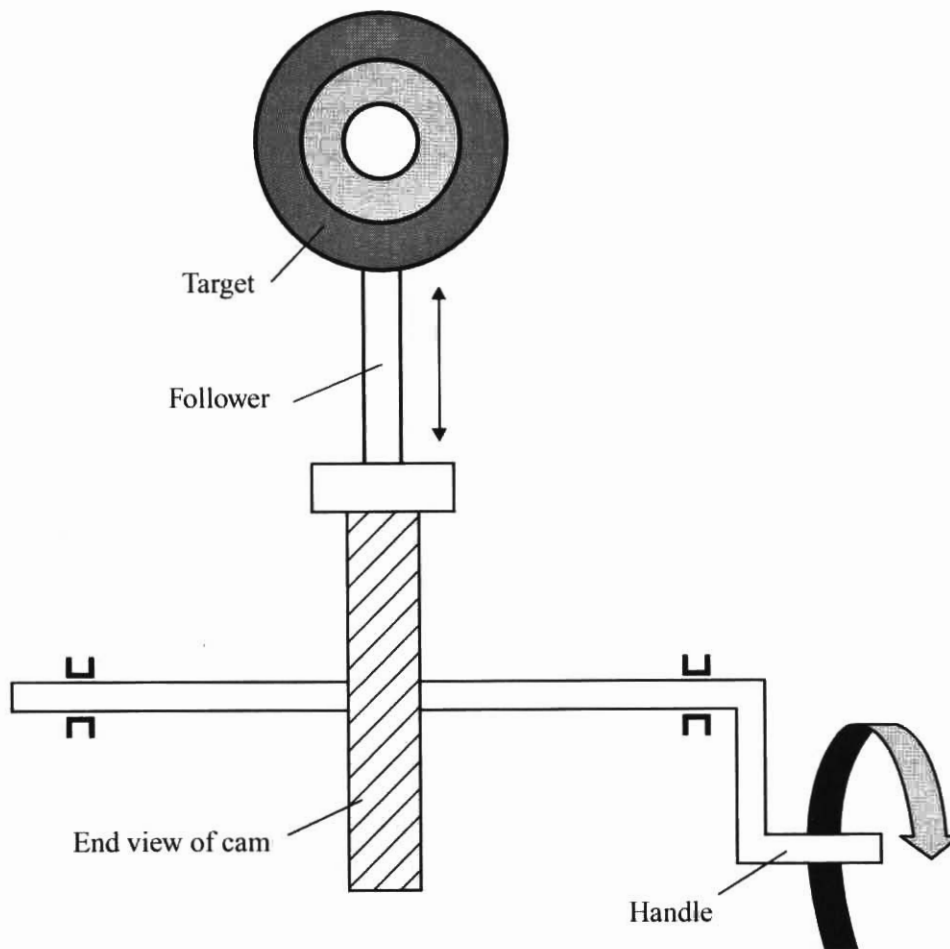
- (ii) Name the type of follower shown in **Fig. 4**.

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

Examiner Only

Marks Remark

- (b) The target in a toy is shown in **Fig. 5**. As the handle is rotated through one turn, the target is required to rise, then fall, and then remain at rest or dwell.



**Fig. 5**

- (i) Select the correct cam from **Fig. 4** to produce this motion.

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

- (ii) Explain how the rest or dwell is produced by the cam shape.

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

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

10 (a) Write down the name of each electrical unit used to measure current, voltage and resistance.

Current \_\_\_\_\_

Voltage \_\_\_\_\_

Resistance \_\_\_\_\_ [3]

(b) Resistors are used with LEDs in electronic circuits.



Source: *Electronic Products*, Collins, ISBN 0-0032001204, page 84

(i) What does the term LED mean?

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

(ii) Suggest a suitable reason for using an LED in an electronic circuit.

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

(iii) State the reason for using a resistor with an LED in an electronic circuit.

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

(c) State the purpose of a conductor and an insulator in an electronic circuit and give an example of each.

(i) Purpose: Conductor \_\_\_\_\_  
 \_\_\_\_\_ [1]

(ii) Purpose: Insulator \_\_\_\_\_  
 \_\_\_\_\_ [1]

(iii) Example: Conductor \_\_\_\_\_  
 \_\_\_\_\_ [1]

(iv) Example: Insulator \_\_\_\_\_  
 \_\_\_\_\_ [1]

11 Fig. 6 shows two methods, A and B, for transmitting power from a motor to an output shaft.

Examiner Only	
Marks	Remark

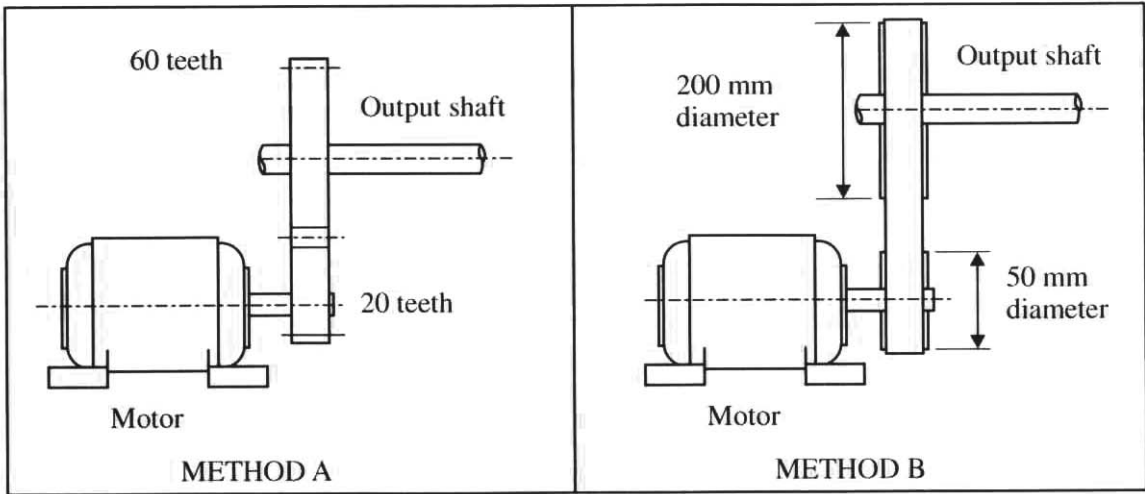


Fig. 6

(a) Complete the following:

(i) Which transmission requires lubrication?

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

(ii) Which transmission can slip if the output shaft jams?

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

(iii) Which transmission would be used if the distance between the motor and the output shaft is large?

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

(iv) Which transmission would be used if an exact speed ratio is required?

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

**(b)** The motor runs at 1440 rev/min. Determine:

**(i)** The speed of the output shaft in transmission A.

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

**(ii)** The speed of the output shaft in transmission B.

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

**(c) (i)** Explain how the transmission A could be changed so that the motor and the output shaft rotate in the same direction.

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

**(ii)** What effect would this change have on the speed of the output shaft?

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

Examiner Only

Marks Remark

Marks	Remark



12 Computer control processes are widely used in industry for automatic processes. Fig. 7 shows a bottle to be filled with lemonade by such a process.

To fill the bottle it must be positioned under a valve which controls the flow of lemonade. A screw top is then attached to the bottle.

(a) Complete the flow chart for this operation by inserting the listed operations in the correct order. [5]

(b) Complete the two decision loops. [4]

Operations

- Close valve
- Fix screw top
- Is the bottle full?
- Open valve to let lemonade flow
- Is the bottle present?

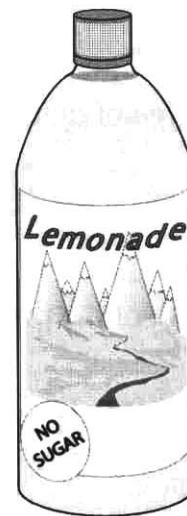
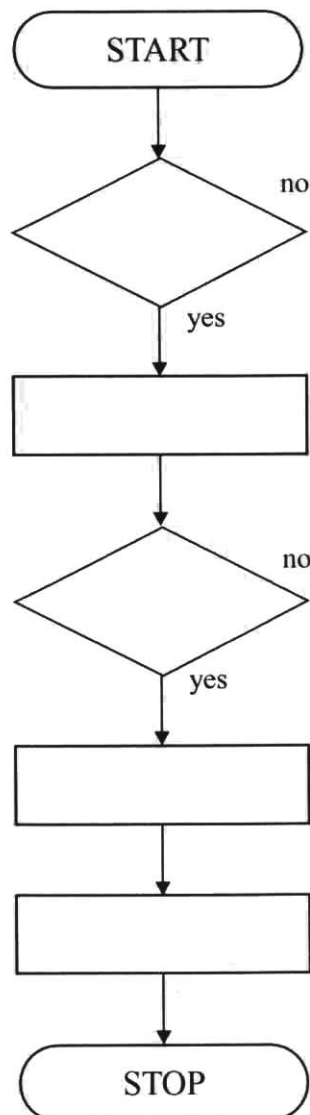


Fig. 7



- 13 A pneumatic cylinder is used in a guillotine to cut strips of plastic as shown in Fig. 8.

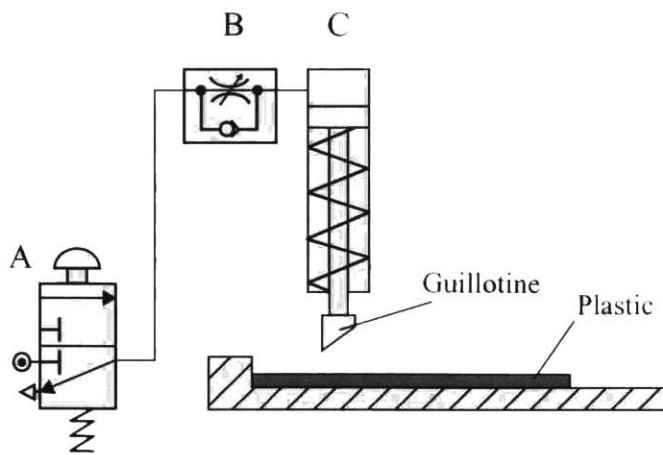


Fig. 8

- (a) (i) Name the type of cylinder shown.

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

- (ii) Which stroke of the piston (outstroke or instroke) is speed controlled?

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

- (iii) Give a reason for your answer.

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

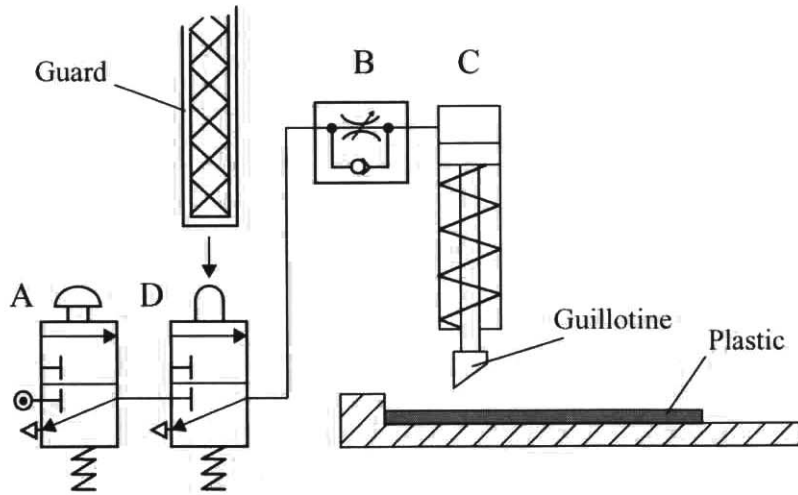
- (iv) Explain how this speed can be changed.

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

Examiner Only

Marks Remark

(b) The circuit in **Fig. 8** is modified to improve safety. This new modified circuit is shown in **Fig. 9**.



**Fig. 9**

(i) Which **one** of the following is used to actuate valve D?

**Roller    Lever    Plunger    Pilot air**

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

(ii) Explain how the guillotine can be operated as shown in **Fig. 9**.

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

Examiner Only

Marks    Remark

14 Different forms of energy are used in children’s toys to make them move.

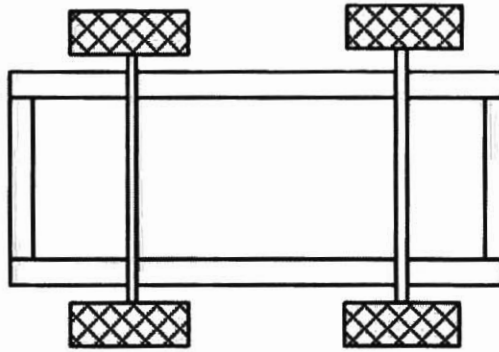
(a) Name **one** appropriate energy source for each specific type of toy.

- Mechanical toy: \_\_\_\_\_ [1]
- Electrical toy: \_\_\_\_\_ [1]
- Pneumatic toy: \_\_\_\_\_ [1]

(b) **Fig. 10(a)** shows a toy car that must travel on its own power. **Fig. 10(b)** shows a plan view of the chassis and wheels. Select one of the above energy sources, and explain using sketches and notes how the energy source can be fitted and connected to the rear wheels. [6]



**Fig. 10(a)**



Plan view of chassis and wheels

**Fig. 10(b)**

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15 Fig. 11 shows a pictorial sketch of an aluminum block required for a pupil's project. The block requires four M6 threaded holes which are 30 mm deep.

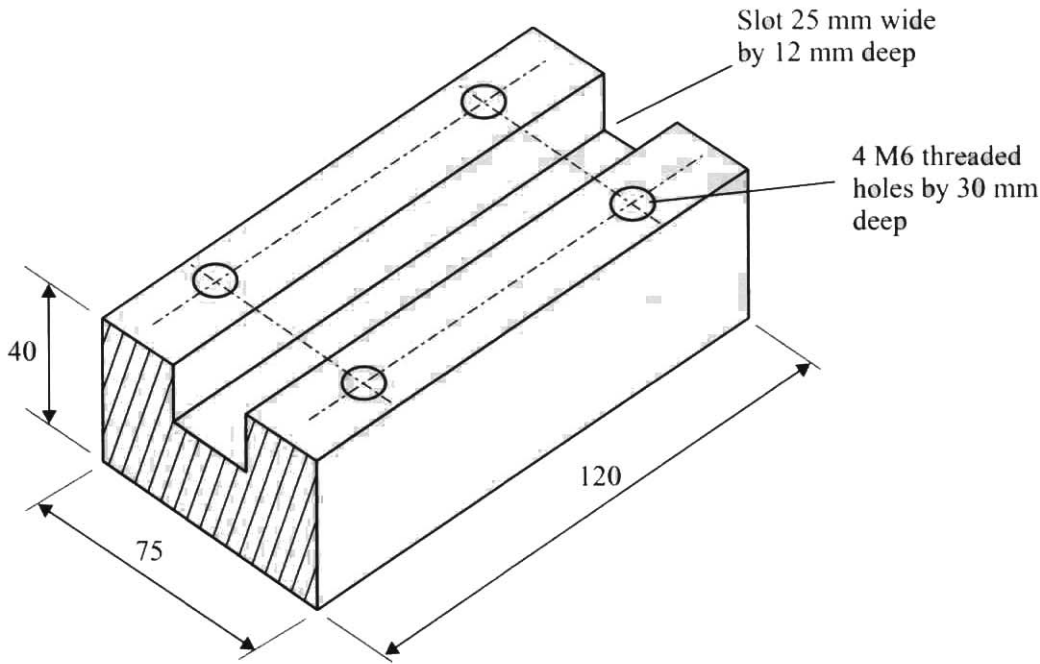


Fig. 11

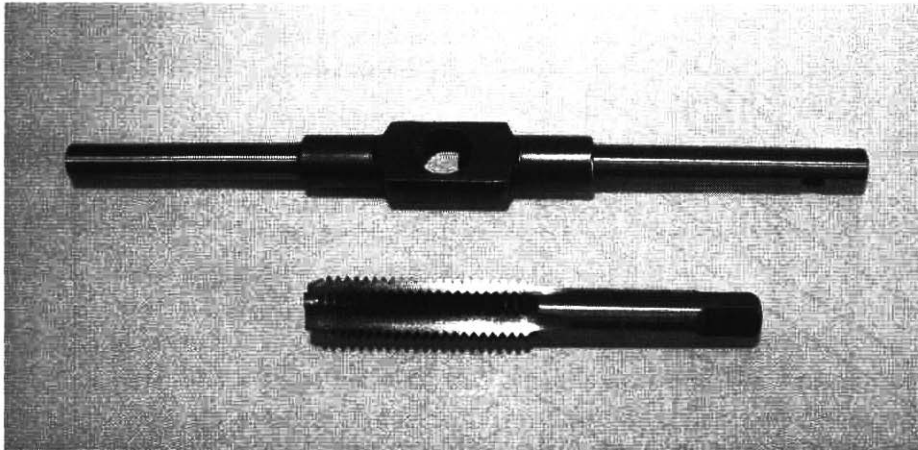
(a) Using the list below, select the workshop machine that could be used to cut the slot in the aluminium.

- Bandsaw**
- Lathe**
- Milling machine**
- Drilling machine**

Machine: \_\_\_\_\_ [2]

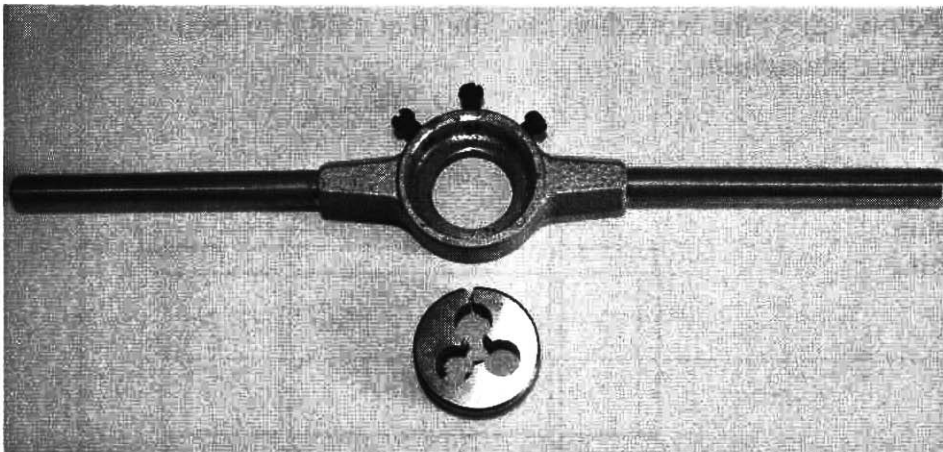


(b) The picture below shows the hand tool used to thread the holes. Name the tool.



Tool: \_\_\_\_\_ [2]

(c) The picture below shows the hand tool used to thread a round bar. Name the tool.



Tool: \_\_\_\_\_ [2]

(d) List the **three** main stages in producing a threaded hole.

Stage 1: \_\_\_\_\_

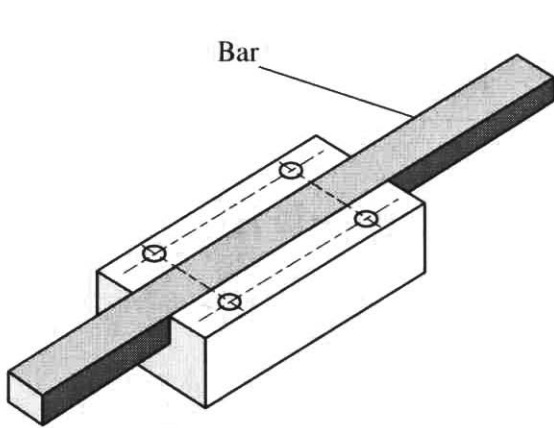
Stage 2: \_\_\_\_\_

Stage 3: \_\_\_\_\_ [3]

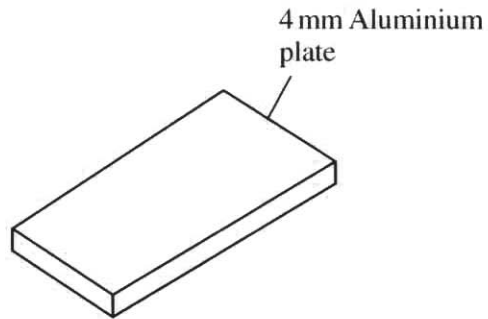
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Marks	Remark

- (e) A rectangular bar is inserted into the block as shown in **Fig. 12**. The aluminium plate shown in **Fig. 13** is to be attached and easily removed from the top of the block.

Show by means of sketches and notes how the 4 mm thick plate could be attached to the block and easily removed if required. [6]



**Fig. 12**



**Fig. 13**

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Marks	Remark
Quality of written communication	

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**THIS IS THE END OF THE QUESTION PAPER**

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