Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012

Technology and Design

Unit 2: Systems and Control

Element 2: Mechanical and Pneumatic Control Systems

GTD22

[GTD22]

TUESDAY 29 MAY, 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.
Answer **all** questions.
On **page 3** we have provided formulae for you to use with this paper.

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 × Area ($F = P \times A$)

Answer **all** questions.

Examiner Only	
Marks	Remark

1 (a) (i) **Fig. 1** shows a pneumatic cylinder.

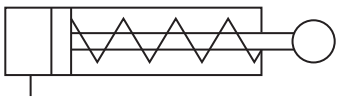


Fig. 1

Name the valve used to control the movement of this cylinder.

_____ [1]

(ii) Give **one** application for this type of cylinder.

_____ [2]

(iii) For the cylinder shown in **Fig. 1**

Piston area = 300 mm^2
Air pressure = 0.5 N/mm^2
Force required to compress spring = 50 N

Calculate the force the cylinder can exert.

_____

_____

_____

_____ [4]

(b) **Fig. 2** shows part of a pneumatic circuit.

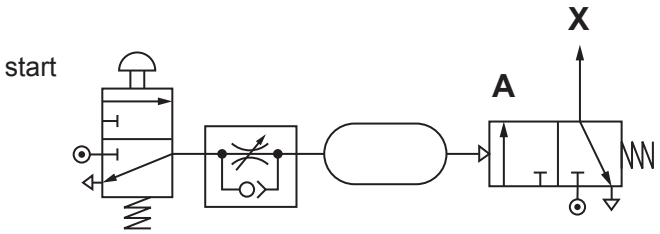


Fig. 2

(i) For valve **A** complete **Table 1** below:

Table 1

Number of switching positions	
Number of ports	
Method of actuation	
Method for resetting	

[4]

(ii) Explain how a signal is produced at **X** when the start button is operated.

_____

_____

_____

_____ [4]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(c) **Fig. 3** shows a pneumatic cylinder which is used to push heavy parts out of a holder one at a time.

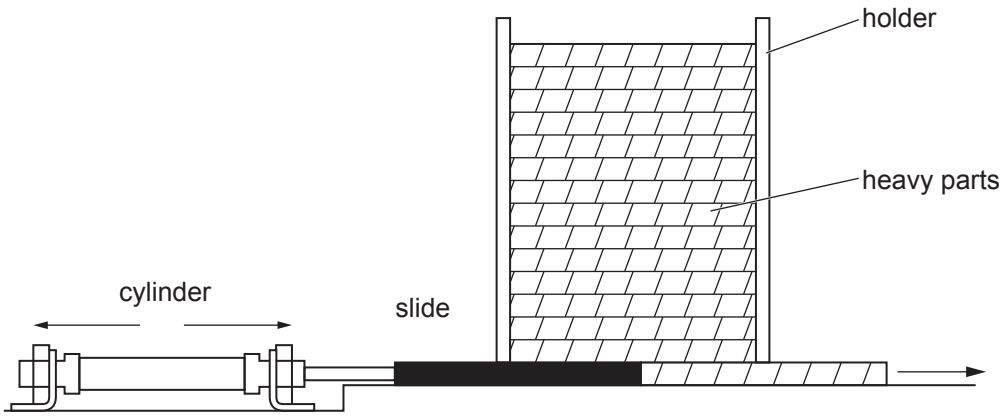


Fig. 3

The pneumatic circuit used to control the cylinder is shown in **Fig. 4**.

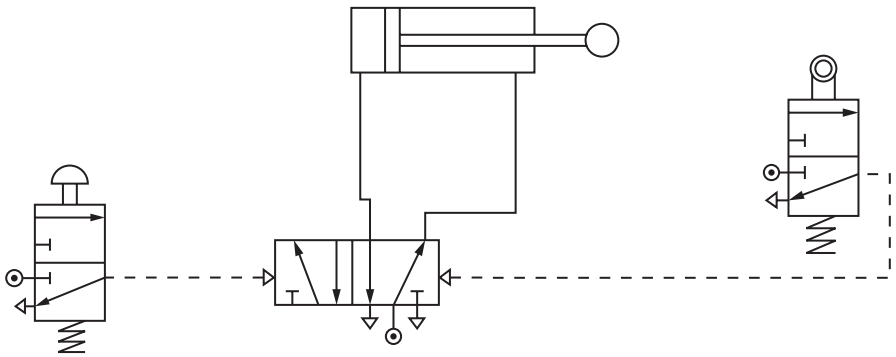


Fig. 4

(i) State **two** factors which should be considered in selecting the cylinder.

1. _____

2. _____ [4]

(ii) The circuit is to be modified to include the following features:

- The speed of pushing the parts is to be controlled.
- The process is to run continuously when the start button is pressed for an instant.

Modify the circuit in **Fig. 4** showing the additional valves required and any changes needed to existing valves. [9]

(d) **Fig. 5** shows a pneumatic circuit which is used on a packaging machine.

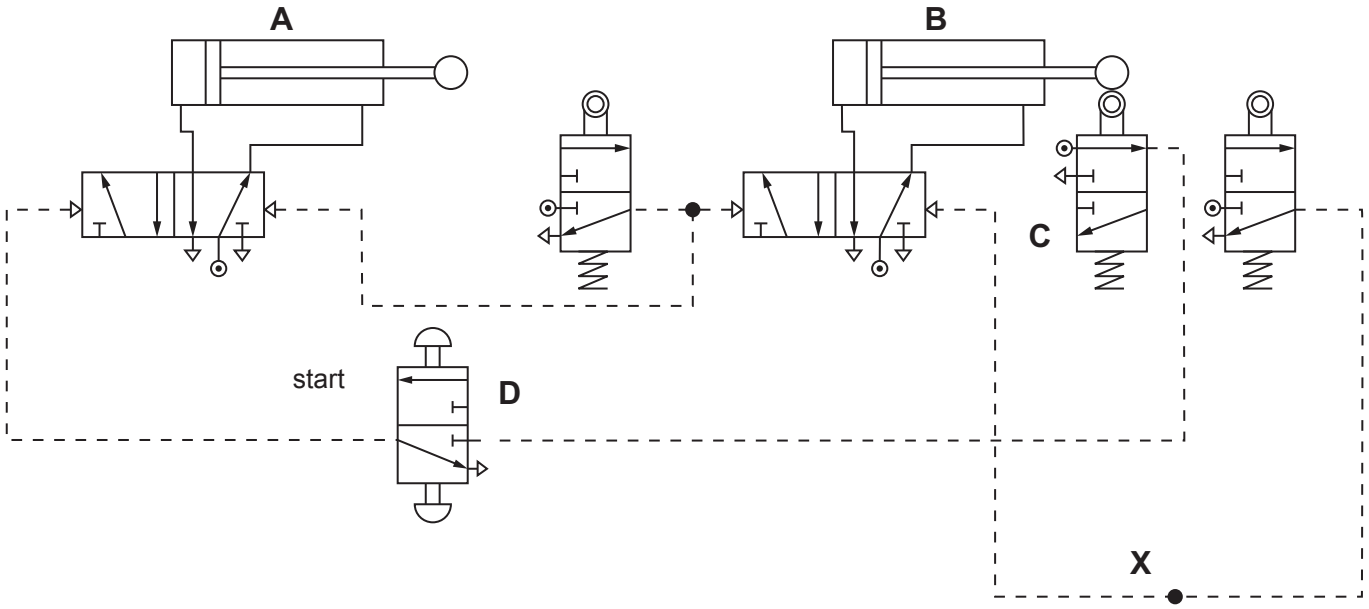


Fig. 5

(i) Valve **C** is connected through valve **D**.
State the logic combination used.

_____ [2]

(ii) State the sequence of operation of the cylinders when the start button is pressed.

_____

_____

_____ [8]

(iii) If the start valve is moved to the position in the circuit marked **X** state the position of the cylinders when it is reset, i.e. switched off.

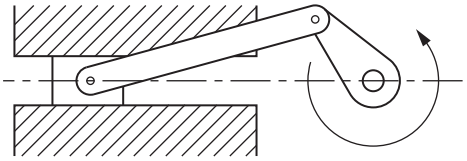
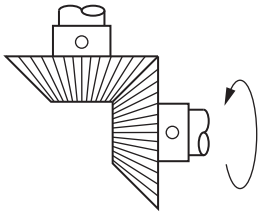
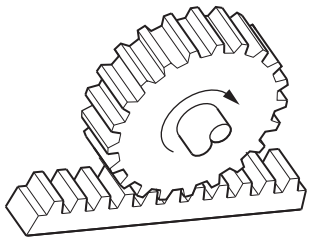
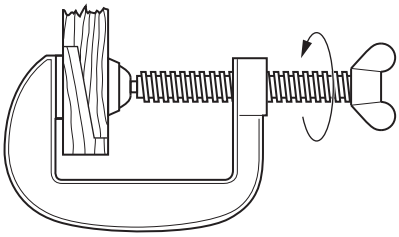
_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** **Table 2** shows four different mechanisms and the input motion in each case.
Complete **Table 2** by inserting the correct name for each mechanism and its output motion.

Table 2

Mechanism	Name	Output Motion
		
		
		
		

[8]

(b) **Fig. 6** shows three types of cam.

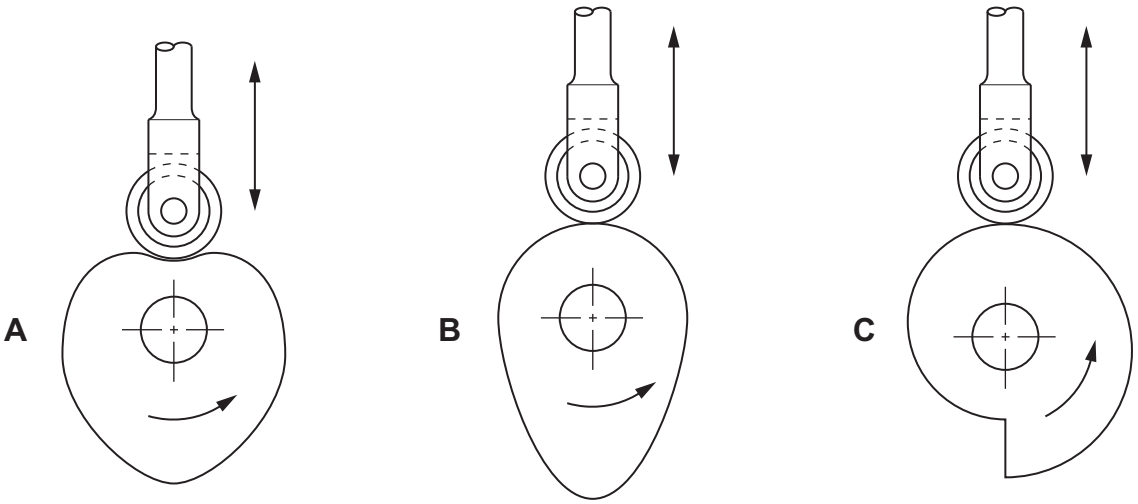


Fig. 6

(i) State the correct names for each of the cams labelled as **A**, **B** and **C** in **Fig. 6**.

A _____

B _____

C _____ [3]

(ii) Select the appropriate cam to give each of the following motions to the follower:

A steady rise with a quick return.

_____

A steady rise, a steady fall, followed by a dwell or rest.

_____

A steady rise and a steady fall.

_____ [3]

(iii) Which **one** of the cams can only operate in one direction of rotation?

_____ [2]

Examiner Only	
Marks	Remark

(c) **Fig. 7** shows a mechanism used in a winch for raising loads.

Examiner Only	
Marks	Remark

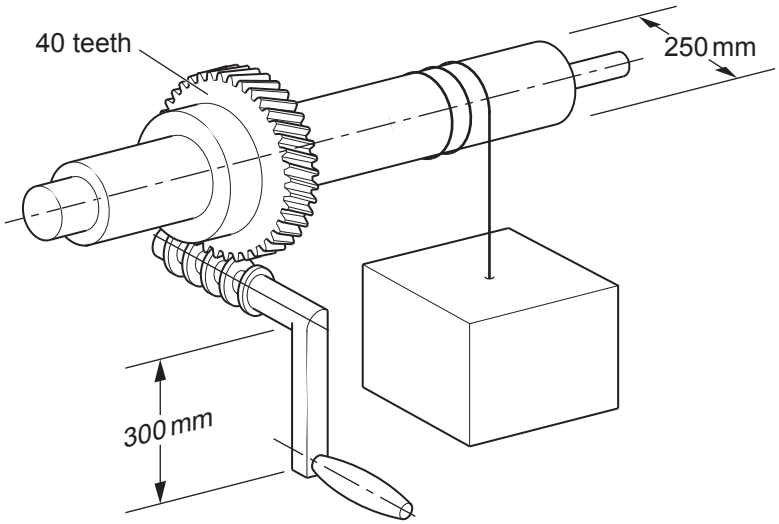


Fig. 7

(i) Name the mechanism shown.

_____ [2]

(ii) The mechanical advantage of the winch is 30.
Calculate the effort required to raise a load of 2.4 kN.

_____

_____

_____

_____

_____ [4]

(iii) If the crank handle is turned through one revolution how far will the load rise?
(Circumference of a circle $= \pi \times$ diameter)

_____

_____

_____

_____ [6]

(iv) Calculate the velocity ratio of the winch.

_____

_____

_____

_____ [4]

(v) The winch in **Fig. 7** is to be modified so that the velocity ratio is increased.
Suggest **two** ways in which this could be achieved.

1. _____

_____

2. _____

_____ [6]

(vi) What other suitable mechanism could be used in the winch in place of the mechanism shown?

_____ [2]

Examiner Only

Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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