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GENERAL CERTIFICATE OF SECONDARY EDUCATION

DESIGN AND TECHNOLOGY

SYSTEMS AND CONTROL TECHNOLOGY

Paper 6 Pneumatics (Higher Tier)

MONDAY 2 JUNE 2008

Morning

Time: 1 hour 15 minutes

Candidates answer on the question paper

Additional materials: No additional materials are required

CUP/T44779

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or 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.

INFORMATION FOR CANDIDATES

- The number of marks for each question 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.

For Examiner's Use	
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Total	

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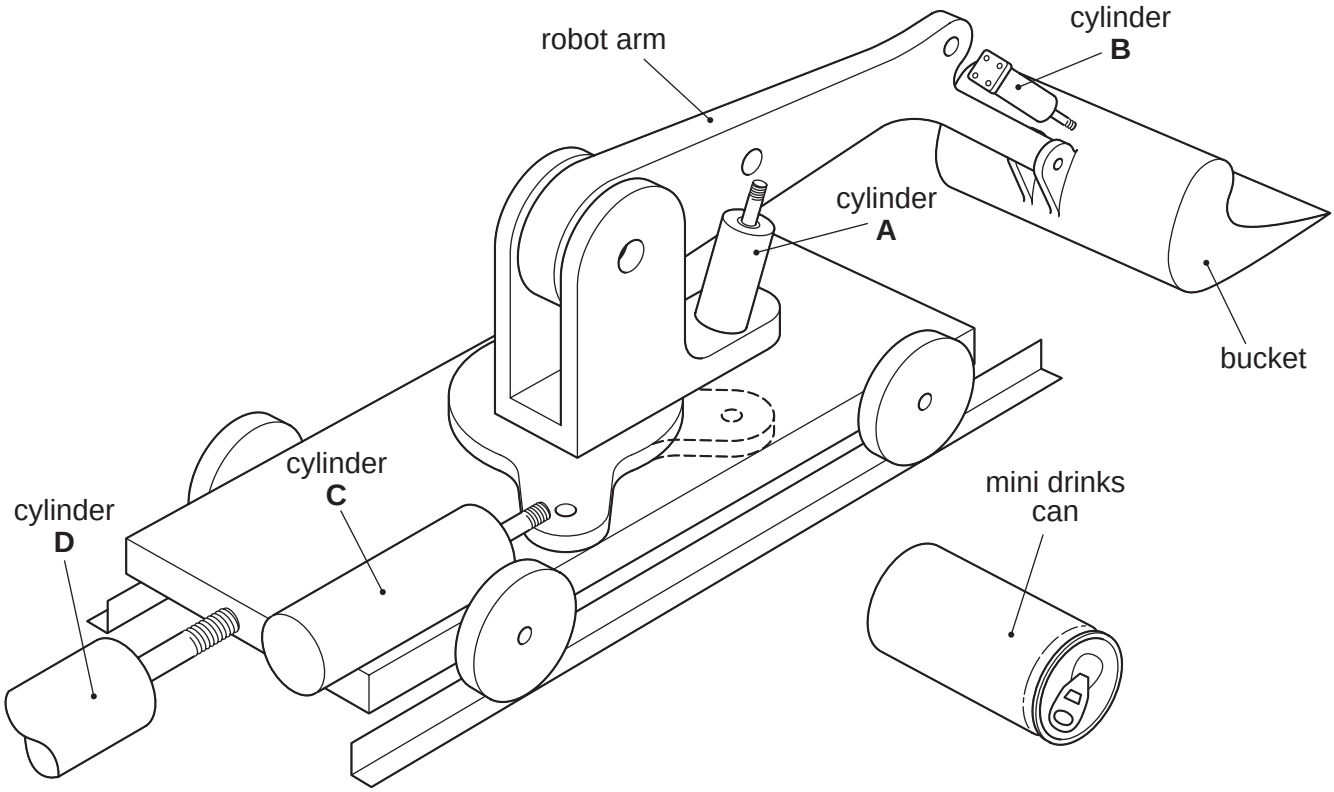

Fig. 1

Fig. 1 shows a demonstration robot. The robot is controlled by pneumatics.

The robot moves forwards and backwards on its wheels. The arm and bucket are used to pick up mini drinks cans. The robot arm can be turned through 90° to tip the mini drink can into a skip

1 Manufacturers of pneumatically controlled robots use computers when:

- designing the control system;
- testing prototype pneumatic circuits;
- controlling pneumatic systems.

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

1.....[1]

2 .....[1]

3 .....[1]

(b) State **two** benefits to the manufacturer of using computer simulation to test prototype circuits.

1 .....[1]

2 .....[1]

(c) Robots are now used extensively in the manufacturing industry.

State **two** advantages to the manufacturer of changing from manually operated machines to computer controlled robots.

1 .....[1]

2 .....[1]

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

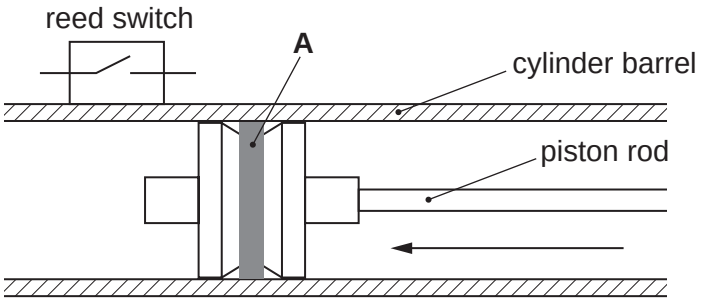

Fig. 2

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

(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.

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.....[2]

2 The robot arm is raised and lowered by cylinder **A**, as shown in Fig. 3 below.

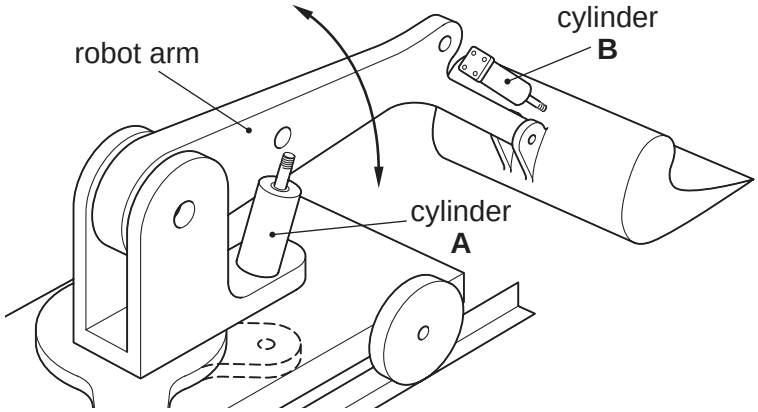


Fig. 3

Fig. 4 shows details of the threaded end of the piston rod and the Robot Arm.

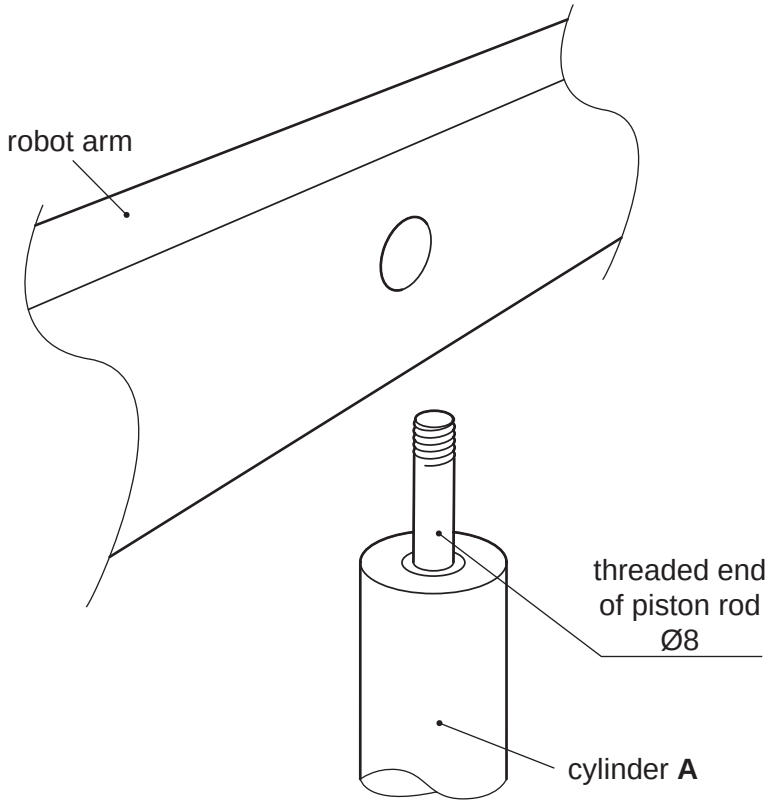


Fig. 4

(a) Using sketches and notes, complete Fig. 4 to show a component that will fit on the threaded end of the Ø8 piston rod and attach to the robot arm allowing the two parts to move as required. [5]

(b) The rear of cylinder **B** shown in Fig. 5, needs to be attached to the mounting lug on the robot arm so that the cylinder can pivot when tipping the bucket.

Draw on Fig. 5 a bracket that will locate with the Ø10 hole in the mounting lug .

Add a suitable locking device that will prevent the bracket from coming away from the mounting lug during use.

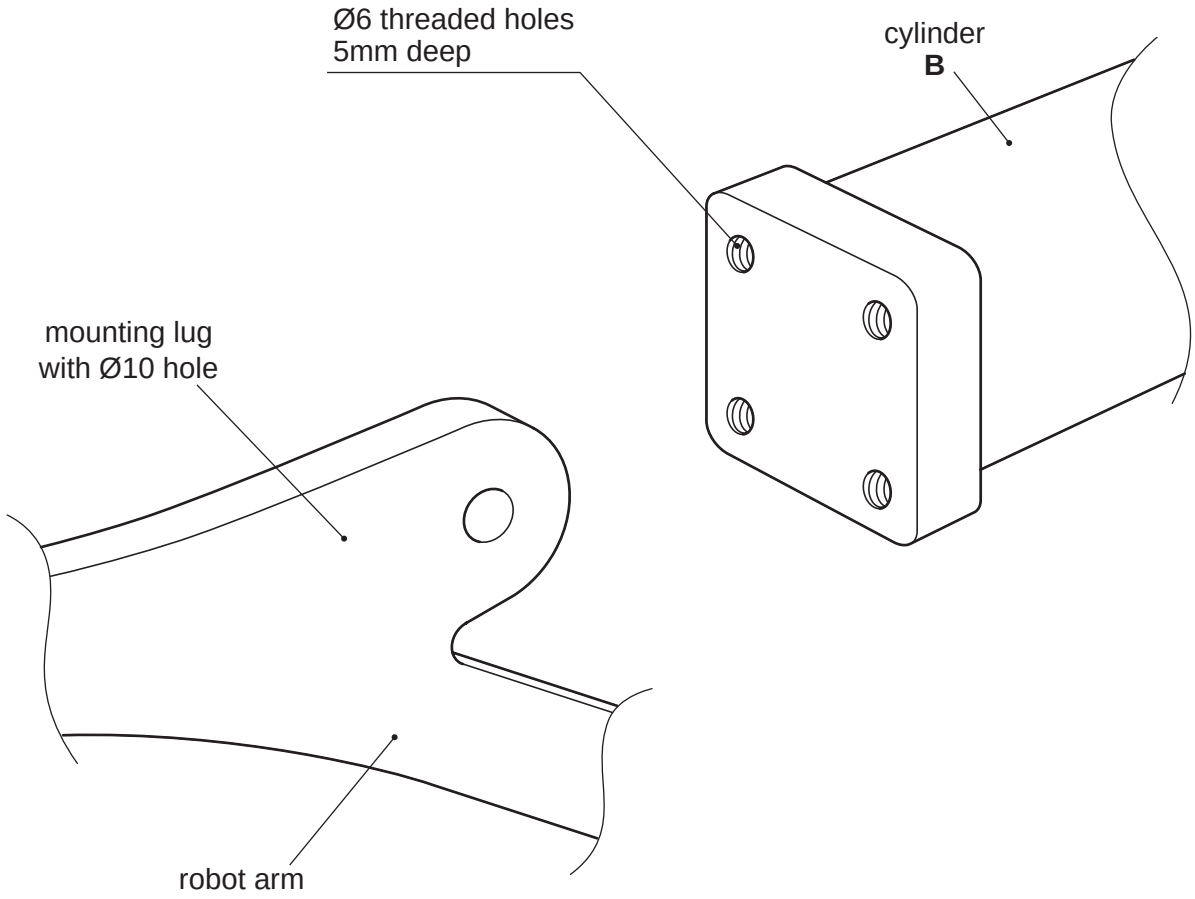


Fig. 5

[5]

3 The robot is used to load drink cans into a skip.
Fig. 6 shows the robot and a simplified plan view of the layout of the robot and the skip.

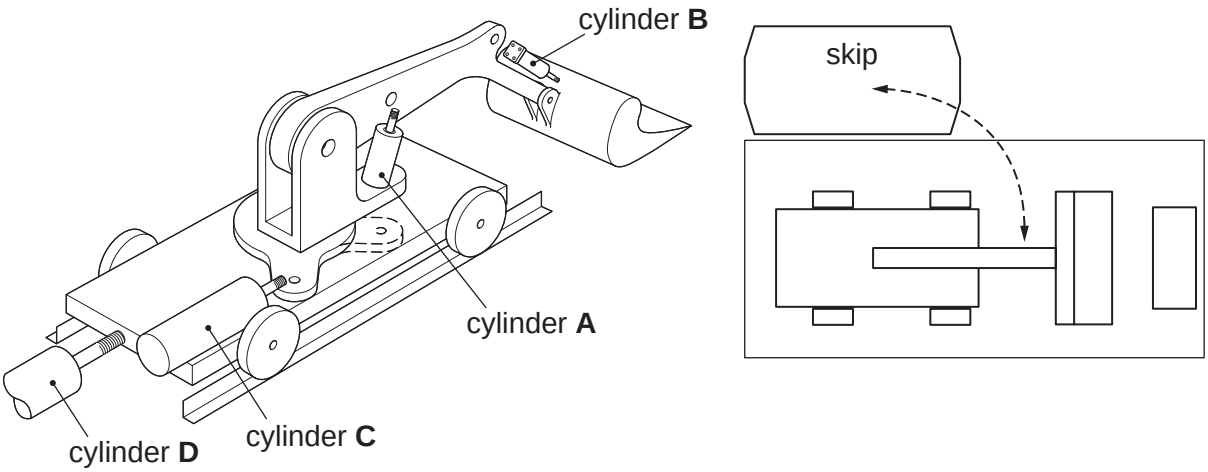


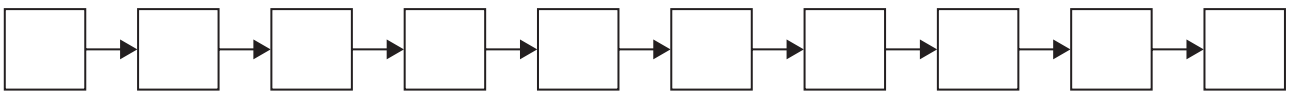
Fig. 6

At the start of the operation all the cylinders are instroked. The sequence of operation is:

the bucket is tipped downwards;
the robot moves forward to collect a can in the bucket;
the bucket is tipped back, the arm is raised and the robot moves back;
the arm is rotated through 90 degrees and the bucket tips the can into the skip;
the arm is swung back to its original position;
the bucket is tipped back and the arm is lowered.

Put the numbers of the processes into the chart in the correct sequence for one complete cycle of the operation.

1 Outstroke **B**	5 Outstroke **A**
2 Instroke **B**	6 Instroke **A**
3 Outstroke **C**	7 Outstroke **D**
4 Instroke **C**	8 Instroke **D**



[10]

4 A suitable cylinder is required for the rotation of the robot arm.

The cylinder chosen for this operation has a bore diameter of 12 mm and a piston rod diameter of 4 mm.

Tests showed that a force of 15 N was required to rotate the arm through 90° on the outstroke.

(a) Calculate the **minimum** air pressure supply to rotate the arm on the outstroke using the formula:

F = P × A **Area of circle = πr^2**

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.....[5]

(b) When the system was tested at the minimum air pressure, the robot arm turned. When the "operating valve" for the cylinder to instroke was actuated, nothing happened.
The components and circuitry had been correctly connected.

Explain why the arm refused to rotate on the **instroke**.

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.....[4]

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

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.....[1]

5 Fig. 7 shows the symbol for a special type of cylinder. This could be used to prevent the robot arm from coming to a sudden stop when cylinder **A** instrokes and outstrokes.

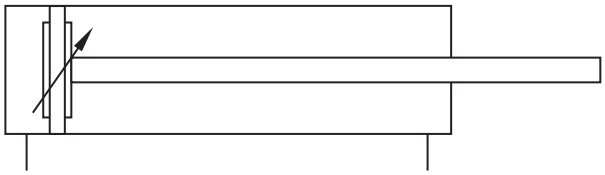

Fig. 7

(a) (i) State the name of this special type of cylinder

.....[1]

(ii) Explain how this special type of cylinder prevents a sudden stop at both ends of the stroke.

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.....[4]

(b) Compressed air powered robots need a built in safety system which will detect an obstruction. One way to detect an obstruction is to use a diaphragm valve in a pressure decay sensing circuit.

Fig. 8 shows a circuit that will return the rotating arm to its start position if an obstruction is detected.

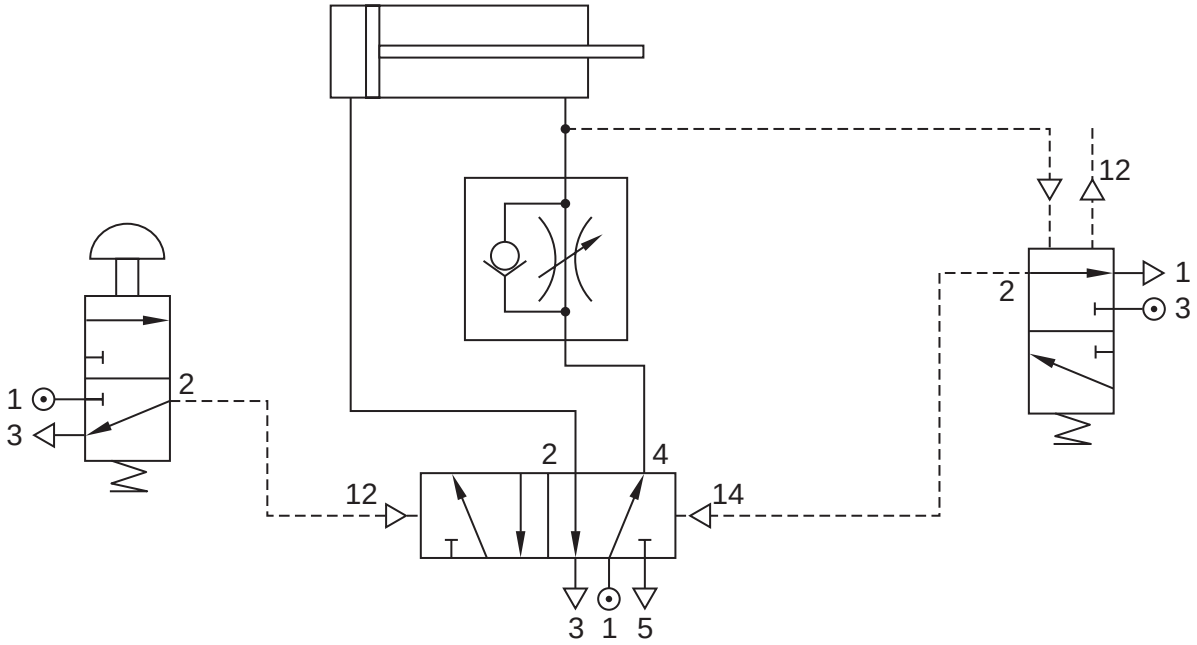

Fig. 8

Explain how this pressure decay circuit works.

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