Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2013

Technology and Design

Unit 2:
Systems and Control

Element 2: Mechanical and Pneumatic Control Systems

[GTD22]

ML

FRIDAY 7 JUNE, 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.
Write your answers in the spaces provided in this question paper.
Complete in blue or 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 $= \dfrac{\text{number of teeth on a driven gear}}{\text{number of teeth on a driver gear}}$

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 $= \dfrac{Load}{Effort}$

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

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

[Turn over

Element 2

Mechanical and Pneumatic Control Systems

Answer **all** questions

Examiner Only	
Marks	Remark

1 (a) (i) Look at **Table 1**. It shows the symbols for different methods of operating pneumatic valves.

Table 1

Symbol	Name of Symbol
	
	
	
	

[4]

Complete **Table 1** by writing down the correct name for each symbol from **Table 2.**

Table 2

Roller
Push Button
Plunger
Lever
Pilot Air

Examiner Only	
Marks	Remark

(ii) Choose the methods from **Table 2** that would be used to operate:

- A valve to confirm the position of a piston rod

_____ [1]

- A valve that is to be operated from a distance

_____ [1]

(b) **Fig. 1** below shows the components used to give a time delay.

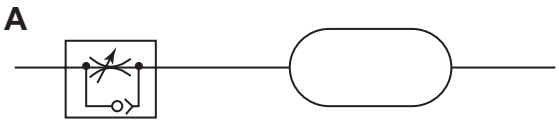

Fig. 1

(i) Describe the function of valve **A** in the circuit.

_____ [1]

(ii) Describe **two** ways in which the time delay can be increased.

1. _____

_____

2. _____

_____ [4]

[Turn over

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Marks	Remark

(c) **Fig. 2** shows a pneumatic cylinder that is used to push heavy boxes onto a delivery chute.

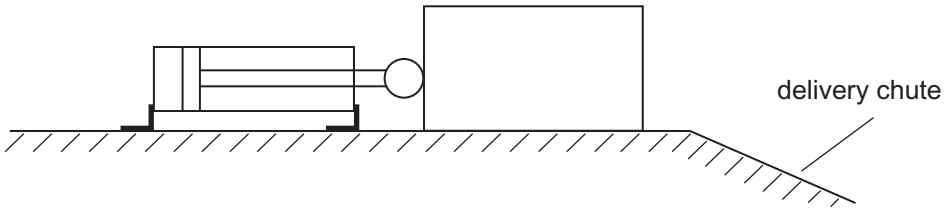

Fig. 2

Fig. 3 shows the pneumatic circuit to control the cylinder in **Fig. 2**.

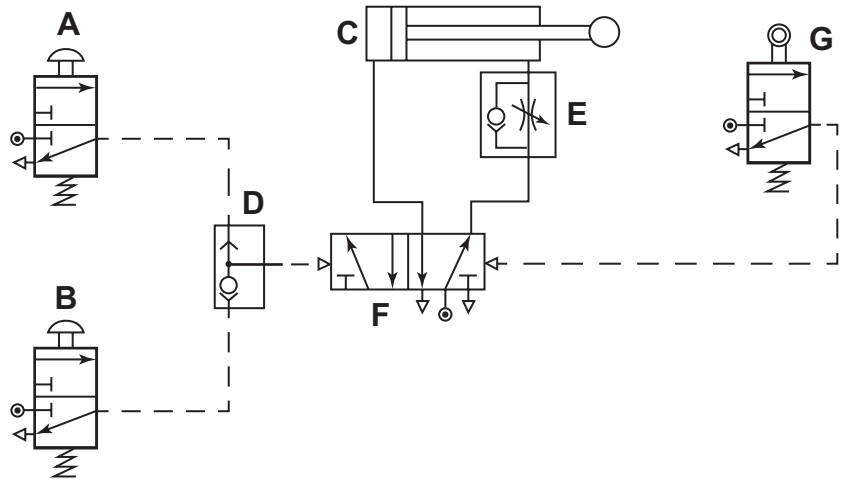

Fig. 3

(i) Write down **two** factors that determine the size of the force the cylinder can exert.

1. _____

2. _____ [2]

(ii) Describe briefly how the circuit operates.

_____

_____

_____ [3]

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Marks	Remark

(iii) Explain the purpose of valve **E** in **Fig. 3**.

_____

_____ [2]

(iv) During the building of the circuit two errors were made:

Error 1: Valve **D** was left out as shown in **Fig. 4**.
(Compare with **Fig. 3**).

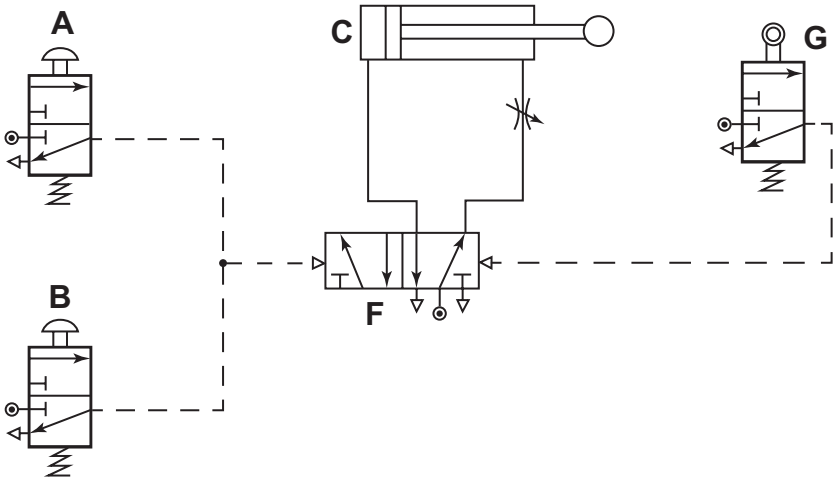


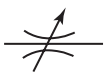
Fig. 4

Explain what happens to the supply air when button **A** is pressed.

_____

_____ [3]

Error 2: The valve shown below was fitted in **Fig. 4** instead of valve **E,** as shown in **Fig. 3**.



Explain how this error would affect the operation of the circuit.

_____

_____ [3]

[Turn over

(d) **Fig. 5** shows part of a pneumatic circuit.

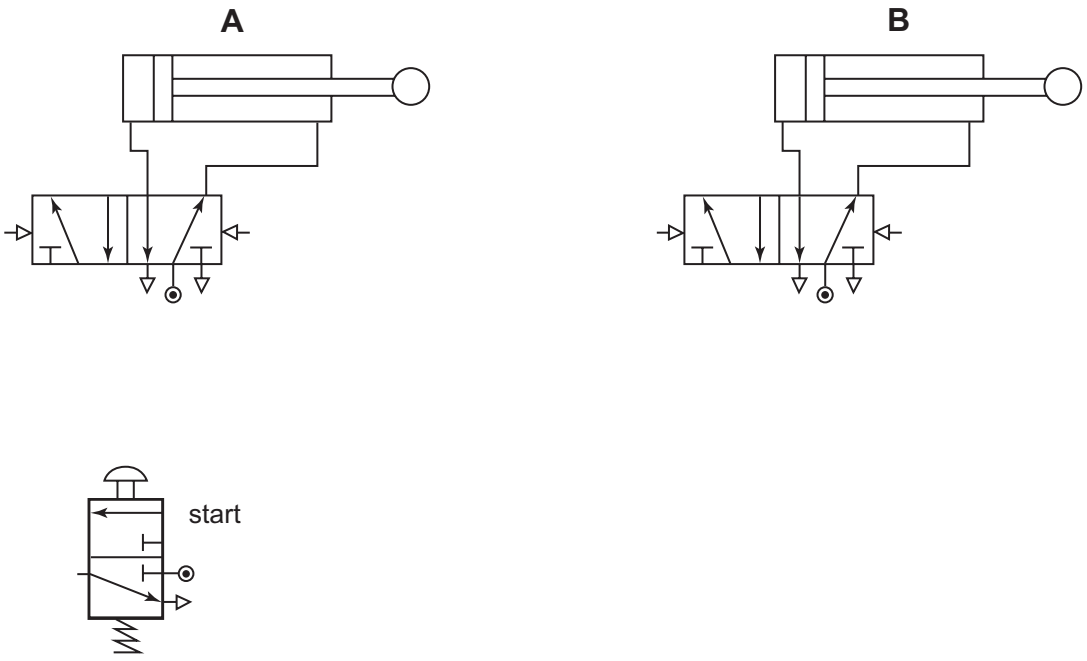


Fig. 5

(i) When the start button is pressed for an instant the cylinders are to move in the following sequence:

- Cylinder **A** and cylinder **B** outstroke at the same time.
- When the **outstroke** of cylinder **B** is confirmed cylinder **A** instrokes.
- When the **instroke** of cylinder **A** is confirmed cylinder **B** instrokes.

Complete **Fig. 5**, showing the connecting pipes and additional valves needed, for the circuit to operate in this sequence. [12]

(ii) The circuit is to be modified so that cylinder **A** cannot instroke until the outstroke of **both** cylinders is confirmed.

Outline how this could be done

_____

_____

_____ [4]

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Marks	Remark
Total Question 1	

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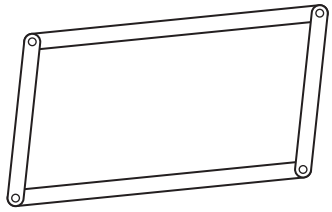
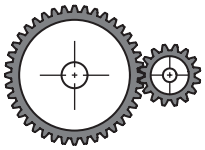
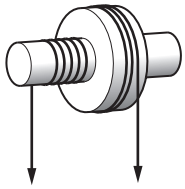
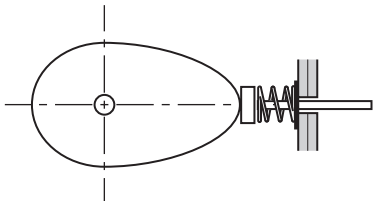
(Questions continue overleaf)

Examiner Only	
Marks	Remark

2 **(a)** Look at **Table 3**. It shows four different mechanisms. Fill in the blank spaces in **Table 3**. Write down the correct name for each mechanism and the correct letter from the list below to describe its function. Each letter may be used only once.

Table 3

Mechanism	Name	Function
		
		
		
		

[8]

Function

A To transmit motion between parallel shafts.

B To convert rotary motion into reciprocating motion.

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

D To enable heavy loads to be raised by small efforts.

(b) **Fig. 6** shows a lever used in a can crusher.

Examiner Only	
Marks	Remark

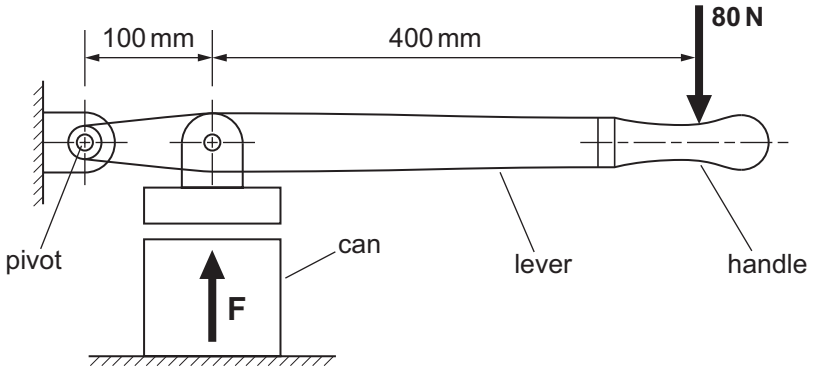


Fig. 6

(i) What could be a suitable material for the lever? Write down a reason for your answer.

Lever material _____

Reason _____ [2]

(ii) Calculate the force **F** at the can when a force of 80 N is applied to the handle.

_____

_____

_____

_____

_____ [4]

[Turn over

Examiner Only	
Marks	Remark

(c) (i) Write down the names of **three** types of belt. Give **one** application for each type of belt.

1. _____

Application _____

2. _____

Application _____

3. _____

Application _____ [6]

(ii) Some belts can become slack. Explain why this can be a disadvantage. Describe **one** method for overcoming the slackness.

Disadvantage _____

_____

Method for overcoming the slackness _____

_____

_____ [4]

Examiner Only	
Marks	Remark

(iii) Look at **Fig. 7**. It shows a gearbox that is driven by an electric motor through a belt and pulley system.

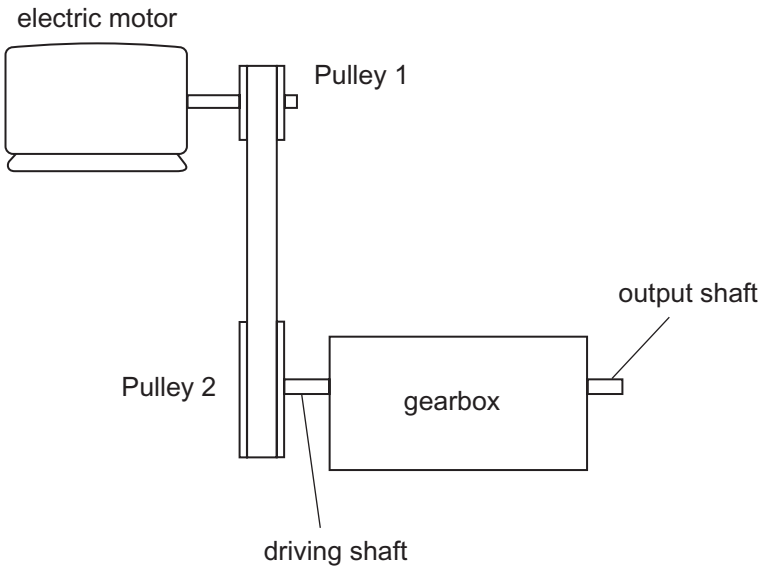


Fig. 7

Is the speed of Pulley 1 faster or slower than Pulley 2?

_____

Write down a reason for your answer.

_____

_____ [2]

[Turn over

Examiner Only	
Marks	Remark

(d) Look at **Fig. 8**. It shows the internal layout of the gearbox in **Fig. 7**. The number of teeth (**T**) are shown on the gear wheels. The driving shaft rotates at 800 rev/min.

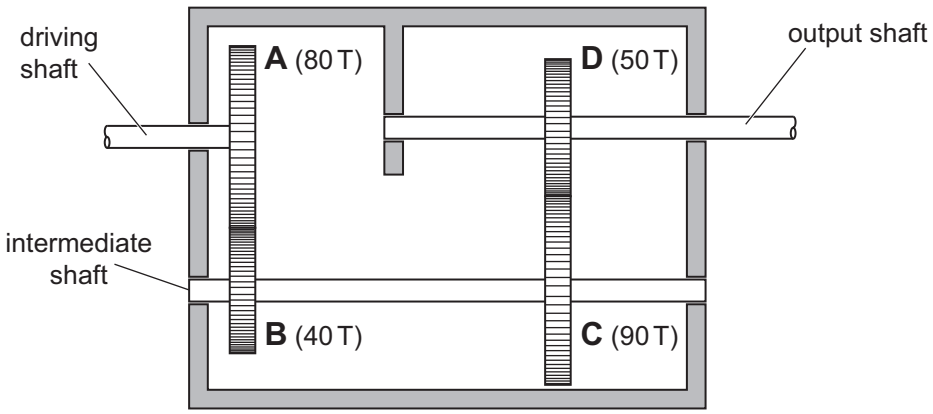


Fig. 8

(i) Write down the type of gear train shown in **Fig. 8**.

_____ [2]

(ii) Write down **one** advantage of this type of gear train.

_____ [2]

(iii) Calculate the speed of the output shaft.

_____

_____

_____

_____

_____ [6]

(iv) The gearbox in **Fig. 8** is to be changed to give an output speed of 3200 rev/min by changing wheels **C** and **D** only. Gear wheels 30T, 45T, 60T and 75T may be used.

Choose **two** of the above wheels to replace **C** and **D** and make up a suitable drive.
Label the chosen wheels as **C** and **D**.

[4]

Examiner Only	
Marks	Remark
Total Question 2	

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

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