Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2015

Technology and Design

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

[GTD22]

GTD22

MONDAY 8 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.
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 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 $= \dfrac{\text{number of teeth on driven gear}}{\text{number of teeth on driver gear}}$

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 $= \dfrac{Distance\ moved\ by\ effort}{Distance\ moved\ by\ load}$

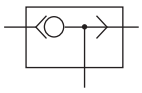
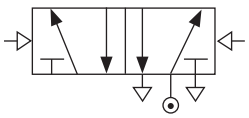
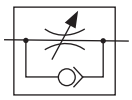
4 Pneumatics
Force = Pressure × Area ($F = P \times A$)

[Turn over

Answer **all** questions

1 **(a)** **Table 1** shows the symbols for three pneumatic valves.

Table 1

Symbol	Name of valve
	
	
	

[3]

(i) Complete **Table 1** by inserting the correct name for each symbol.

(ii) Select the valve from **Table 1** which would be used to:

- Control the movement of a double acting cylinder

_____ [1]

- Control the flow of air in one direction

_____ [1]

(b) **Fig. 1** shows three valves which could be used in operating a machine.
The machine can be operated from two positions:

- By operating valves **A** and **B**

  Or

- By operating valve **C**

Complete the circuit in **Fig. 1** to show how this could be achieved.

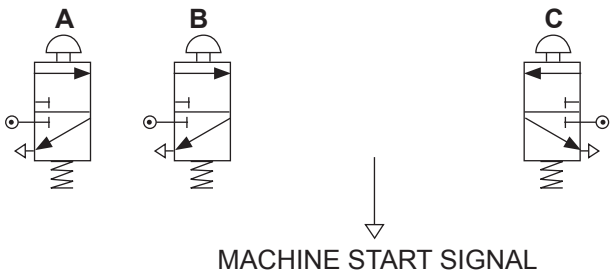


Fig. 1

[4]

(c) **Fig. 2** shows a pneumatic circuit.

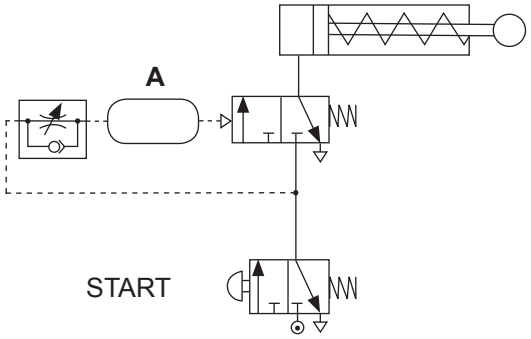


Fig. 2

(i) Name the component **A** _____ [1]

(ii) Explain how the circuit operates when the start button is pressed and held in.

_____

_____

_____ [4]

(d) **Fig. 3** shows a pneumatic circuit.

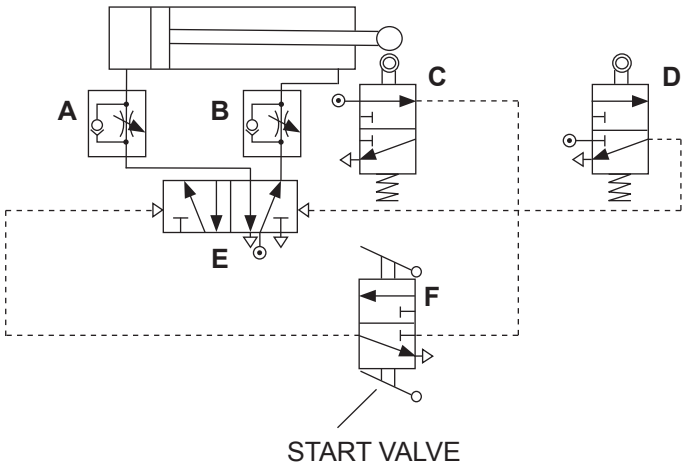


Fig. 3

(i) The cylinder piston has a cross sectional area of 300 mm^2 and the cross sectional area of the piston rod is 100 mm^2.

Supply pressure = 0.5 N/mm^2

Calculate the force the cylinder can exert on the instroke.

[4]

(ii) Describe the operation of the circuit when the start valve is operated.

[4]

(iii) Which valve controls the speed of the outstroke of the cylinder?

[2]

(iv) Explain how the stroke of the cylinder in this circuit can be adjusted.

[2]

(v) Explain briefly how the circuit could be modified so that the cylinder could be stopped in the outstroked position.

[2]

[Turn over

(e) **Fig. 4** shows a part of a pneumatic circuit which is used in a conveyor system for moving parcels.

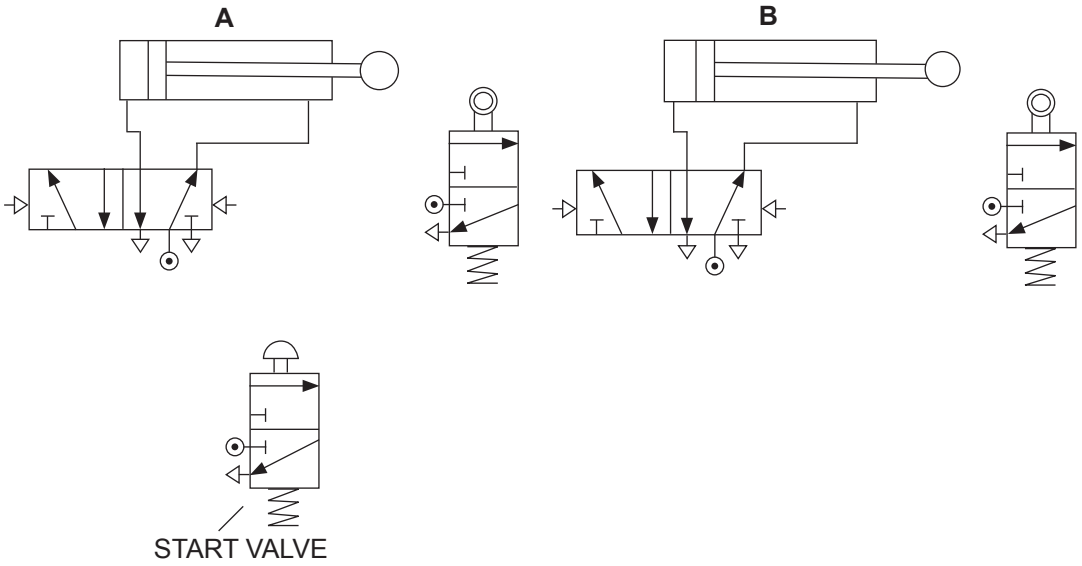


Fig. 4

When the start button is pressed for an instant the cylinders are to move in the following sequence.

- Cylinder **B** outstrokes.
- Cylinder **A** then outstrokes and at the same time cylinder **B** instrokes.
- Cylinder **A** then instrokes.

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

(ii) The circuit is to be modified so that the signal for **B** to outstroke cannot be given until **A** has instroked.

Outline how this could be achieved.

_____

_____

_____

_____ [4]

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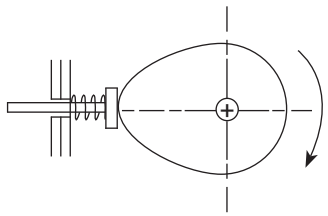
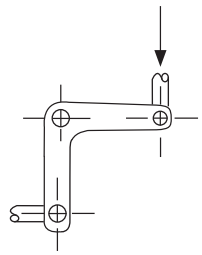
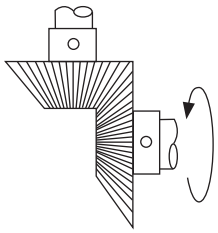
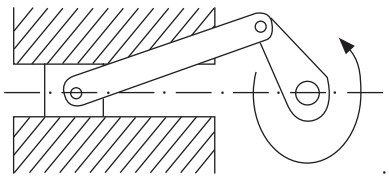
(Questions continue overleaf)

2 (a) (i) **Table 2** shows four different mechanisms. The input motion in each mechanism is shown by an arrow. Complete **Table 2** by inserting the correct name for each mechanism and its type of output motion.

Table 2

Mechanism	Name	Output Motion
		
		
		
		

[8]

(ii) In some mechanisms the input and output motions cannot be reversed.

Which **one** of the mechanisms in **Table 2** is in this category?

_____ [1]

(iii) Name the mechanism shown in **Fig. 5**.

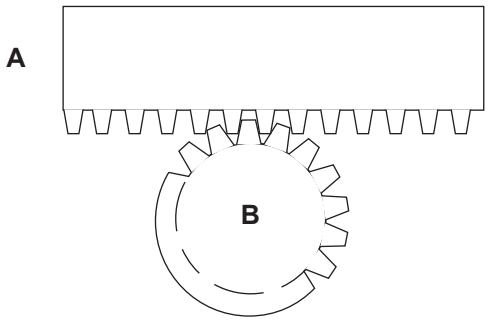


Fig. 5

_____ [1]

(iv) State the type of input motion which should be applied at **A** to produce oscillation at **B**.

_____ [2]

(b) **Fig. 6** shows a mechanism for transmitting power to an output shaft.

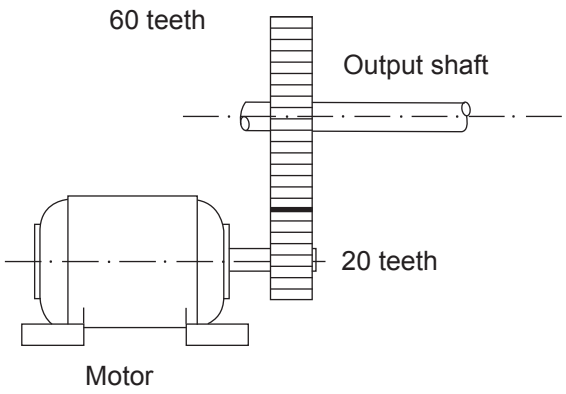


Fig. 6

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

_____ [1]

(ii) The motor runs at 960 rev/min.

Determine the speed of the output shaft.

[3]

(iii) Explain how the transmission could be modified so that the motor and output shafts rotate in the same direction.

_____ [1]

(iv) What effect would this modification have on the speed of the output shaft?

_____ [1]

(v) A large change of speed is required at the output shaft in **Fig. 6**. Suggest a suitable method to achieve this output.

_____ [2]

[Turn over

(c) **Fig. 7** shows a different method for transmitting power to an output shaft.

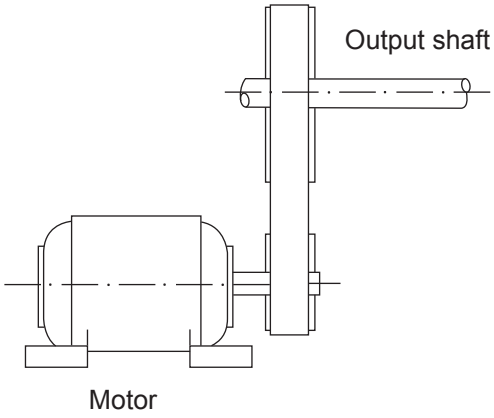


Fig. 7

(i) Name the mechanism shown in **Fig. 7**.

_____ [1]

(ii) Outline **one** advantage and **one** disadvantage of this method compared to that in **Fig. 6**.

Advantage _____ [1]

Disadvantage _____ [1]

(iii) **Fig. 6** and **Fig. 7** show two possible methods for transmitting power to the output shaft. Suggest **one** other method that could be used.

_____ [1]

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(d) **Fig. 8** shows a machine which is used to press discs from sheets of material.

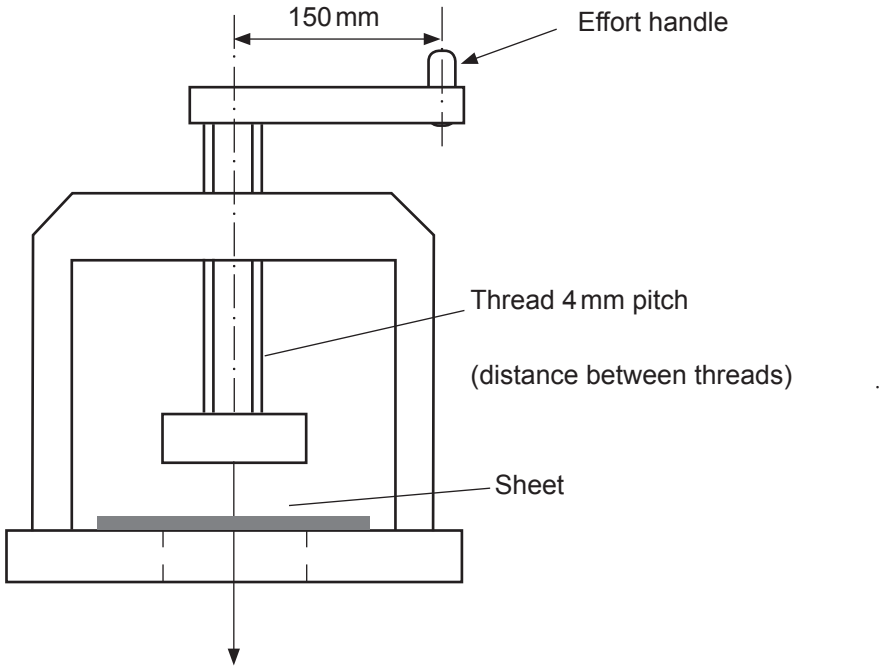

Fig. 8

(i) The press uses a screw thread.

Give **two** other examples where a screw thread is used to produce a large force.

1. _____ [1]

2. _____ [1]

(ii) The mechanical advantage of the press is 50.

Calculate the effort required to produce a press force of 6 kN.

_____

_____

_____ [4]

(iii) Calculate the velocity ratio of the press.

_____

_____

_____

_____ [6]

(iv) Suggest **two** ways in which the design of the press could be modified to increase the velocity ratio.

1. _____

2. _____ [4]

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

Examiner Number