Rewarding Learning

Centre Number

7	1			

Candidate Number

General Certificate of Secondary Education
2014

Technology and Design

Unit 2:
Systems and Control

Element 2: Mechanical and Pneumatic Control Systems

[GTD22]

GTD22

TUESDAY 3 JUNE, AFTERNOON

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.
Questions which require drawing or sketching should be completed using an HB pencil. All other questions must be completed in blue or black ink. **Do not write 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 $=$ $\dfrac{\text{number of teeth on driven gear}}{\text{number of teeth on driver gear}}$

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

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

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

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

5 Circumference of a circle $= \pi \times$ diameter

Answer **all** questions

Examiner Only	
Marks	Remark

1 A company uses pneumatics in a number of operations that includes stamping and clamping.

(a) **Fig. 1** shows a pneumatic cylinder which is used in a clamping operation.

The parts being glued are to be held together for a short time before being released.

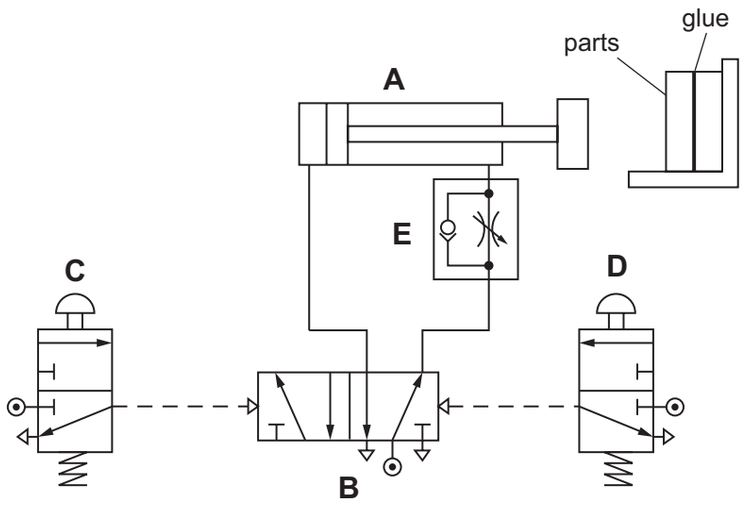

Fig. 1

(i) Name the type of cylinder shown at **A**.

_____ [1]

(ii) Name valve **B**.

_____ [1]

(iii) State the type of air used to activate valve **B**.

_____ [1]

(iv) State how this air is activated.

_____ [1]

(v) Which valve controls the speed of clamping?

_____ [1]

(b) An alternative circuit for controlling the cylinder is shown in **Fig. 2**.

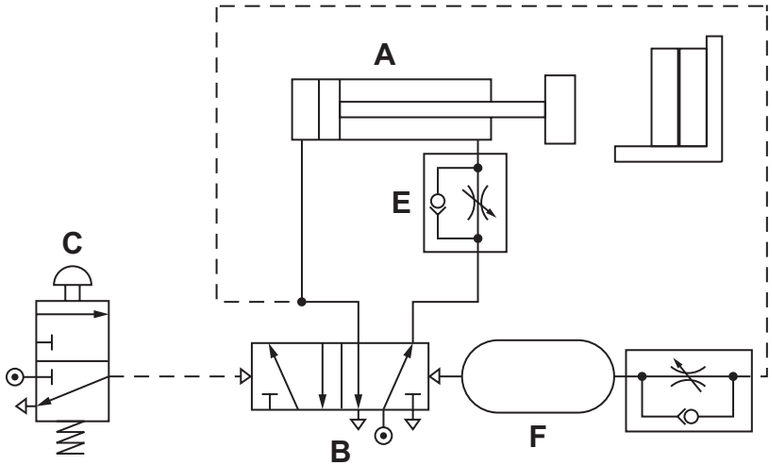

Fig. 2

(i) Name the component **F** in **Fig. 2**.

_____ [1]

(ii) Describe how the circuit in **Fig. 2** operates when the start button **C** is pressed for an instant.

_____

_____

_____

_____ [6]

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[Turn over

(iii) Give **one** advantage of the circuit in **Fig. 2** compared to that in **Fig. 1**.

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Marks	Remark

_____

_____ [2]

(iv) Suggest how the following faults which occurred in the operation of the circuit in **Fig. 2** could be corrected.

- The clamping force was too small.

_____

_____ [2]

- The clamping time was too short.

_____

_____ [2]

(c) **Fig. 3** shows part of a pneumatic circuit.
The two cylinders are operated using valves **A**, **B** and **C**.

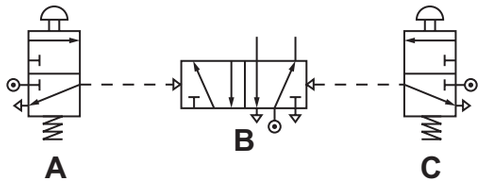

Fig. 3

(i) The cylinders are to operate as follows:

- Both cylinders extend when a push button is operated for an instant.
- The speed of the cylinders on the outstroke is to be controlled individually.
- Both cylinders retract when another button is pressed for an instant.

Complete the circuit in **Fig. 3** to operate in this sequence showing all the connecting pipes and additional valves required. [8]

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(ii) The two cylinders in **Fig. 3** are used in a clamping process.

The total clamping force required is 600 N.
The supply pressure is 0.6 N/mm^2.

Calculate the required cross-sectional area for each cylinder.

[3]

(d) The company uses pneumatics in a packaging process.
Part of the pneumatic circuit used in the process is shown in **Fig. 4**.

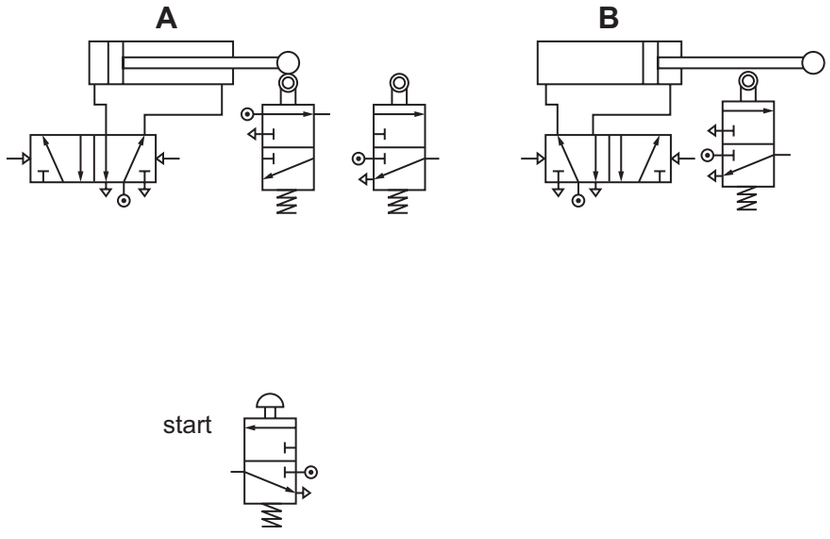

Fig. 4

The cylinders are required to operate in the following sequence when the start button is operated for an instant.

Start **A**+, **B**−, **A**−, **B**+

(i) Complete **Fig. 4** by adding the pipework to give the required sequence. [8]

(ii) Explain how the circuit should be modified to run continuously when the start button is pressed for an instant.

_____

_____

_____

_____ [3]

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[Turn over

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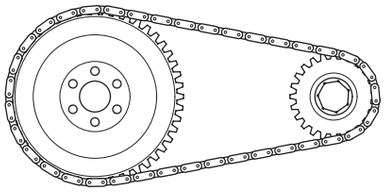
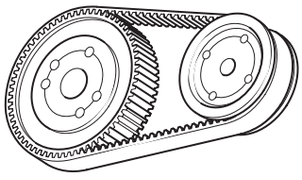
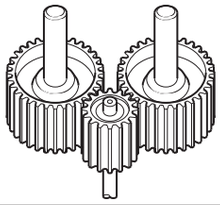
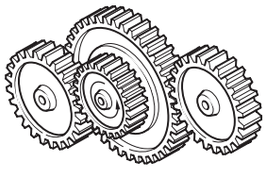
2 **(a)** **Table 1** shows four systems for transmitting motion between parallel shafts.

Complete **Table 1** by inserting the correct name for each method and the appropriate letter from the list below to describe its function.

Table 1

Method	Name	Letter
		
		
		
		

[8]

Function

A To provide a quiet transmission for timing purposes, requiring no lubrication.

B To produce a high gear ratio.

C To transmit motion between shafts a large distance apart.

D To transmit motion between adjacent shafts using an idler gear.

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(b) **Fig. 5** shows a brake pedal which is used to apply a force to a brake cylinder.

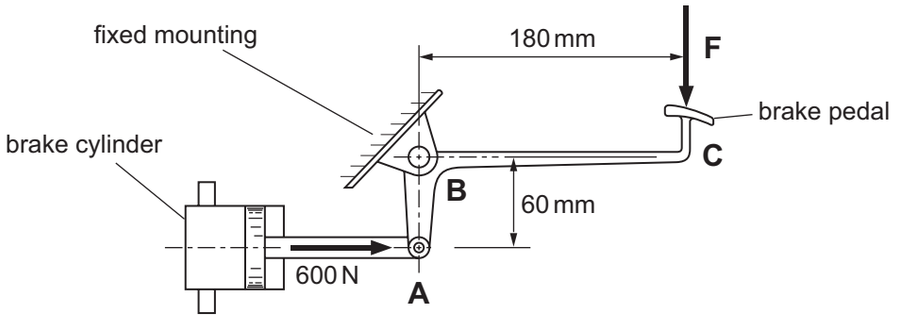

Fig. 5

(i) State the type of output motion produced at the cylinder.

_____ [1]

(ii) State the type of lever labelled **A B C**.

_____ [2]

(iii) Calculate the force **F** required on the brake pedal to produce a force of 600 N on the brake cylinder.

_____

_____

_____

_____ [4]

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(c) (i) Name the three types of follower shown in **Fig. 6**.

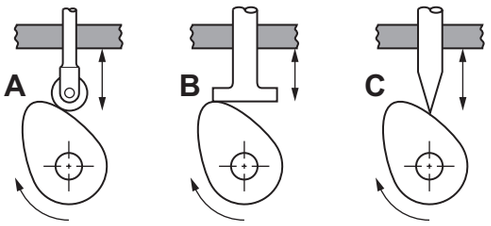

Fig. 6

A _____

B _____

C _____ [3]

(ii) Select the follower from **Fig. 6** that:

- Produces least friction. _____
- Follows complex shapes closely. _____ [2]

(iii) Name the type of cam shown in **Fig. 7**.

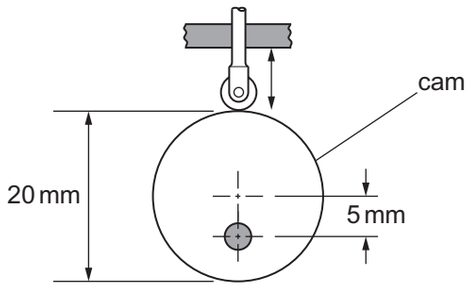

Fig. 7

Name _____ [1]

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(iv) Calculate how far the follower in **Fig. 7** will fall if the cam is turned through 180 degrees.

_____

_____

_____ [3]

(d) **Fig. 8** shows a gear train which is used to move the table of a machine when a handwheel is turned.

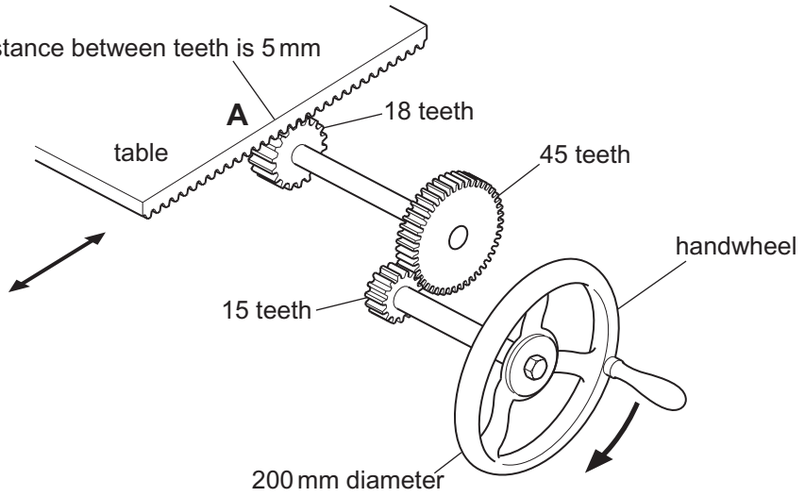

Fig. 8

(i) Name the mechanism shown at **A**.

Mechanism _____ [2]

(ii) If the handwheel is rotated once calculate:

- The distance moved by the effort.

[4]

- The velocity ratio.

[8]

(iii) If the mechanism is modified by changing the 45 tooth wheel to a 60 tooth wheel explain how this would affect the movement of the table for one revolution of the handwheel.

[2]

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Question Number	**Marks**
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