

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Advanced Subsidiary GCE**

**D&T: SYSTEMS AND CONTROL TECHNOLOGY 2521/02**

UNIT 4 Systems and Control Technology 1

**Papers 2521/01 and 2521/02 should both be available to candidates for the full 2 hour examination session**

Tuesday **10 JANUARY 2006** Morning 48 minutes

This paper is to be taken with 2521/01 in the same examination session of 2 hours

Candidate Name	Centre Number	Candidate Number										
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**TIME** Approximately 48 minutes should be spent on this paper (Paper 2521/02)

**INSTRUCTIONS TO CANDIDATES**

- This paper is to be taken with 2521/01 in the same examination session of 2 hours.
- Write your name, Centre number and Candidate number in the boxes above.
- Answer any **two** questions in 2521/02.
- Write your answers, in blue or black ink, in the spaces on the question paper.

**INFORMATION FOR CANDIDATES**

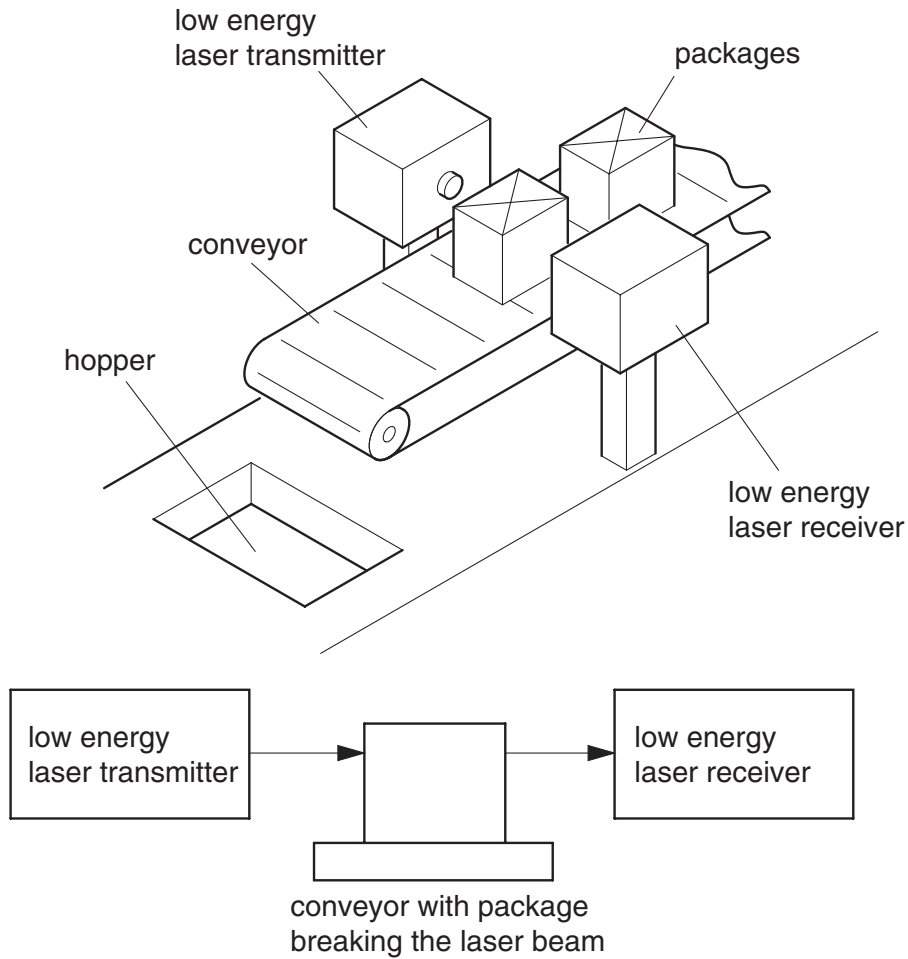
- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is 36.
- Please note that the instruction ‘discuss’ denotes that you should:
  - identify **three** relevant issues/points raised by the question;
  - explain why you consider **two** of these issues/points to be relevant;
  - use a specific example/evidence to support your answer.
- All dimensions are in millimetres.

FOR EXAMINER'S USE	
<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>4</b>	
<b>5</b>	
<b>6</b>	
<b>TOTAL</b>	

**This question paper consists of 20 printed pages and an insert.**

Answer any **two** questions.

- 1 Fig. 1 shows part of a low energy laser system designed to count packages on a conveyor belt.



**Fig. 1**

- (a) (i) Give **one** advantage of using a low energy laser system to count packages.

.....[1]

- (ii) Give **two** other methods of electronically counting the packages as they pass.

Method 1 .....

.....[1]

Method 2.....

.....[1]

(b) Fig.2 shows the system used in the package counter.

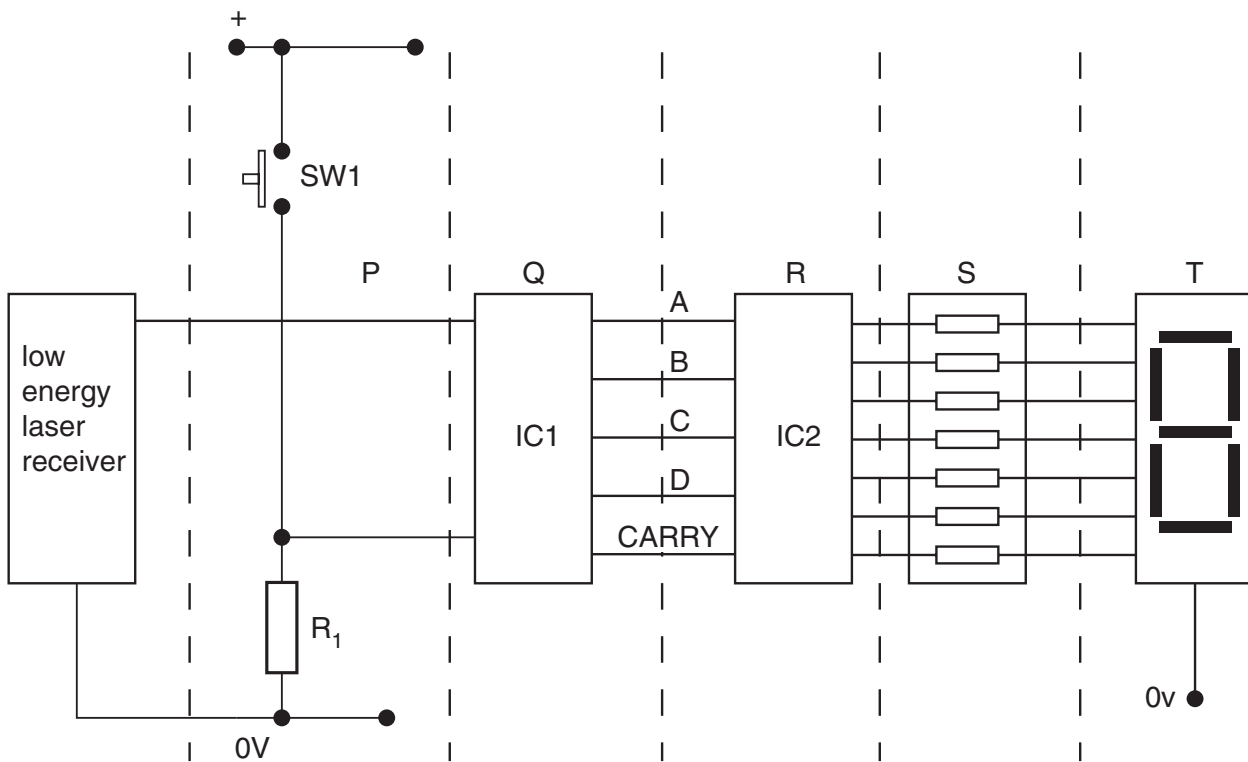


Fig. 2

(i) Name the following parts of the circuit shown in Fig. 2.

Part P

.....[1]

Part Q

.....[1]

Part R

.....[1]

Part S

.....[1]

Part T

.....[1]



2 Fig. 3 shows a system diagram for a set of disco lights.

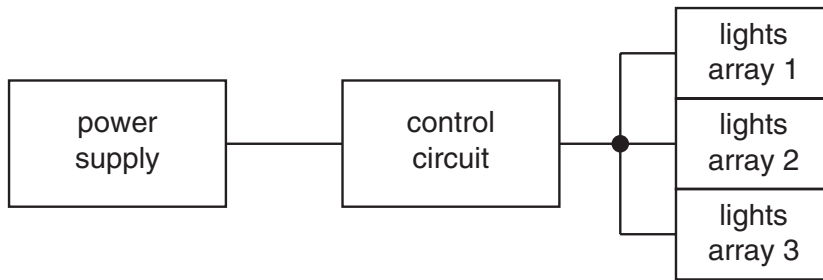


Fig. 3

The designer tests the system and decides to use high intensity LEDs instead of filament bulbs.

(a) (i) Give **two** reasons why this choice was made.

Reason 1. ....[1]

Reason 2 .....[1]

(ii) Fig. 4 shows part of a development circuit. The designer has to calculate the value of the resistors needed to ensure the disco light arrays work reliably. The LED has a forward current of 25 mA and a forward voltage of 2 volts.

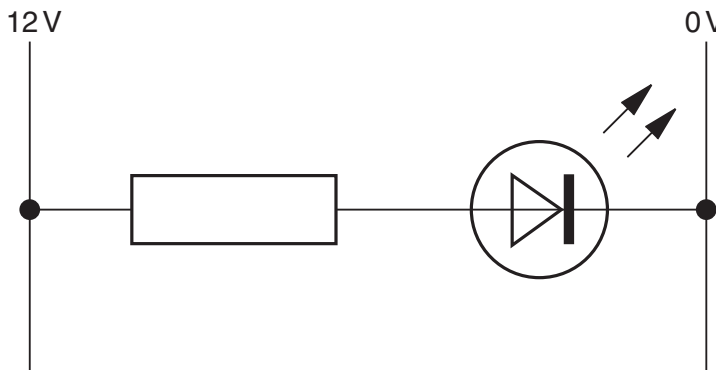


Fig. 4

Calculate the value of the resistor needed for the LED.

.....  
.....  
.....[2]

The system is clocked by a square wave generator of variable frequency.

- (iii) Draw a circuit that will provide a suitable square wave.

[3]

- (iv) The designer decides to use a 4-bit binary counter with outputs connected to the logic system that controls the LED arrays.  
Fig. 5 shows the block diagram.

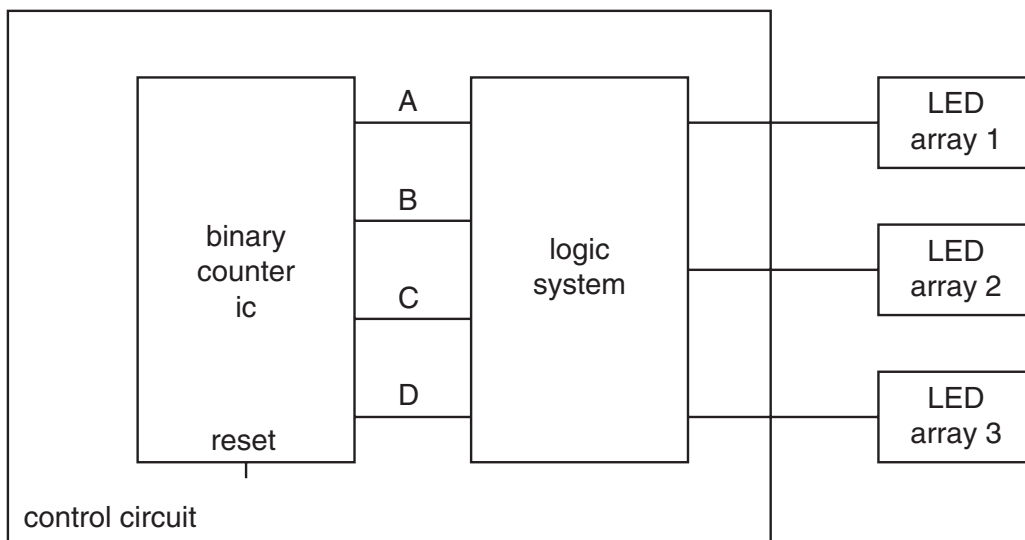


Fig. 5

Fig. 6 shows the inputs to the logic system.

	LOGIC INPUT	LOGIC INPUT	LOGIC INPUT	LOGIC INPUT
PULSE	D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1

**Fig. 6**

Show, with the aid of a diagram, how you would reset the binary counter on the third pulse.

[2]

(b) The designer finds that the current drawn by the LED array is greater than a logic gate can carry. The choice of interface between the logic output and the LED array is either a MOSFET or a relay system.

(i) Explain why the MOSFET would be preferred to a relay in this application.

.....  
 .....  
 ..... [2]

(ii) State **one** disadvantage of using a relay in this application.

.....  
 ..... [1]





3 Fig. 7 shows an electric mixer used in domestic kitchens.



Fig. 7

(a) (i) Give two reasons why food mixers have a range of mixing speeds.

.....[1]

.....[1]

(ii) State two ways of achieving a range of mixing speeds.

.....[1]

.....[1]

(b) Fig. 8 shows a prototype drive system.



Fig. 8

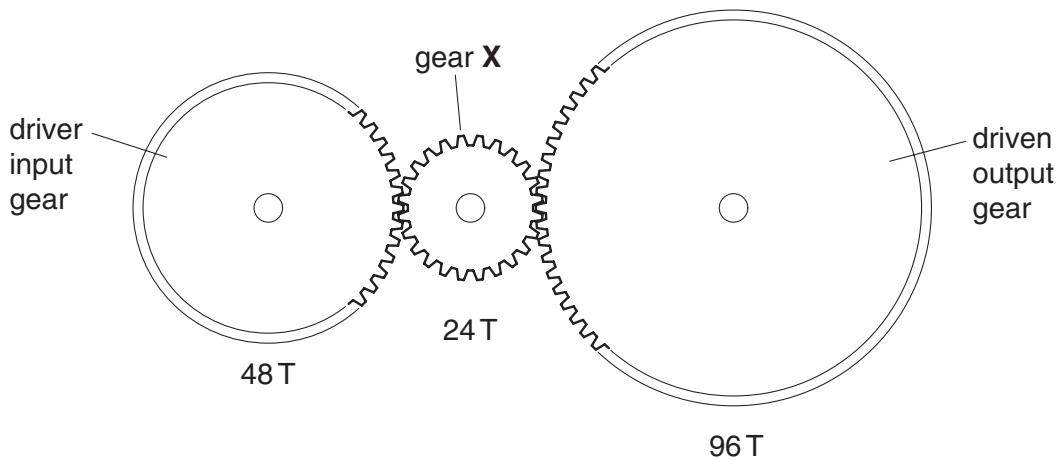
(i) Name the mechanism shown in Fig. 8.

.....  
.....[1]

(ii) Give one benefit of using this type of mechanism.

.....  
.....[1]

(c) Fig. 9 shows part of the speed reduction system used in the prototype mixer.



**Fig. 9**

(i) Name gear X.

.....[1]

(ii) Calculate the speed of the driven gear if the driver gear rotates at 2400 rpm.

.....  
 .....  
 .....[2]

(d) The motor shaft is supported in ball bearings. Draw and label a complete ball race bearing.

[3]



4 Fig. 10 shows a hand held cordless electric drill/screwdriver.

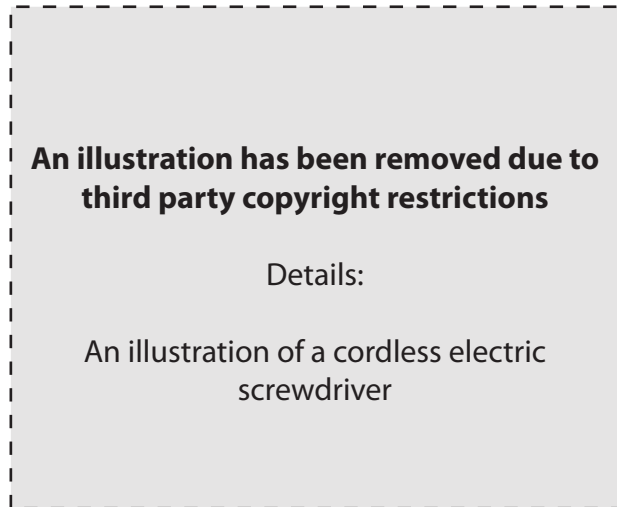


Fig. 10

(a) (i) Give two advantages of an electric screwdriver over a manual screwdriver.

Advantage 1.....[1]

Advantage 2.....[1]

(ii) The torque rating of an electric drill/screwdriver is one of its main specification points.

Give the meaning of torque.

.....

[1]

Fig. 11 shows the screwdriver bit for a No 2 screw.

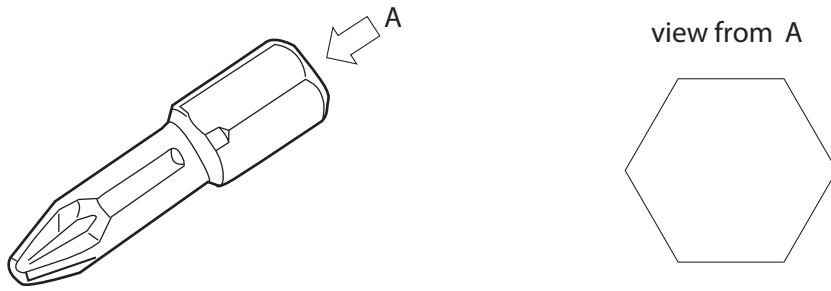


Fig. 11

- (iii) The manufacturer has designed the bit for a specific screw size.  
Give two reasons why this is the case.

Reason 1 .....[1]

Reason 2 .....[1]

- (iv) Explain why the screwdriver bit is shaped as view from A in Fig. 11.

.....

.....

.....

.....[3]

- (b) The gearbox casing of the electric drill/screwdriver is made from mild steel.

- (i) Give two reasons why mild steel is suitable for the gearbox casing.

Reason 1 .....[1]

Reason 2 .....[1]

- (ii) The gear shaft bearings are made from phosphor bronze.  
Give two reasons why phosphor bronze is suitable for the gear shaft bearings.

Reason 1 .....[1]

Reason 2 .....[1]



- 5 Fig. 12 shows a drilling machine that has a pneumatically positioned drilling table. The drilling table can be positioned so that 4 x 6 mm holes can be drilled in a workpiece.

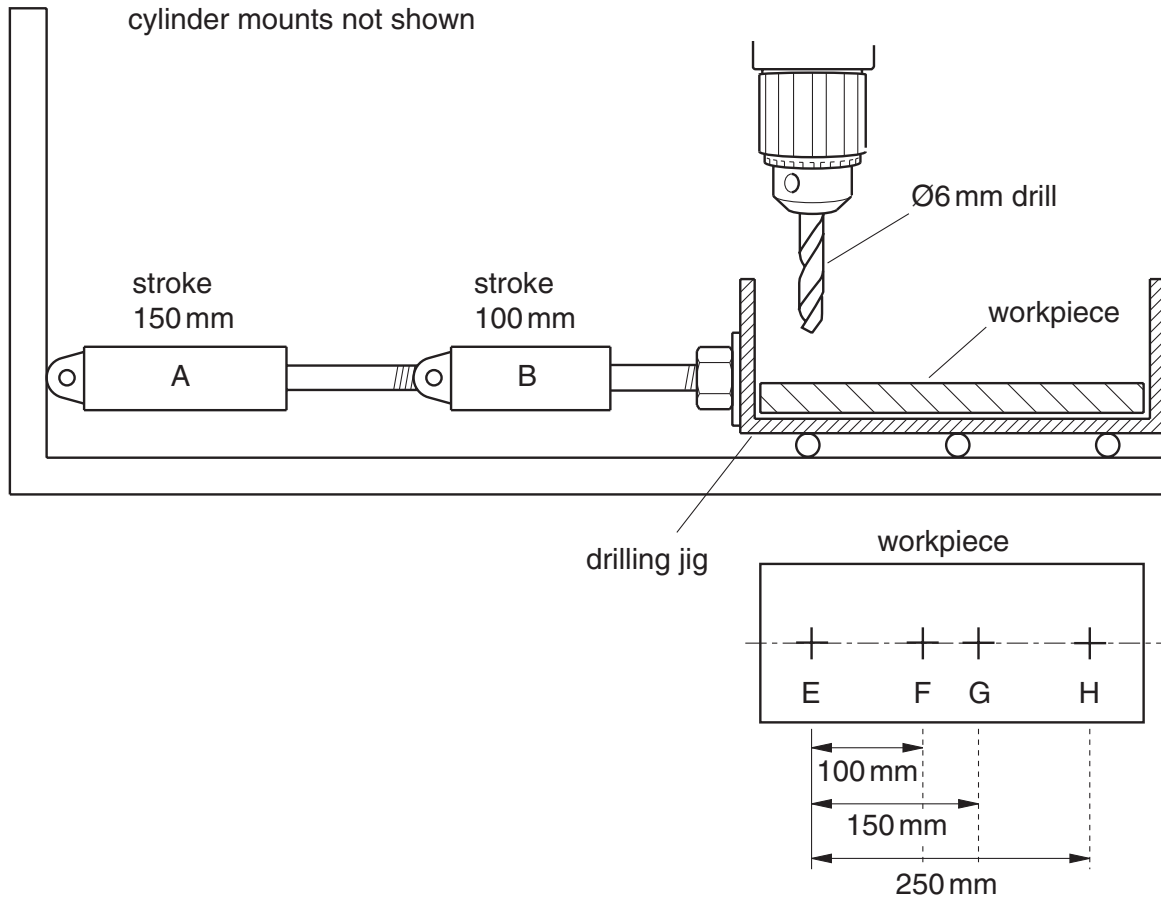


Fig. 12

The two cylinders are coupled together and pneumatically operated to move the table to the hole positions shown.

- (a) Complete the table below to show the state of each cylinder (instroked or outstroked) to achieve the four hole locations required.

HOLE	CYLINDER A	CYLINDER B
E	OUTSTROKED	OUTSTROKED
F		
G		
H		

[6]





6 Fig. 13 shows the circuit for a pneumatic clamping machine that is used to hold two pieces of material together.

(a) (i) State which valve is operated in order to close the clamp.

.....[1]

(ii) State the method used to operate valves **A** and **B**.

.....[1]

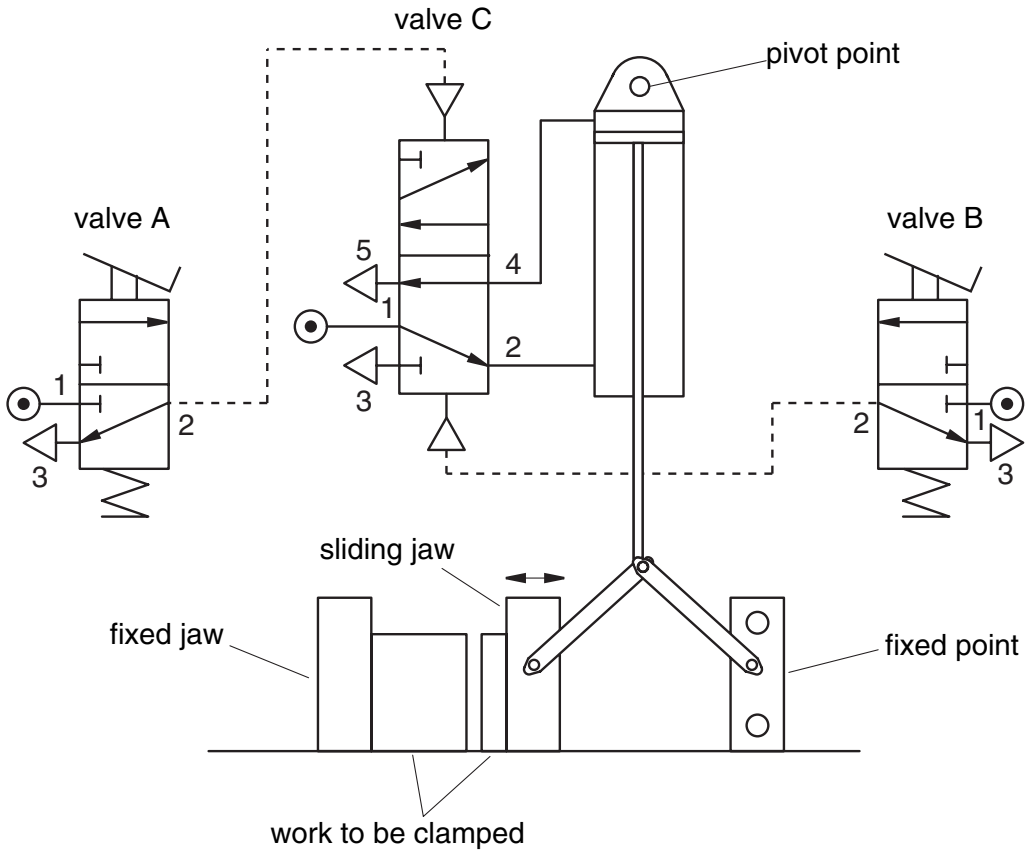


Fig. 13

(b) (i) Explain why it is important for the cylinder to be pivoted.

..... P  
 ..... Q  
 ..... S  
 .....[3]

- (ii) If a single acting cylinder was used in place of the double acting cylinder state which two components could be removed and still allow the clamp to operate.

Component 1 .....[1]

Component 2 .....[1]

- (iii) Give **one** disadvantage of using a single acting cylinder for this application.

.....  
.....[1]

- (c) Add to Fig. 14 a uni-directional restrictor that will cause the clamp to close slowly and open quickly.

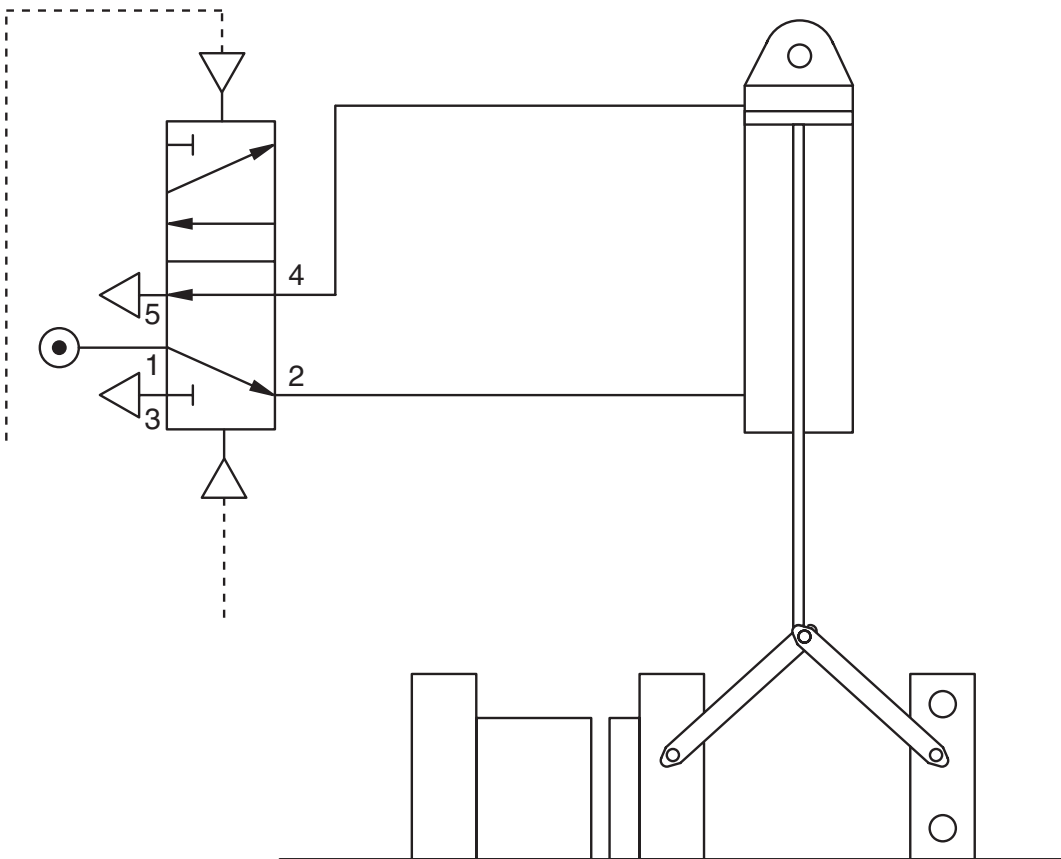


Fig. 14

[4]

