www.xtrapapers.com

Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2018

Technology and Design

Unit 2:
Systems and Control
Element 2: Mechanical and Pneumatic Control Systems

MV18

[GTD22]

FRIDAY 25 MAY, AFTERNOON

Time

1 hour, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write on blank pages.
Questions which require drawing or sketching should be completed using an H.B. pencil.
All other questions must be completed using black ink only.
Do not write in pencil or with a gel pen.
Answer **all** questions.

Information for Candidates

The total mark for this paper is 80.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

www.xtrapapers.com

Formulae for GCSE Technology and Design

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

1 Gear ratio of a simple gear train $= \dfrac{\text{number of teeth on driven gear}}{\text{number of teeth on driver gear}}$

For a compound gear train:
Total Gear ratio = the product of the gear ratios of all the subsystems
i.e. $GR_T = GR_1 \times GR_2 \times GR_3 \ldots$

2 Mechanical Advantage $= \dfrac{\textbf{Load}}{\textbf{Effort}}$

3 Velocity Ratio $= \dfrac{\textbf{Distance moved by effort}}{\textbf{Distance moved by Load}}$

4 Pneumatics
Force = Pressure × Area (**F** = **P** × **A**)

www.xtrapapers.com

Answer **all** questions

1 (a) **Fig.1** shows part of a pneumatic circuit.

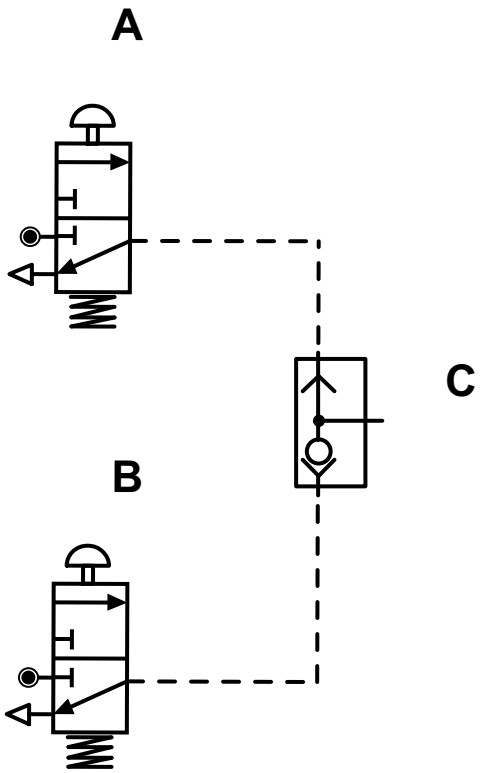


Fig. 1

(i) Name the valves **A** and **C**. [2 marks]

A _____

C _____

(ii) Name the logic combination for valves **A** and **B**. [1 mark]

_____

www.xtrapapers.com

(b) Fig. 2 shows a pneumatic cylinder and a control valve.

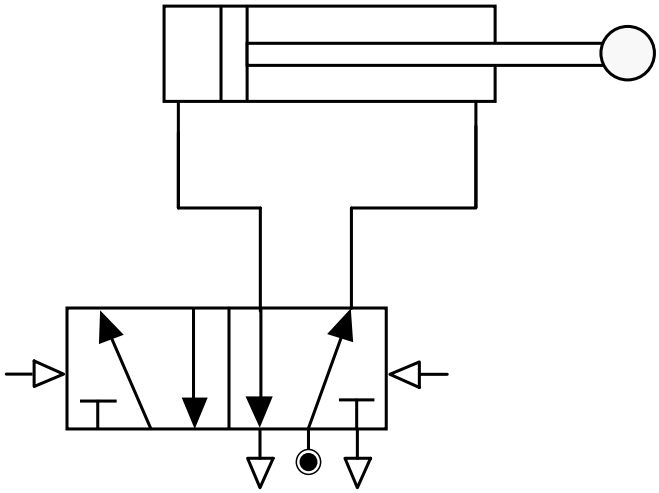


Fig. 2

(i) Name the type of cylinder shown. [1 mark]

_____

(ii) State **two** factors which determine the force the cylinder can exert. [2 marks]

1. _____

2. _____

(iii) Give **one** other feature which should be considered in selecting a cylinder. [1 mark]

_____

www.xtrapapers.com

(iv) Complete **Table 1** below for the valve shown in **Fig. 2**. [4 marks]

Table 1

Number of switching positions	
Number of ports	
Method of actuating	
Method of resetting	

www.xtrapapers.com

(c) A circuit used to control a cylinder is shown in **Fig. 3**.

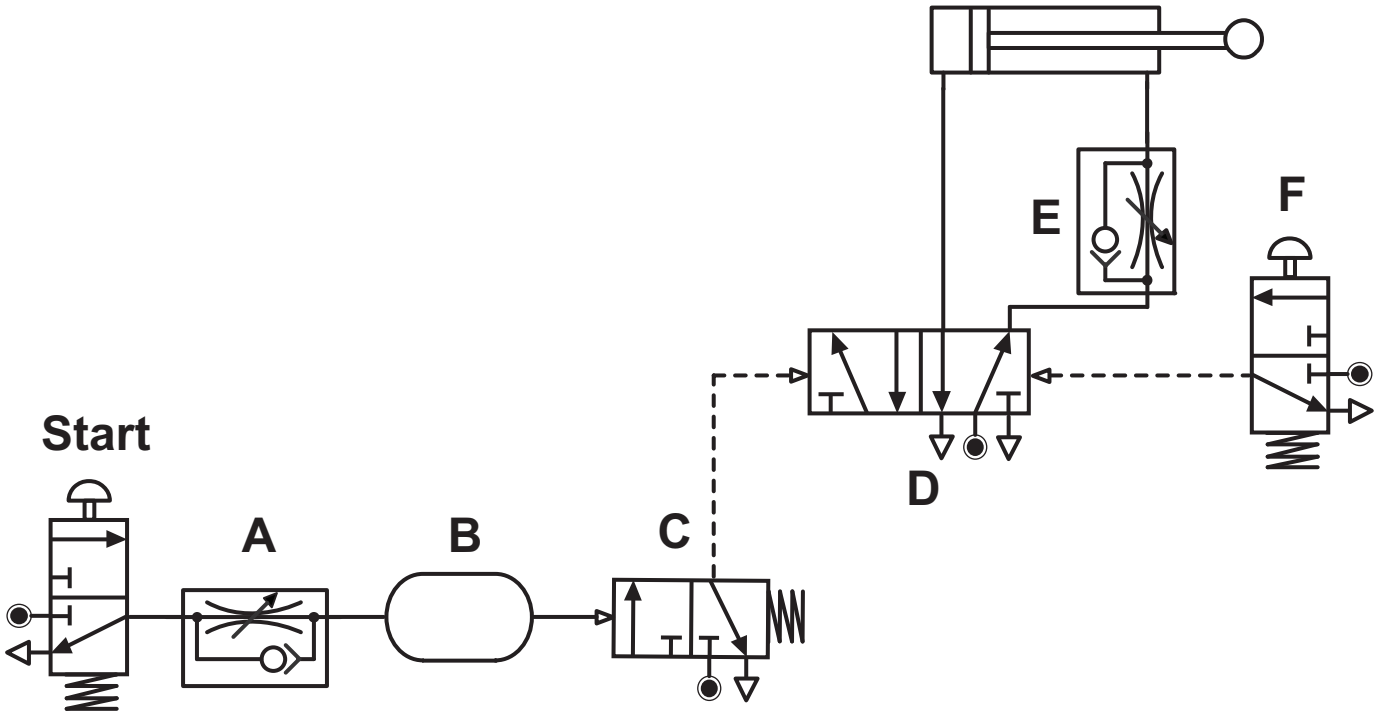


Fig. 3

(i) What happens when the start button is pressed for a brief instant? [1 mark]

_____

(ii) Explain how the components **A**, **B**, **C**, **D**, **E** and **F** control the movement of the cylinder. [6 marks]

A _____

B _____

C _____

D _____

E _____

F _____

www.xtrapapers.com

(iii) Explain how the speed of the cylinder outstroke could be reduced. [2 marks]

_____

(iv) Suggest how the circuit could be changed so that the cylinder retracts automatically. [2 marks]

_____

www.xtrapapers.com

(d) **Fig. 4** shows two pneumatic cylinders which are controlled by valves **A**, **B**, and **C**.

When button **C** was pressed for an instant, one of the cylinders outstroked, while at the same time the other instroked.

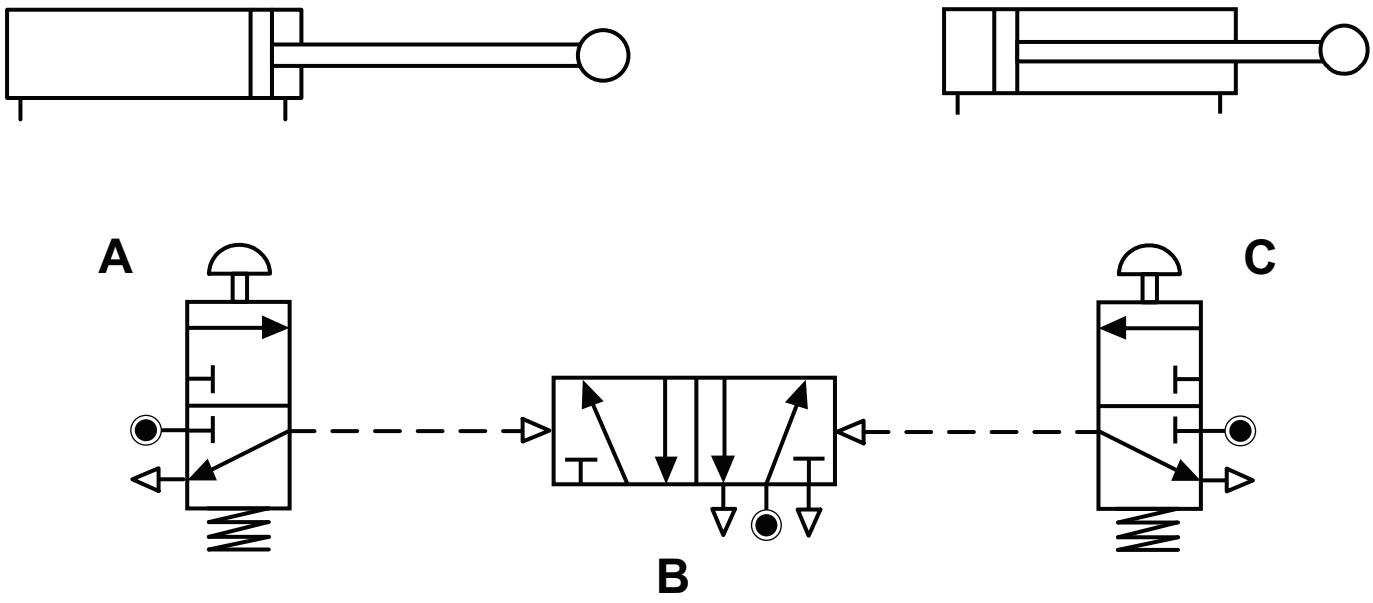


Fig. 4

(i) Complete the circuit in **Fig. 4** to operate this sequence showing all the connecting pipes. [4 marks]

(ii) Give **one** advantage for the method of actuating valve **B** shown. [2 marks]

www.xtrapapers.com

BLANK PAGE

(Questions continue overleaf)

www.xtrapapers.com

(e) Fig. 5 shows a pneumatic circuit used in a packaging machine.

The process runs when a package operates valve **C** and the **start button** is pressed for an instant.

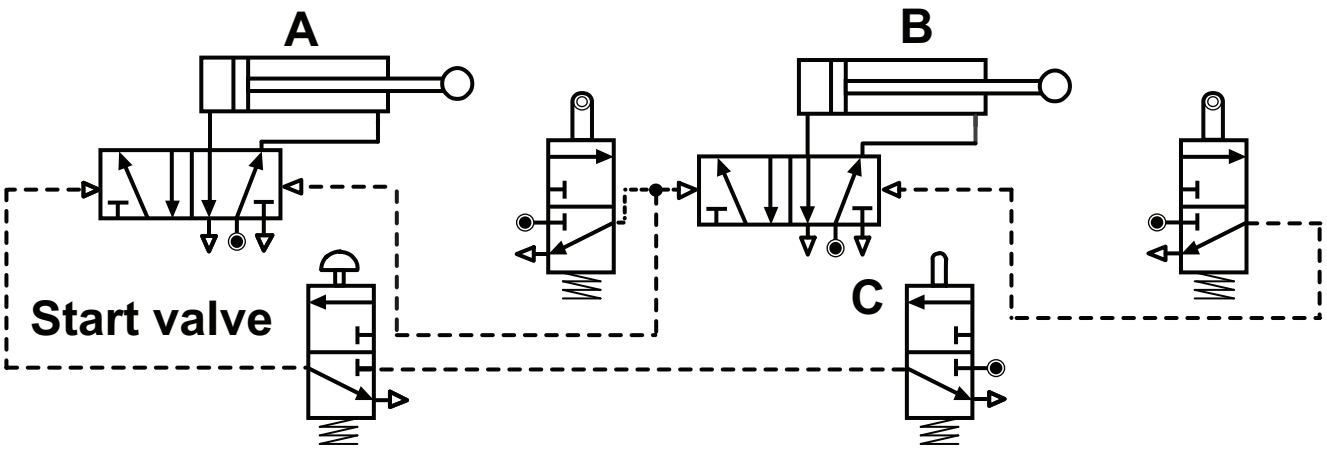


Fig. 5

(i) State the logic combination for valve **C** and the start valve. [1 mark]

_____

(ii) Write down the sequence of operation of the cylinders when the process runs. [5 marks]

_____

www.xtrapapers.com

(iii) Explain briefly how the circuit should be modified so that:

- it operates automatically when a parcel is detected. [2 marks]

_____

_____

- cylinder **A** cannot outstroke until cylinder **B** has fully retracted. [4 marks]

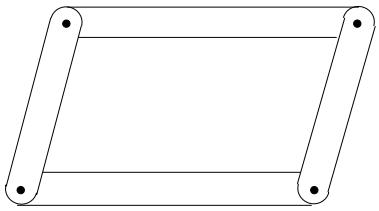
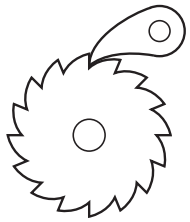
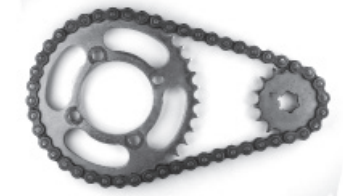
_____

_____

www.xtrapapers.com

2 (a) **Table 2** shows four different mechanisms. Complete **Table 2** by inserting the correct name for each mechanism and the appropriate letter from the list below to describe its function. Each letter may be used only once. [8 marks]

Table 2

Mechanism	Name	Function
		
		
© Hemera Technologies/PhotoObjects.net/Thinkstock		
 © enterphoto / iStock / Thinkstock		

Function

A To transmit motion between shafts a large distance apart.

B To convert rotary motion to linear motion.

C To allow rotation in one direction only.

D To keep surfaces an equal distance apart as they are moved.

www.xtrapapers.com

(b) (i) Name the type of cam shown in **Fig. 6**. [1 mark]

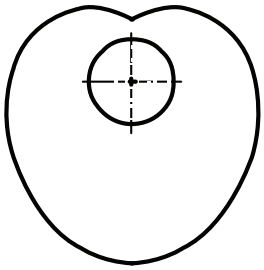


Fig. 6

Name _____

(ii) State the type of output motion the cam can produce. [1 mark]

_____

(iii) Name another mechanism which can produce the same type of output motion. [1 mark]

_____

www.xtrapapers.com

(iv) Name the three types of follower shown in **Fig. 7**.
[3 marks]

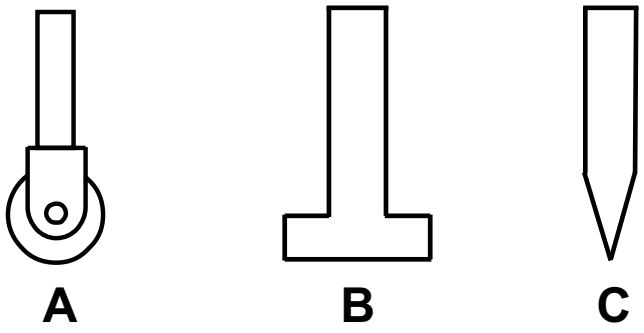


Fig. 7

A _____

B _____

C _____

(v) Select a follower from **Fig. 7** which could be used with the cam shown in **Fig. 6**.

Give a reason for your choice.
[1 mark for follower, 1 mark for reason]

Follower _____

Reason _____

www.xtrapapers.com

BLANK PAGE

(Questions continue overleaf)

www.xtrapapers.com

(c) **Fig. 8** shows a linkage used in a machine.

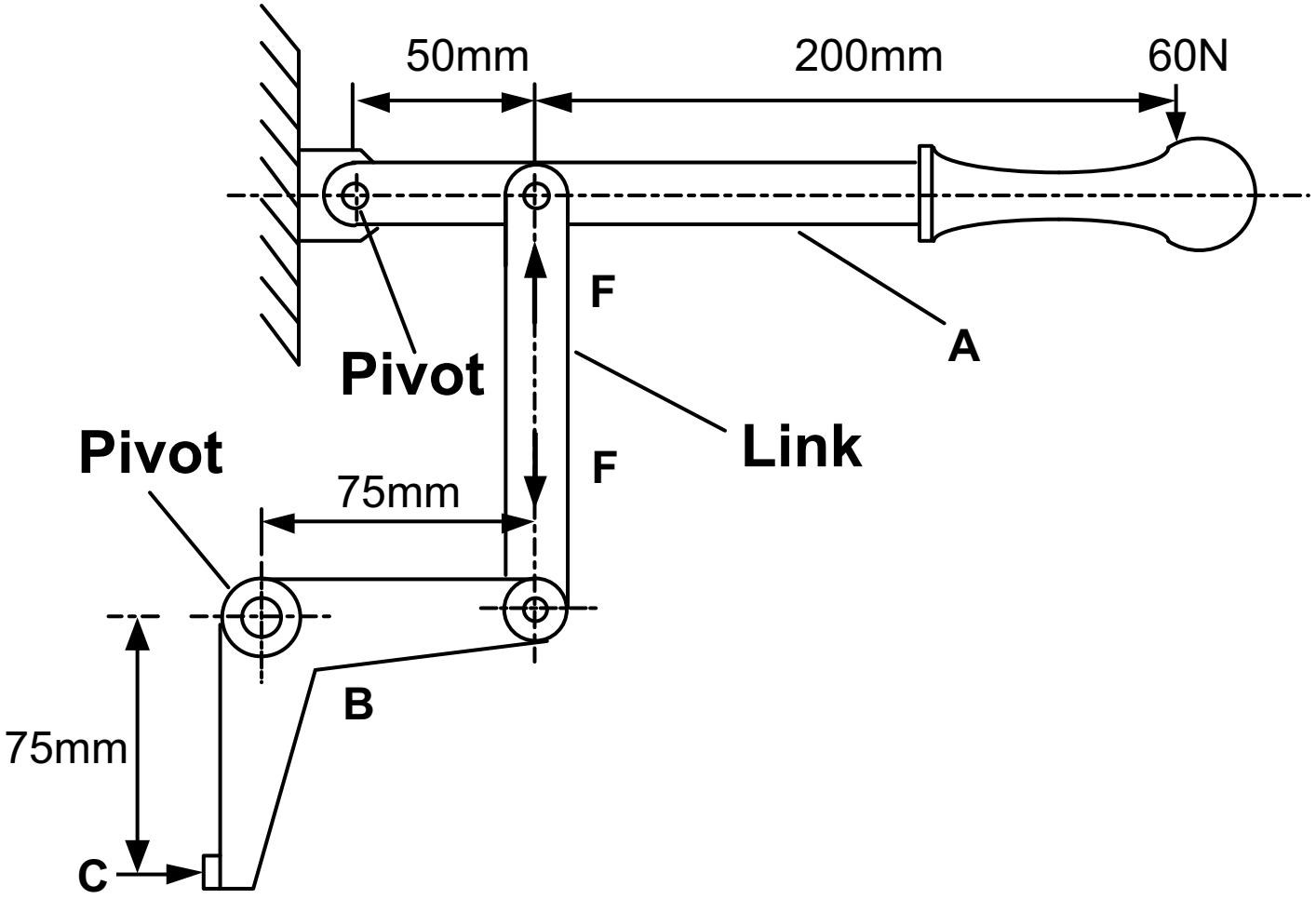


Fig. 8

(i) State the class of lever shown at **A** in **Fig. 8**.
[1 mark]

_____

(ii) Calculate the force **F** produced in the link when a force of **60 N** is applied to the handle. [4 marks]

_____

_____

_____

_____

_____

www.xtrapapers.com

(iii) State the type of lever shown at **B** in **Fig. 8**. [1 mark]

_____

(iv) Determine the force produced at **C** by the force of **60 N** applied to the handle. [2 marks]

_____

www.xtrapapers.com

(d) **Fig. 9** shows a winch used for raising loads. The load drum is driven through a gearbox which gives a **20:1** reduction in speed.

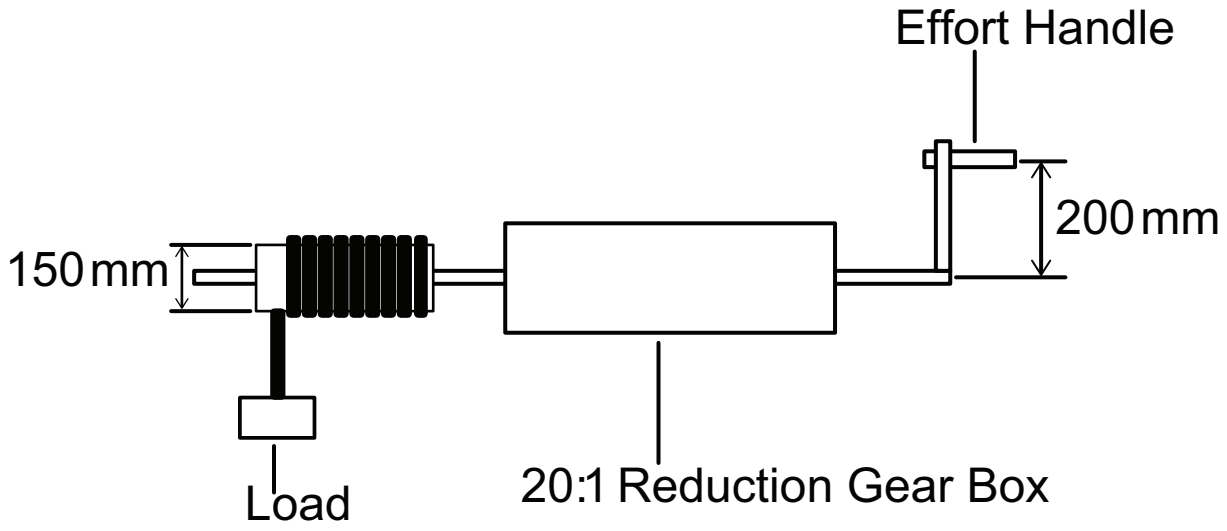


Fig. 9

(i) Determine the distance the load is raised for 10 turns of the handle. [4 marks]

(ii) Determine the velocity ratio of the winch. [4 marks]

www.xtrapapers.com

(iii) Name a different mechanism which could be used in the winch to produce a gear reduction. [2 marks]

Name: _____

(iv) Complete **Fig. 10** to produce a 2D sketch showing a suitable gear arrangement for the gearbox in **Fig. 9**. Gears should be selected from those listed below.

Label each gear to show the number of teeth used. [6 marks]

20 **25** **75** **80** **100** **125** teeth

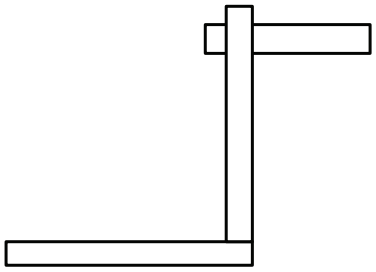


Fig. 10

THIS IS THE END OF THE QUESTION PAPER

www.xtrapapers.com

SOURCES

Resource **Table 2** ... Source: Roller chains with sprockets for motorcycles _iStock_ThinkstockPhotos-476724202.jpgResource 1E
... Source: Screw _ThinkstockPhotos-87508532.jpg

For Examiner's use only	
Question Number	**Marks**
1	
2	
Total Marks	

Examiner Number

Permission to reproduce all copyright material has been applied for.
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA will be happy to rectify any omissions of acknowledgement in future if notified.