



General Certificate of Secondary Education
2015

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]

MONDAY 8 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.

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

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 ($F = P \times A$)

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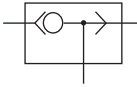
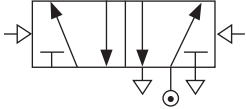
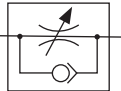


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Answer **all** questions

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

Table 1

Symbol	Name of valve
	
	
	

[3]

(i) Fill in the spaces in **Table 1** by putting the correct name for each symbol.

(ii) Choose the valve from **Table 1** that 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 that 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 done.

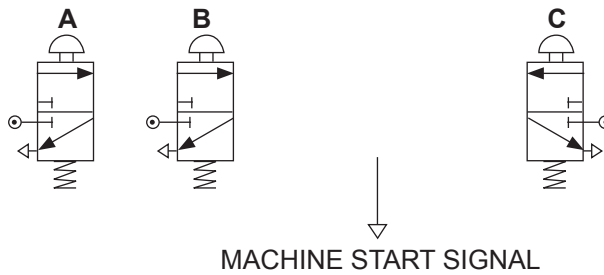


Fig. 1

[4]



(c) Fig. 2 shows a pneumatic circuit.

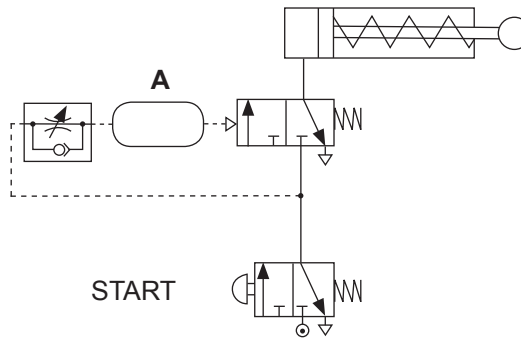


Fig. 2

(i) Write down the name of 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.

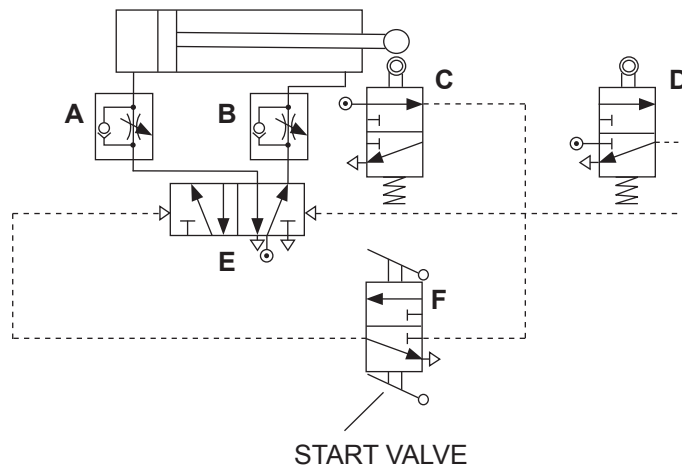


Fig. 3



- (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]

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

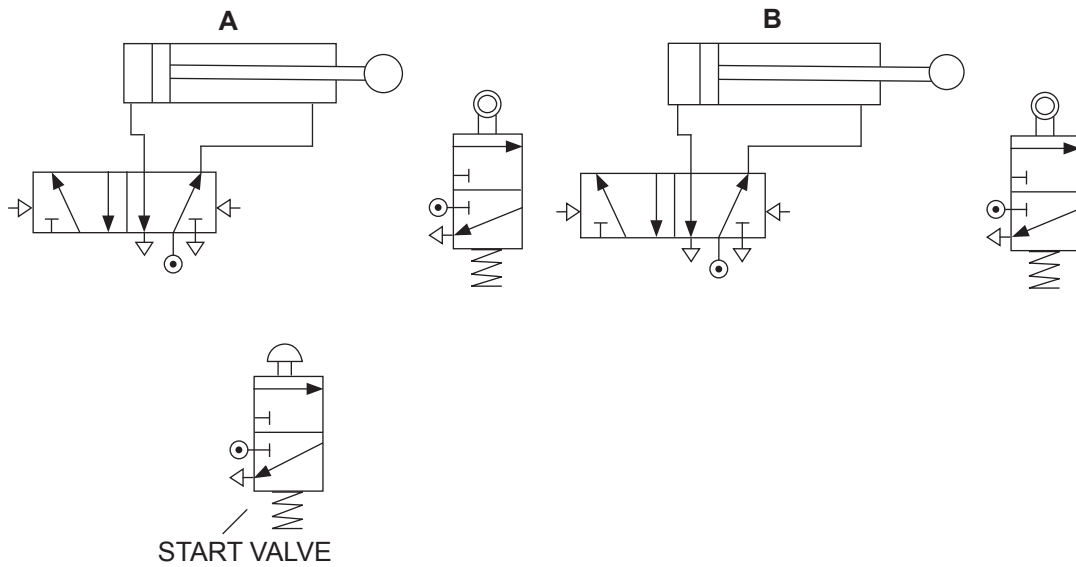


Fig. 4

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.

Write down how this could be achieved.

[4]





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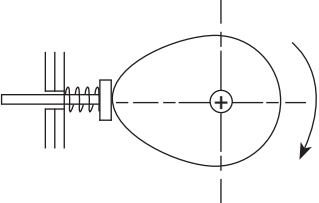
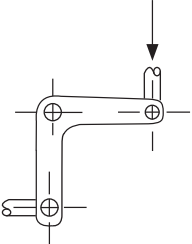
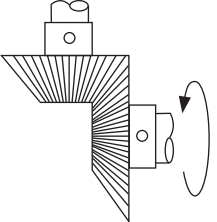
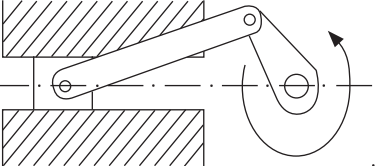
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2 (a) (i) Look at **Table 2**. It shows four different mechanisms. The input motion in each mechanism is shown by an arrow. Fill in the blanks in **Table 2** by putting the correct name for each mechanism and its type of output motion.

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) What is the name of the mechanism shown in **Fig. 5**?

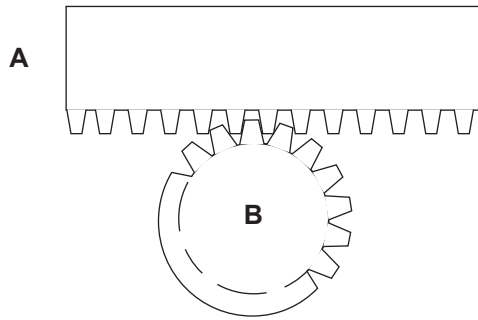


Fig. 5

_____ [1]

(iv) Write down the type of input motion that should be applied at **A** to produce oscillation at **B**.

_____ [2]

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

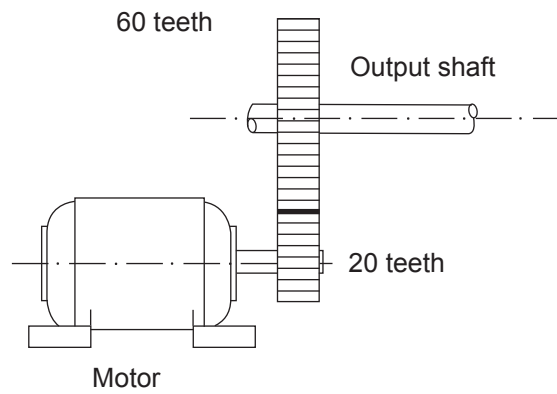


Fig. 6

(i) Write down the name of 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 needed at the output shaft in **Fig. 6**. Write down a suitable method to achieve this output.

_____ [2]

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

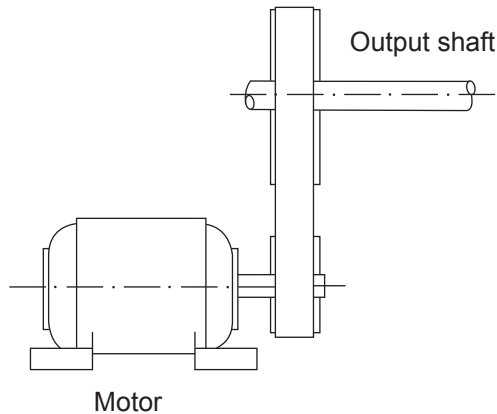


Fig. 7

(i) Write down the name of the mechanism shown in **Fig. 7**.

_____ [1]

(ii) Write down **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. Write down **one** other method that could be used.

_____ [1]





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(d) Look at **Fig. 8**. It shows a machine that is used to press discs from sheets of material.

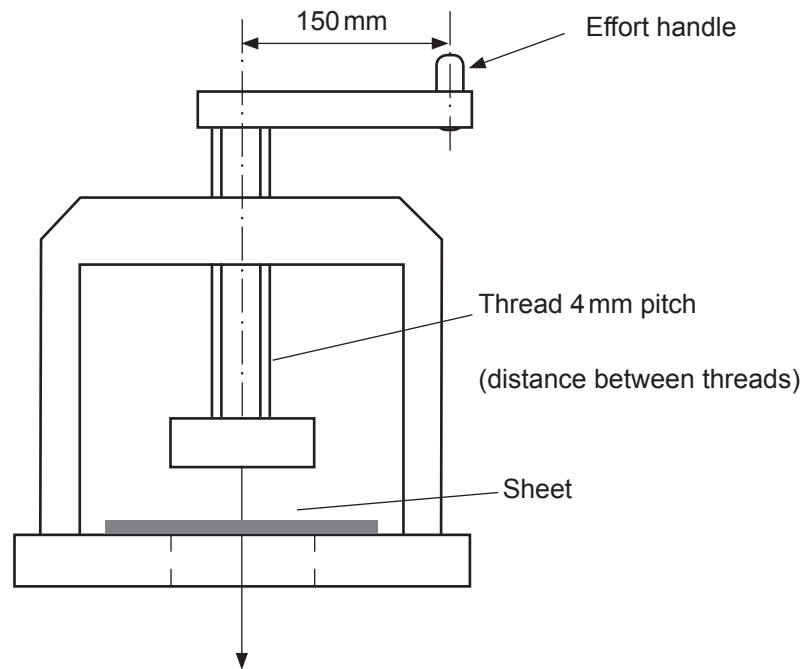


Fig. 8

(i) The press uses a screw thread.

Write down **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 needed to produce a press force of 6 kN.

_____ [4]



(iii) Calculate the velocity ratio of the press.

[6]

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

1. _____

2. _____ [4]

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Question Number	Marks
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