New Specification

Rewarding Learning

Centre Number
71

Candidate Number

General Certificate of Secondary Education
2011

Technology and Design

Unit 2:
Systems and Control

Element 2: Mechanical and Pneumatic Control Systems

[GTD22]

MONDAY 6 JUNE, MORNING

GTD22

TIME

1 hour.

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** questions.
On **page 3** we have provided formulae for you to use with this paper.
Questions for this paper begin on **page 4**.

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.

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

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

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 $= \dfrac{Load}{Effort}$

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

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

Element 2

Mechanical and Pneumatic Control Systems

Answer **all** questions.

Examiner Only	
Marks	Remark

1 Metal parts are to be dipped in a degreasing solution for a given time before painting. The pneumatic cylinder used in this process is shown in **Fig. 1**.

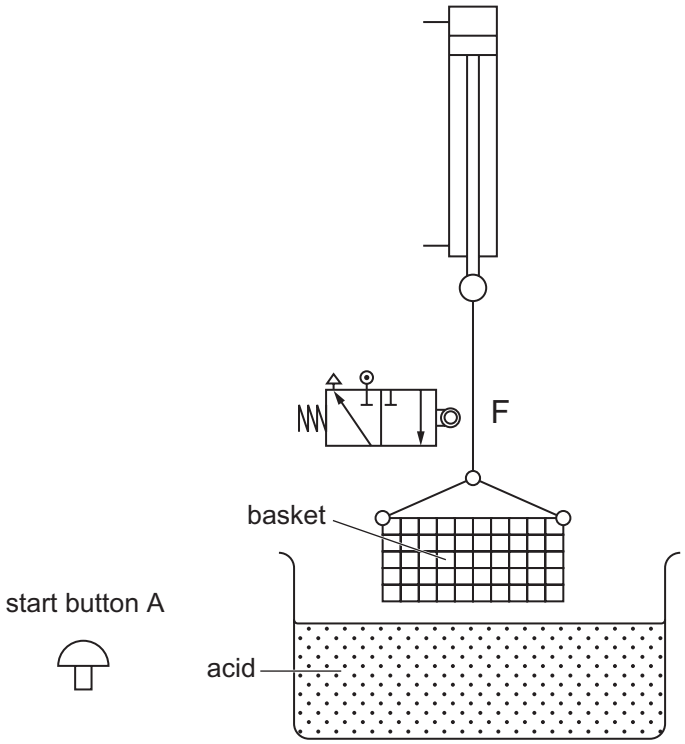

Fig. 1

(a) (i) Name the type of cylinder shown in **Fig. 1**.

_____ [1]

(ii) The cylinder is required to raise a maximum load of 300 N.
Calculate the cross sectional area of the piston required.
Supply pressure = 0.6 N/mm^2.
Cross sectional area of the piston rod = 100 mm^2.

_____

_____

_____

_____ [5]

Examiner Only	
Marks	Remark

(b) The pneumatic circuit used to control the cylinder in **Fig. 1** is shown in **Fig. 2**.

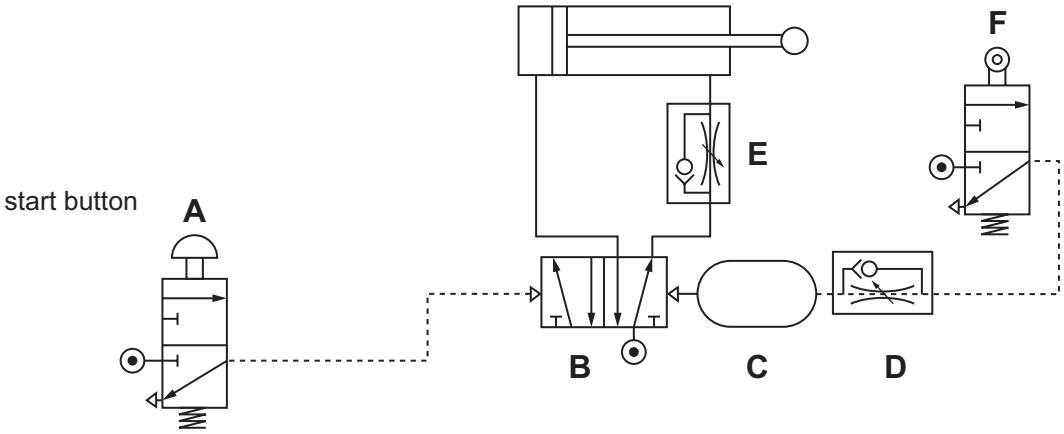

Fig. 2

(i) Name the components **A**, **B**, **C** and **D**.

A _____

B _____

C _____

D _____ [4]

(ii) Describe briefly how the circuit operates when the start button is pressed.

_____

_____

_____

_____

_____ [6]

(iii) State how each of the following could be changed.

- The rate of immersion of the parts

_____

_____ [3]

- The depth to which the parts are immersed

_____

_____ [3]

(iv) The circuit in **Fig. 2** is to be modified so that the start signal can be given from either of two positions.

Show on **Fig. 2** the connecting pipes and additional valves needed to achieve this. [6]

(c) **Fig. 3** shows a lifting device for packages. When a start button is operated for an instant the package is lifted by cylinder **A**. Cylinder **B** then pushes the package onto a gravity-roller conveyor. Both cylinders then return to their initial position.

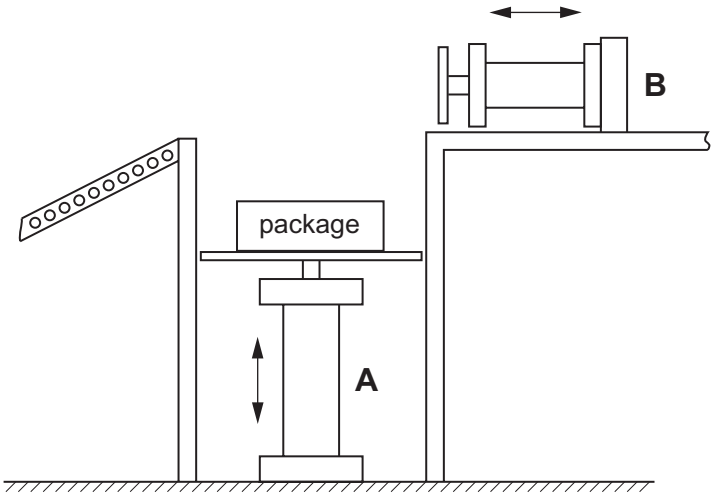

Fig. 3

Examiner Only

Marks	Remark

Part of the pneumatic circuit for **Fig. 3** is shown in **Fig. 4**.

(i) Complete the pneumatic circuit in **Fig. 4** by adding the pipework to give the required sequence.

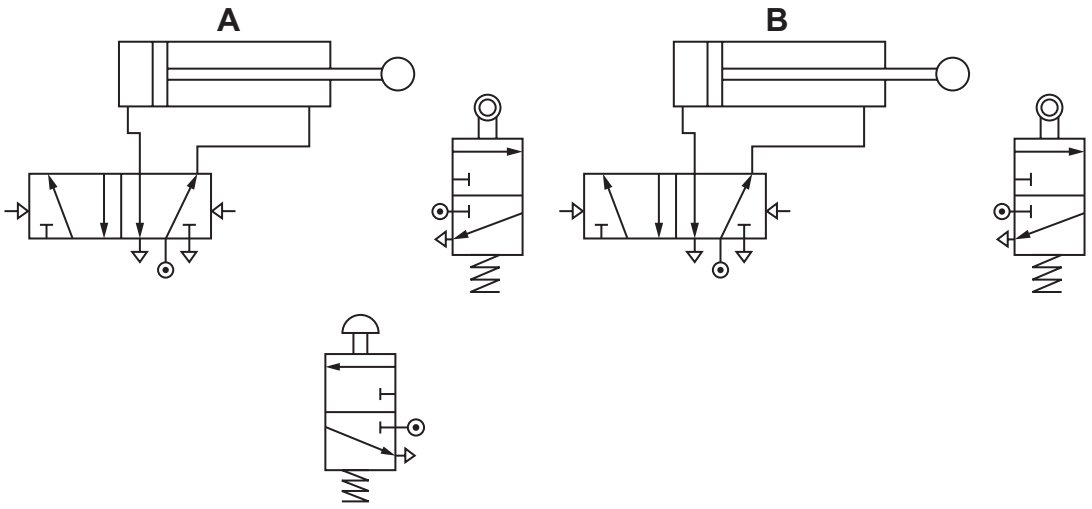

Fig. 4

[8]

(ii) The circuit is to be modified so that the signal to outstroke cylinder **A** cannot be given unless cylinder **B** is fully retracted. Explain briefly how this could be achieved.

_____

_____

_____ [4]

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Marks	Remark

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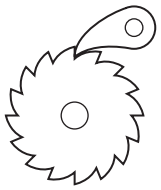
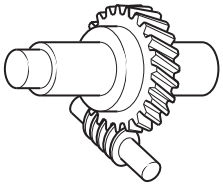
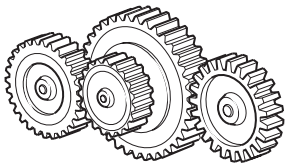
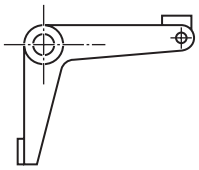
Marks	Remark

2 **(a)** **Table 1** shows four different mechanisms. Complete **Table 1** 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 1

Mechanism	Name	Function
		
		
		
		

[8]

Function

A To make large speed changes.

B To allow rotation in one direction only.

C To change the direction of movement through 90 degrees.

D To convert rotary motion to rotary motion at right angles with a large speed reduction.

(b) Power is to be transmitted from Motor **A** to Shaft **B** parallel to the motor as shown in **Fig. 5**.

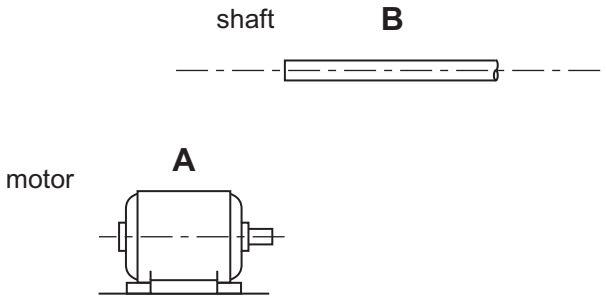


Fig. 5

(i) State **two** factors, other than cost, which should be considered in selecting a method to achieve this.

1. _____

2. _____ [4]

(ii) Name **two** methods which could be used to achieve this.

1. _____

2. _____ [4]

(iii) Give **one** advantage and **one** disadvantage of each method.

Method 1
Advantage _____

Disadvantage _____ [2]

Method 2
Advantage _____

Disadvantage _____ [2]

Examiner Only

Marks	Remark

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Marks	Remark

(c) **Fig. 6** shows a mechanism, used on a machine in which the lever is rotated to produce movement **M**.

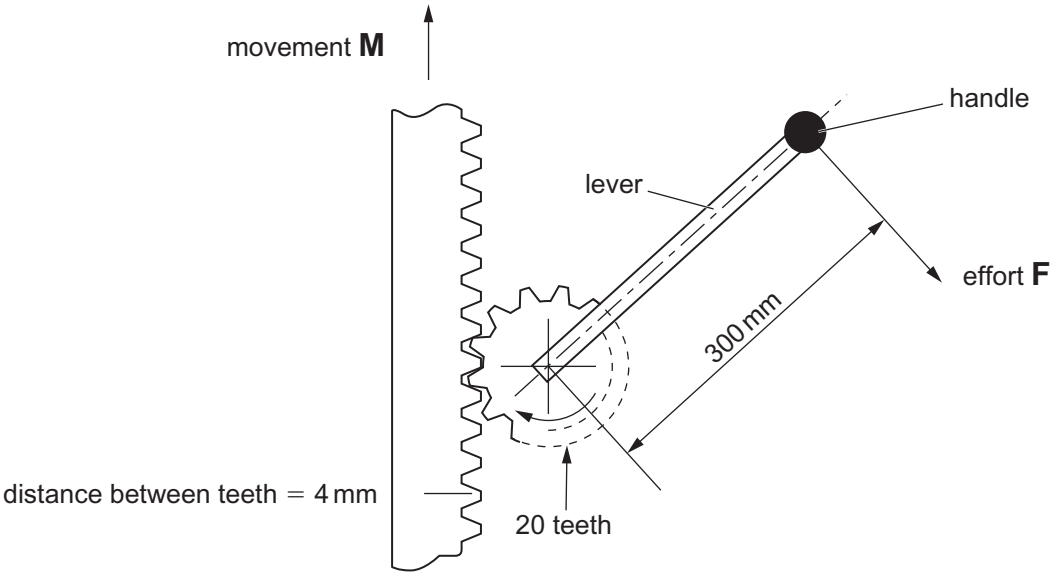

Fig. 6

(i) Name the mechanism in **Fig. 6**.

_____ [2]

(ii) State the type of input and output motion for the mechanism.

Input motion _____

Output motion _____ [4]

(iii) Describe briefly a suitable method for attaching the handle to the lever.

_____

_____

_____ [4]

(iv) The effort **F** is applied to a handle at the end of a lever 300 mm long.
If the lever is turned through 90 degrees calculate:

(Circumference of a circle $= \pi \times$ diameter)

- The distance moved by the effort **F**.

[4]

- The distance moved by **M**.

[4]

- The velocity ratio.

[2]

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Marks	Remark

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