

GENERAL CERTIFICATE OF SECONDARY EDUCATION

DESIGN AND TECHNOLOGY

1957/06

Systems and Control Technology

Paper 6 Pneumatics (Higher Tier)

Candidates answer on the Question Paper

OCR Supplied Materials:

None

Other Materials Required:

None

Wednesday 26 May 2010

Afternoon

Duration: 1 hour 15 minutes



Candidate Forename		Candidate Surname	
-----------------------	--	----------------------	--

Centre Number						Candidate Number				
---------------	--	--	--	--	--	------------------	--	--	--	--

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **50**.
- Dimensions are in millimetres unless stated otherwise.
- Marks will be awarded for the use of correct conventions.
- This document consists of **12** pages. Any blank pages are indicated.

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

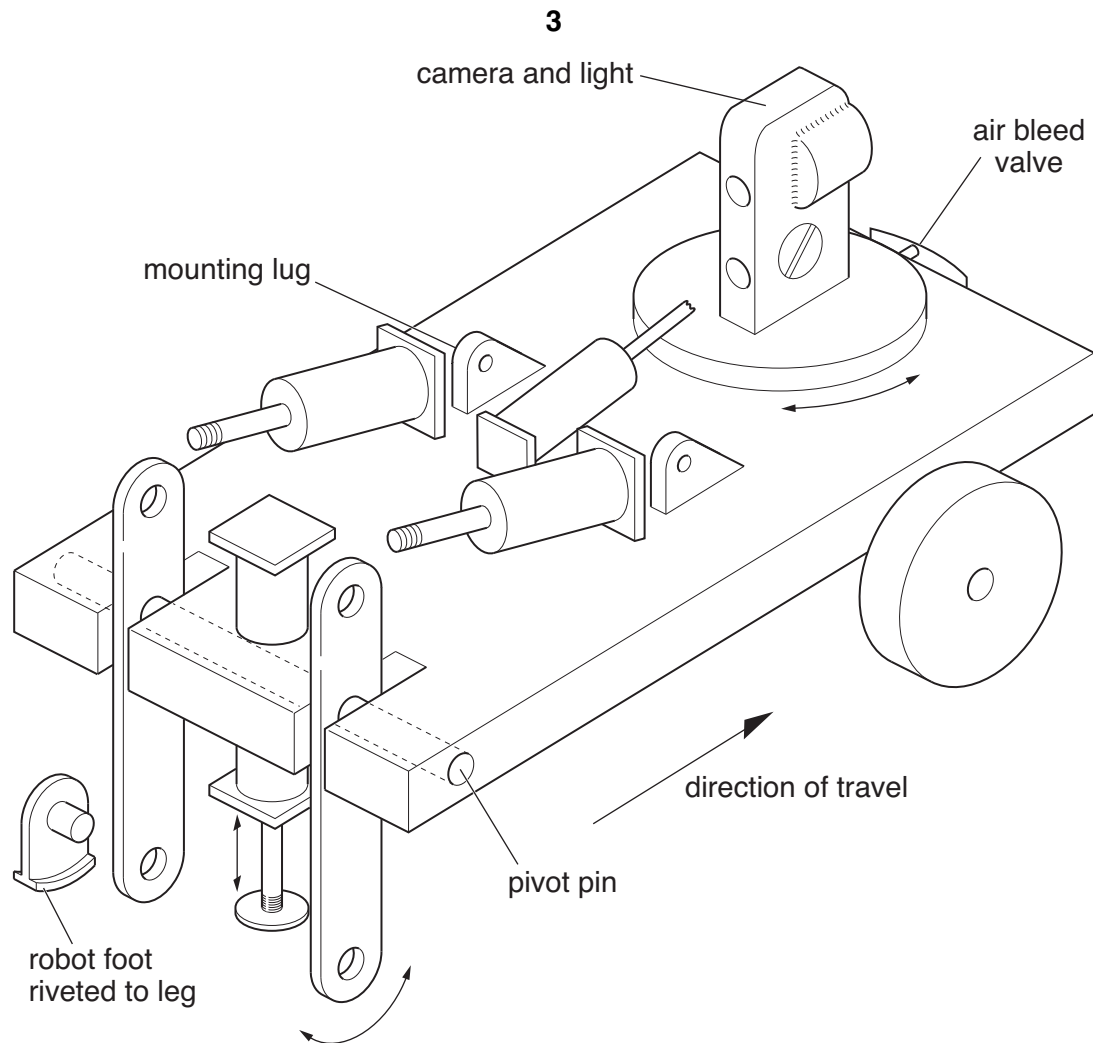


Fig. 1

Fig. 1 shows a pneumatically walking robot.

Movement in the direction of the arrow is achieved by lifting the rear of the robot. The legs are then swung underneath before the robot is lowered. Both legs move out together, propelling the robot forward on its wheels. The camera and light rotates to view inaccessible places.

1 Manufacturers of robots use computers to:

- aid the design process;
- test out circuits;
- control pneumatically operated machines during the making of the robot.

(a) State **three** advantages of using CAD to draw circuit design layouts when designing a pneumatic circuit.

1 _____ [1]

2 _____ [1]

3 _____ [1]

(b) State **two** reasons why computers are often used to simulate the operation of a pneumatic circuit.

1 _____ [1]

2 _____ [1]

(c) A manufacturing company is considering changing its manually operated machines to computer control.

State **two** possible effects on the workforce.

1 _____ [1]

2 _____ [1]

A reed switch cylinder is an important part of the interface between the pneumatic operation and the computer control in the robotic systems.

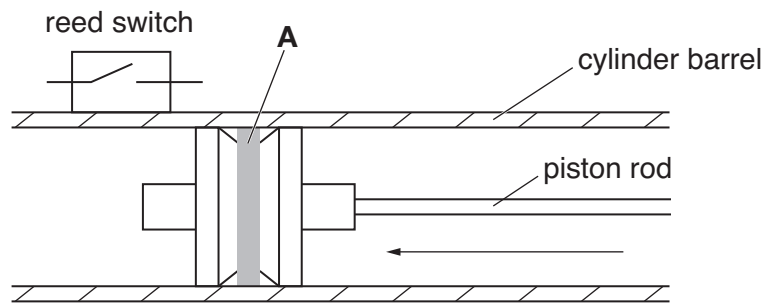


Fig. 2

Fig. 2 shows a simplified version of a reed switch cylinder.

(d) (i) Name the component **A** in Fig. 2.

_____ [1]

(ii) Describe how feedback is provided to the computer when the piston moves in the direction of the arrow shown.

 _____ [2]

[Total: 10]

- 2 Fig. 3 shows the top of one leg and the piston rod of an operating cylinder of the walking robot shown in Fig. 1.

The piston rod must be attached to the leg and allow the cylinder to fully outstroke and instroke to create a walking movement.

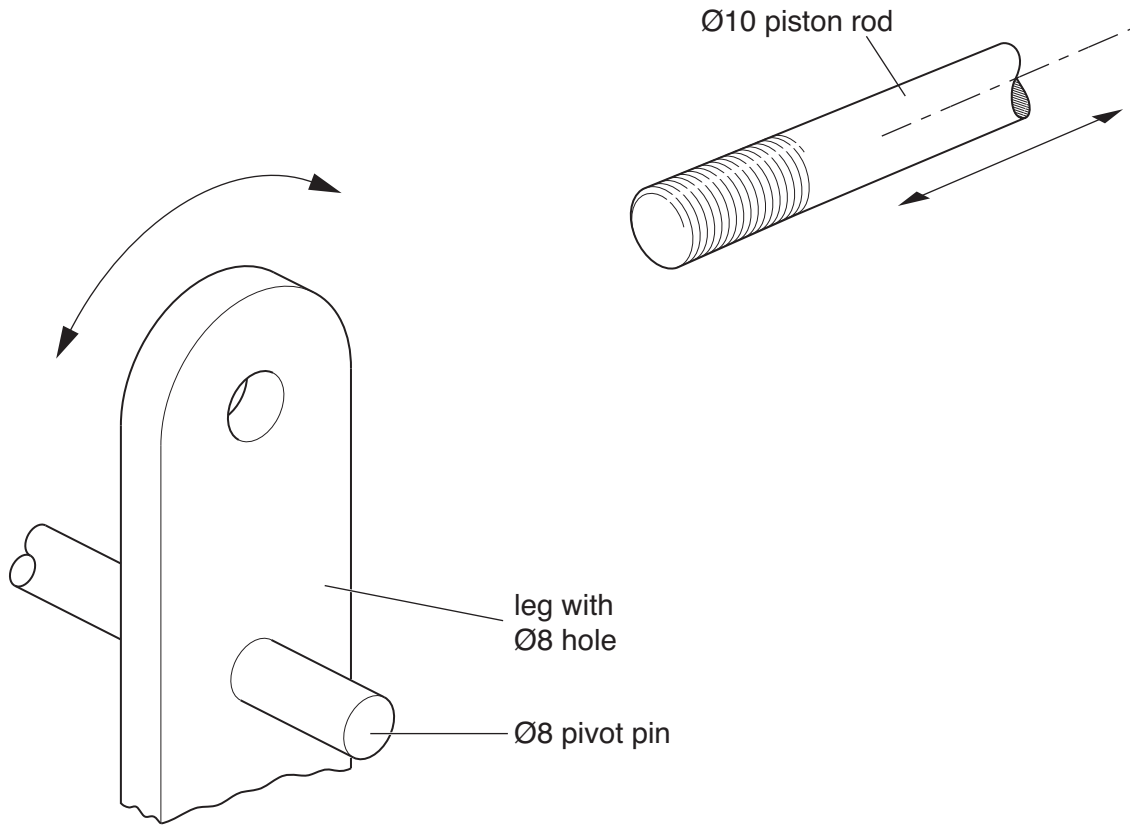


Fig. 3

- (a) Using notes and sketches, complete Fig. 3 to show a component that will fit on the threaded end of the piston rod and attach to the end of the leg allowing the two parts to move as required. [5]

Fig. 4 shows the rear of the cylinder that operates the leg. This cylinder must be attached to the mounting lug on the chassis and allowed to move as required.

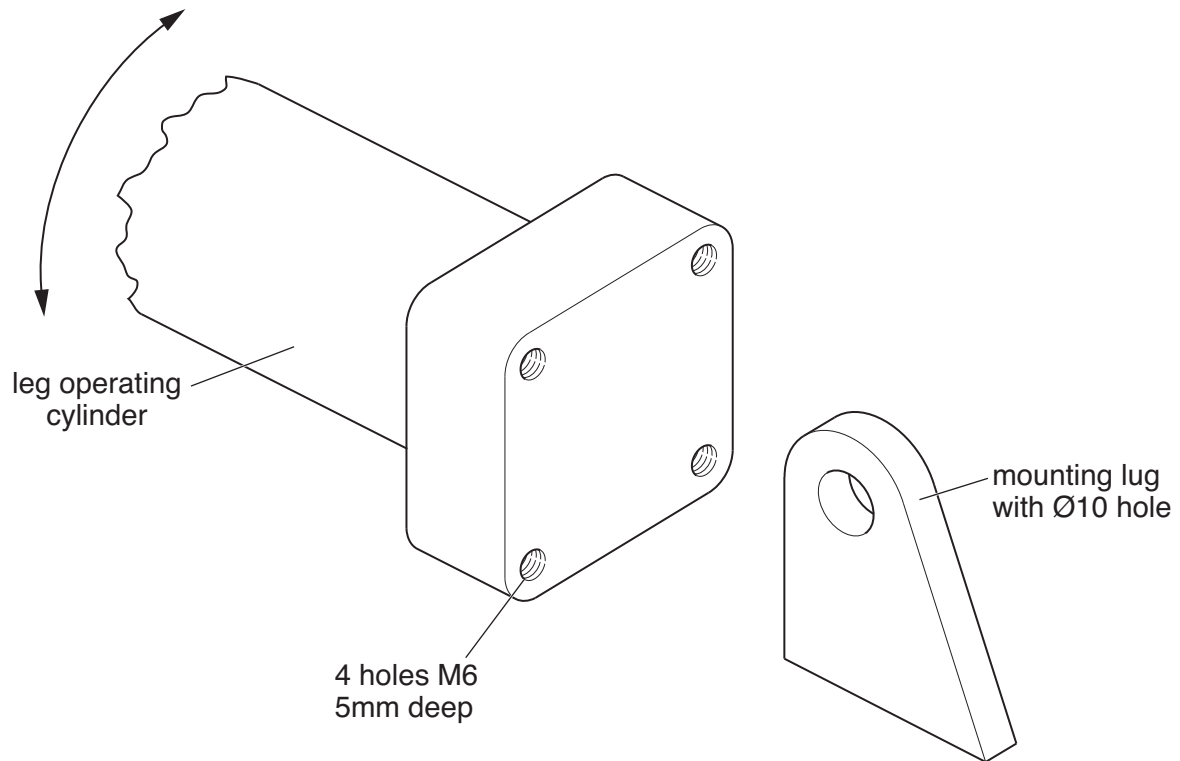


Fig. 4

- (b)** Draw on Fig. 4 a bracket that will secure the cylinder to the mounting lug of the chassis and allow the correct movement of the cylinder. **[5]**

[Total: 10]

3 It is important for the working of the robot that the two legs shown in Fig. 1 are identical.

(a) Explain why it is important that the legs are identical.

[2]

Fig. 5 shows a pneumatically controlled jig for holding the leg when it is being drilled.

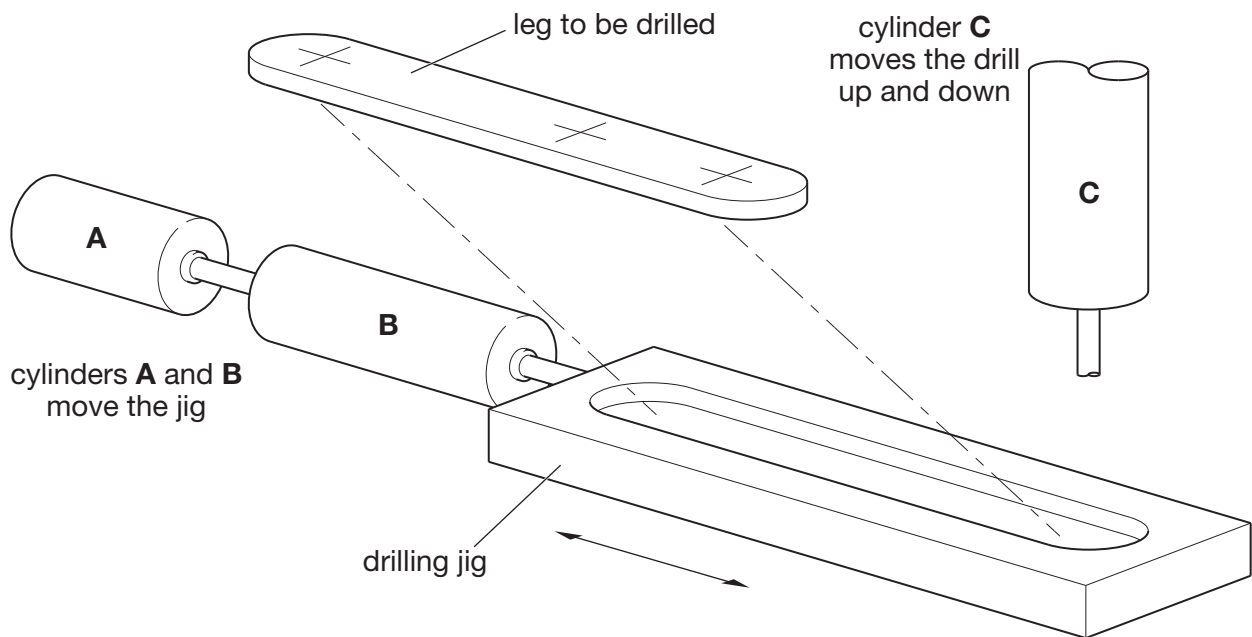


Fig. 5

Each leg is located in the drilling jig ready to be drilled automatically.

The drilling jig is attached to a pair of cylinders **A** and **B** that are connected in tandem. The jig moves allowing each of the three holes to be drilled.

Cylinder **C** has a drill attached to it. When instructed, cylinder **C** will outstroke and drill a hole and then instroke to return to its rest position.

Fig. 6 shows the relative positions of the holes to be drilled and the relative sizes of the operating cylinders.

The distance between holes **1** and **2** = the stroke of cylinder **A**

The distance between holes **2** and **3** = the stroke of cylinder **B**

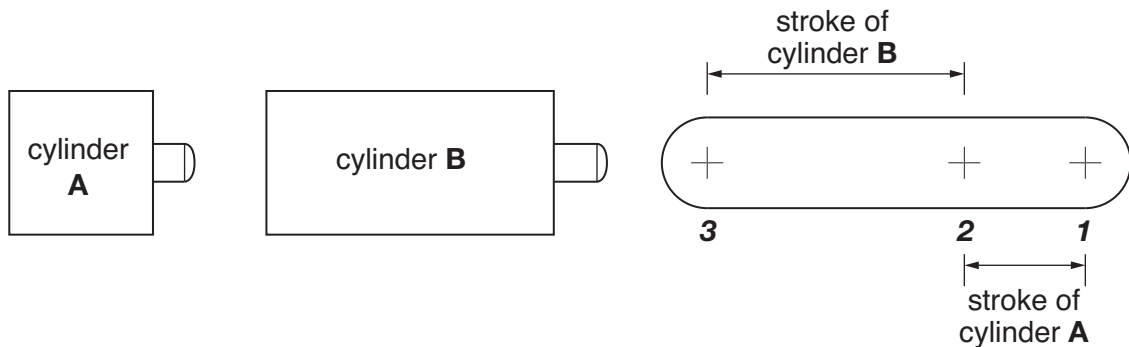


Fig. 6

At the start of the drilling operation all the cylinders are instroked.

The sequence of operation is:

hole **1** is drilled when the jig is in the start position;

the jig moves position and hole **2** is drilled;

the jig moves position and hole **3** is drilled;

the jig returns to the start position.

(b) Put the numbers of the processes into the flow diagram below in the correct sequence for one complete cycle of the operation.

The first two have been done for you.

- | | |
|----------------------|----------------------|
| 1 Outstroke B | 4 Instroke A |
| 2 Instroke B | 5 Outstroke C |
| 3 Outstroke A | 6 Instroke C |



[8]

[Total: 10]

- 4 (a) A suitable cylinder is required for the rotation of the camera and light as shown in Fig. 1.

The cylinder chosen for this operation has a bore of Ø10mm and a piston rod of Ø4mm.

Tests showed that a force of 20N was required to rotate the camera and light through 90° on the outstroke.

Calculate the **minimum** air pressure required to rotate the camera and light on the outstroke. Use the formula **$F = P \times A$** **Area of circle = πr^2**

[5]

- (b) When the system was tested, the camera and light turned, but when the 'operating valve' for the cylinder to instroke was actuated, nothing happened. The components and circuitry had been correctly connected.

Explain why the camera and light refused to rotate on the **instroke**.

[4]

- (c) Describe how the problem could be solved without changing any of the components.

[1]

[Total: 10]

- 5 If the robot hits an obstruction, an air bleed occlusion circuit reverses the direction of travel.

This circuit uses a diaphragm operated spring return valve.

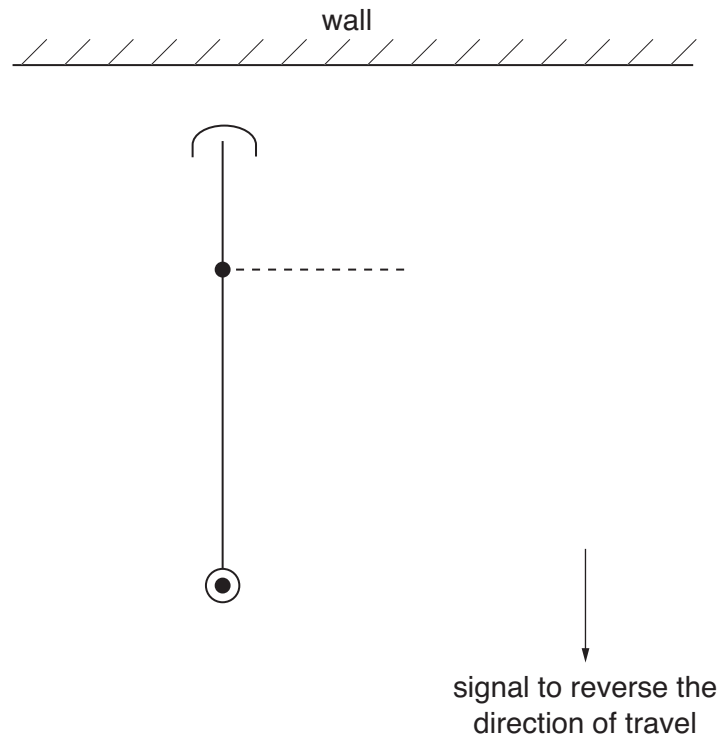


Fig. 7

- (a) Complete Fig. 7 by drawing the diaphragm valve needed to send a signal to reverse the direction of travel. Add any other component needed to operate the system safely. [5]
- (b) Explain how an air bleed occlusion circuit operates.

[5]

[Total: 10]

PLEASE DO NOT WRITE ON THIS PAGE



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations, is given to all schools that receive assessment material and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.