



Rewarding Learning

General Certificate of Secondary Education
2018

Centre Number

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Candidate Number

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Technology and Design

Unit 2:

Systems and Control

Element 2: Mechanical and
Pneumatic Control Systems



[GTD22]

GTD22

FRIDAY 25 MAY, AFTERNOON

TIME

1 hour.

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 outside the boxed area on each page or 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 down the right-hand side of pages indicate the marks awarded to each question or part question.

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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 $\frac{\text{number of teeth on driven gear}}{\text{number of teeth on driver gear}}$

For a compound gear train:

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

i.e. $GR_T = GR_1 \times GR_2 \times GR_3 \dots$

- 2 Mechanical Advantage = $\frac{\text{Load}}{\text{Effort}}$

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

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

[Turn over



Answer **all** questions

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

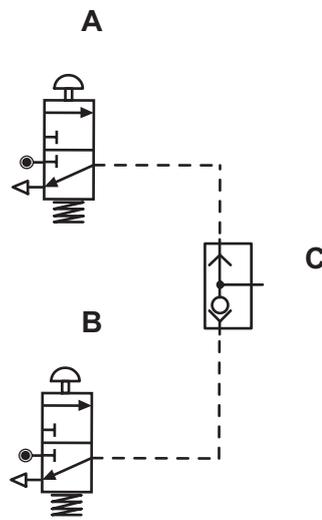


Fig. 1

- (i) Name the valves **A** and **C**.

A _____

C _____ [2]

- (ii) Name the logic combination for valves **A** and **B**.

_____ [1]



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

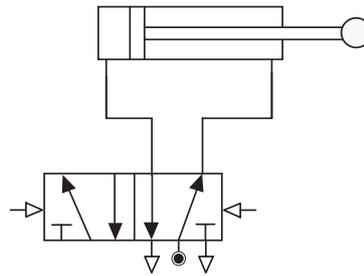


Fig. 2

(i) Name the type of cylinder shown.

_____ [1]

(ii) State **two** factors which determine the force the cylinder can exert.

1. _____

2. _____ [2]

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

_____ [1]

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

Table 1

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

[4]

[Turn over



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

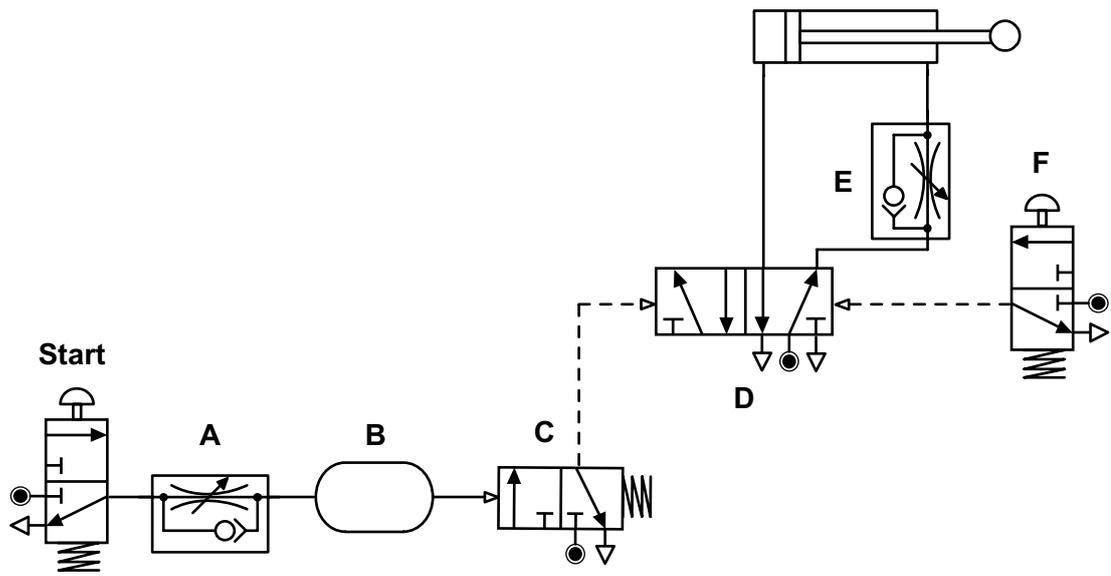


Fig. 3

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

_____ [1]

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

A _____

B _____

C _____

D _____

E _____

F _____ [6]



(iii) Explain how the speed of the cylinder outstroke could be reduced.

_____ [2]

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

_____ [2]

(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.

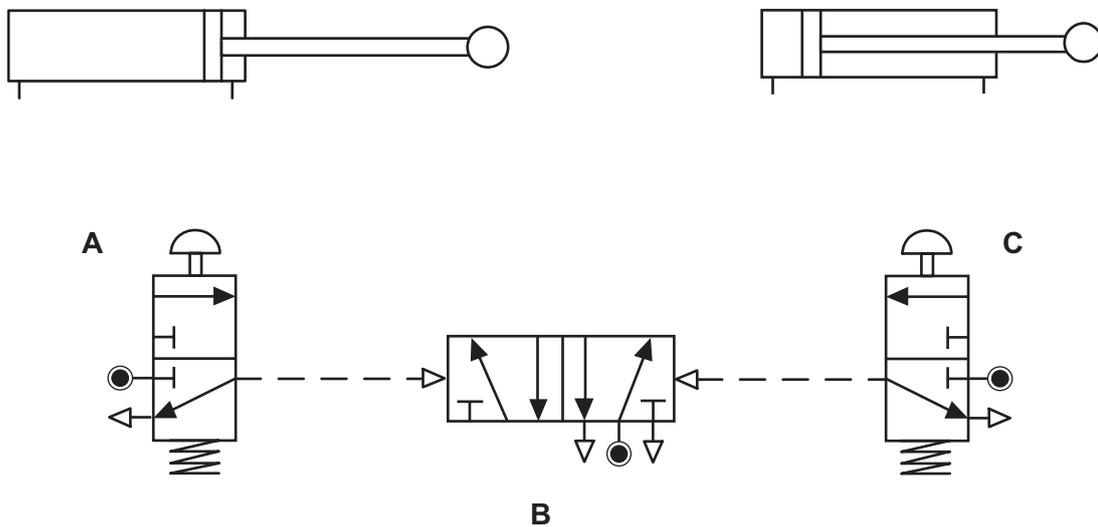


Fig. 4

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

(ii) Give one advantage for the method of actuating valve B shown.

_____ [2]

[Turn over



(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.

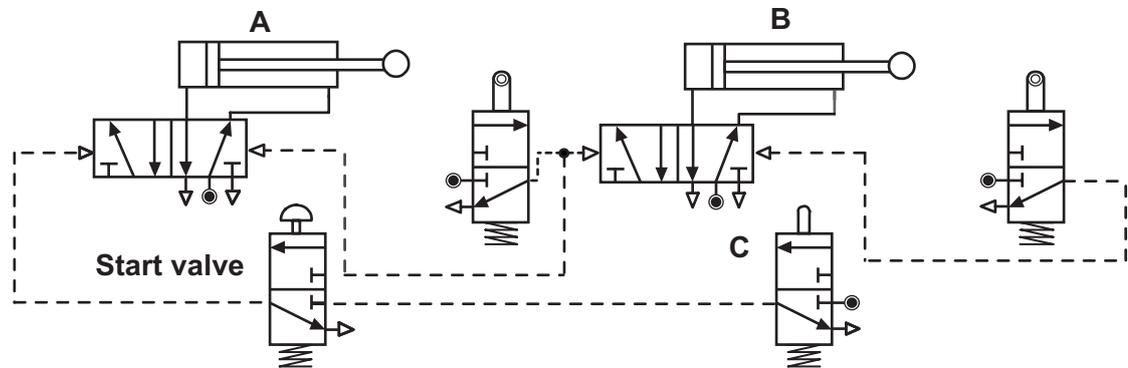


Fig. 5

(i) State the logic combination for valve **C** and the start valve.

_____ [1]

(ii) Write down the sequence of operation of the cylinders when the process runs.

_____ [5]

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

- it operates automatically when a parcel is detected.

_____ [2]

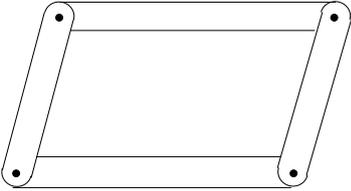
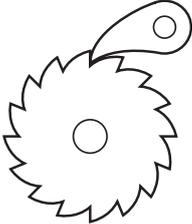
- cylinder **A** cannot outstroke until cylinder **B** has fully retracted.

_____ [4]



- 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.

Table 2

Mechanism	Name	Function
		
		
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[8]

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.

[Turn over



(b) (i) Name the type of cam shown in Fig. 6.

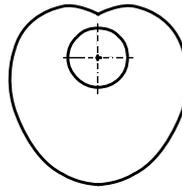


Fig. 6

Name _____ [1]

(ii) State the type of output motion the cam can produce.

_____ [1]

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

_____ [1]



(iv) Name the three types of follower shown in Fig. 7.

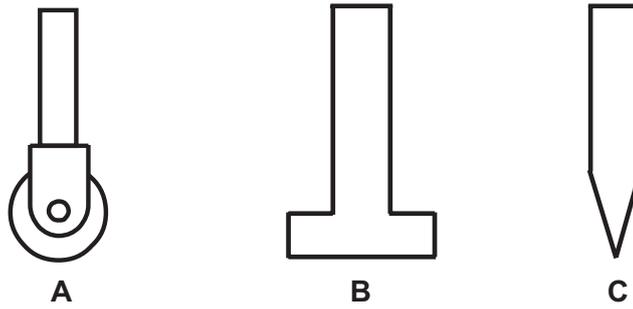


Fig. 7

A _____

B _____

C _____ [3]

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

Give a reason for your choice.

Follower _____ [1]

Reason _____ [1]



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

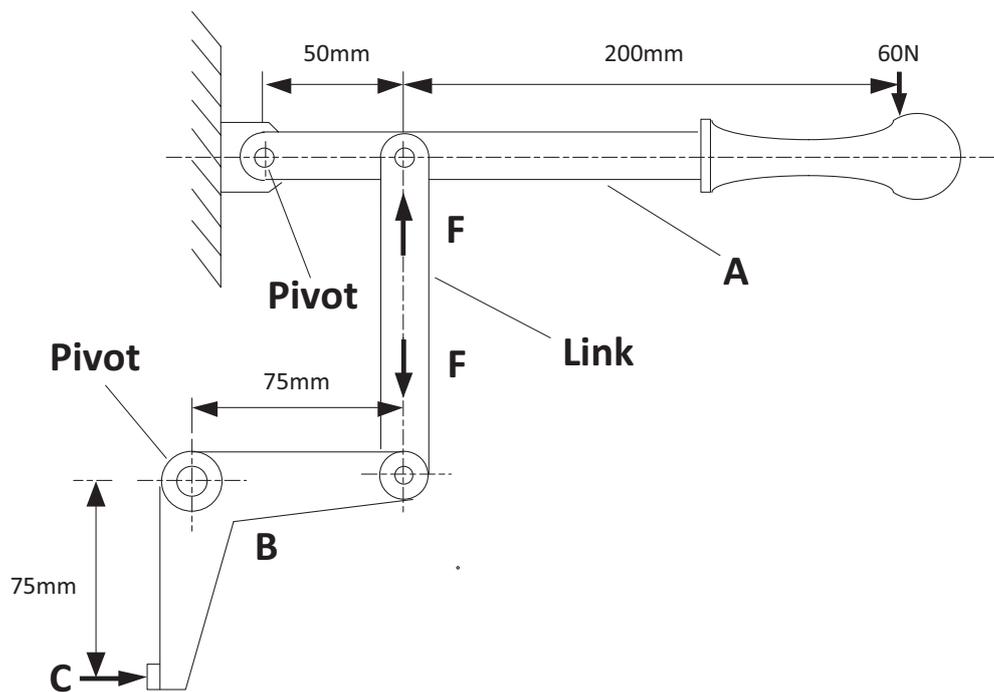


Fig. 8

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

[1]

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

[4]



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

_____ [1]

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

_____ [2]

[Turn over



- (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.

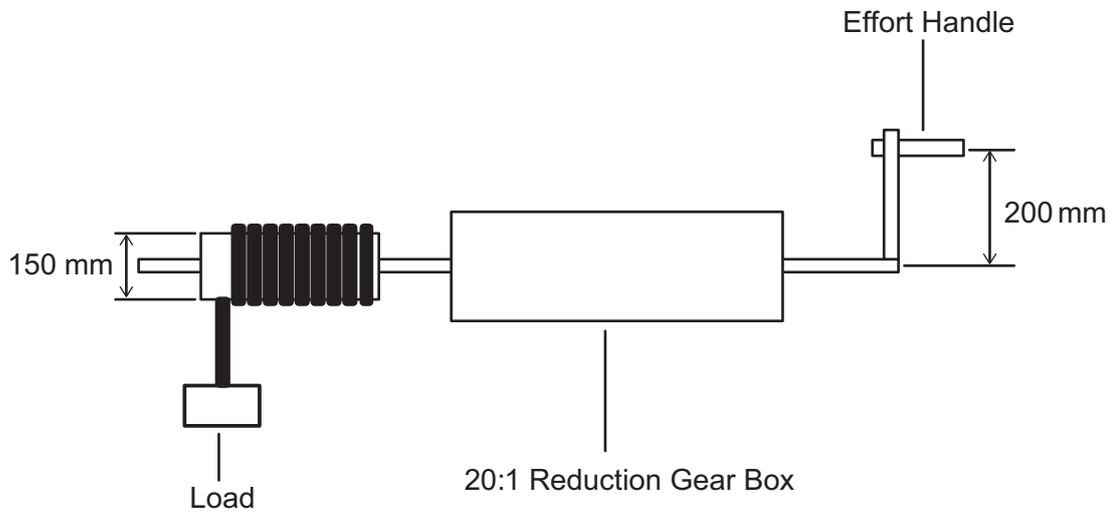


Fig. 9

- (i) Determine the distance the load is raised for 10 turns of the handle.

[4]

- (ii) Determine the velocity ratio of the winch.

[4]



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

Name: _____ [2]

(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.

20 25 75 80 100 125 teeth

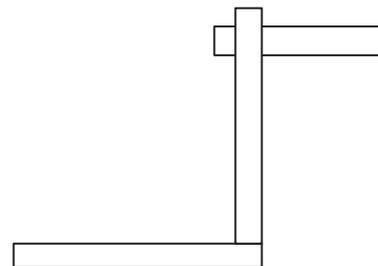


Fig. 10

[6]

THIS IS THE END OF THE QUESTION PAPER



SOURCES

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

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Question Number	Marks
1	
2	
Total Marks	

Examiner Number

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