OCR
Oxford Cambridge and RSA

Friday 25 May 2018 – Afternoon

GCSE DESIGN AND TECHNOLOGY: ELECTRONICS AND CONTROL SYSTEMS

A515/02 Sustainability and technical aspects of designing and making – Pneumatics

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- A calculator may be used for this paper.
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 30 minutes

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Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions in Section A **and** Section B.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- 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).
- Do **not** write in the barcodes.
- Show all working out for calculations.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- The total number of marks for this paper is **80**.
- Your quality of written communication is assessed in questions marked with an asterisk (*).
- Dimensions are in millimetres unless stated otherwise.
- This document consists of **16** pages. Any blank pages are indicated.

A calculator may be used for this paper

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SECTION A

Answer **all** the questions.

You are advised to spend 40 minutes on this section.

On questions 1-5 circle your answer.

1 The 6R reduce describes:

(a) Making more products

(b) Making larger products

(c) Not using unnecessary materials or parts

(d) Buying a product that you never use **[1]**

2 Waste energy from a house can contribute to:

(a) Global cooling

(b) Reducing energy bills for home owners

(c) Global warming

(d) Reducing the demand on power stations **[1]**

3 A product with a small eco-footprint is defined as:

(a) Something that has a large environmental impact

(b) Something that has very little environmental impact

(c) Something that is heavy to transport

(d) Something lightweight and easy to move around **[1]**

4 A hybrid car uses:

(a) Wind energy

(b) Solar power

(c) Fossil fuels only

(d) A combination of fossil fuels and electricity **[1]**

5 Carbon offsetting means:

(a) Moving waste to another country

(b) Maximising profits from fossil fuel

(c) Using carbon credits to compensate for emissions

(d) Calculating how much natural gas is used **[1]**

6 Name the source of geothermal power.

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

7 State **one** non-sustainable method of product disposal.

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

8 Name the category of recycling where glass jars are cleaned and reused for the storage of components.

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

9 State the term used to describe products that fail after a set period of time.

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

10 State the term that describes how products are comfortable and easy to use.

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

Decide whether the statements below are **true** or **false.**

Tick [✓] the box to show your answer.	**True**	**False**	
11 Photochromic inks change colour with varying temperatures.	☐	☐	**[1]**
12 Lead paint is suitable for all electronic products.	☐	☐	**[1]**
13 A biodegradable material will rot naturally.	☐	☐	**[1]**
14 Deforestation can harm the environment.	☐	☐	**[1]**
15 Ethical companies provide poor working conditions.	☐	☐	**[1]**

16 Fig. 1 shows a camera with its protective case, which is suitable for adventure sports.

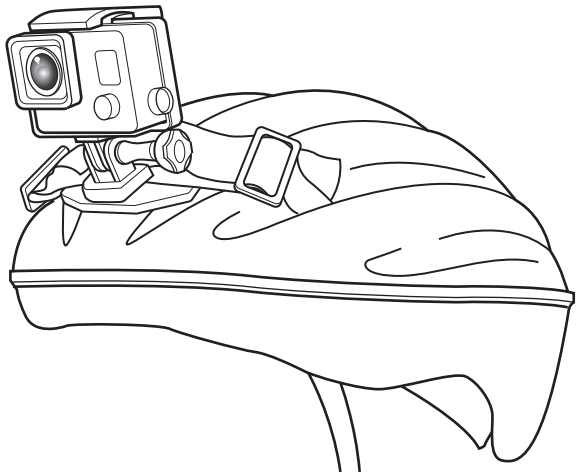

Fig. 1

(a) Give **three** design requirements for the camera casing shown in Fig. 1.

1.....

2.....

3.....

[3]

(b) The camera is powered by a rechargeable internal battery.

Give **two** environmental benefits of using rechargeable batteries to power portable products.

1.....

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2.....

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[2]

(c) Fig. 2 shows a range of fittings available for the camera shown in Fig. 1.

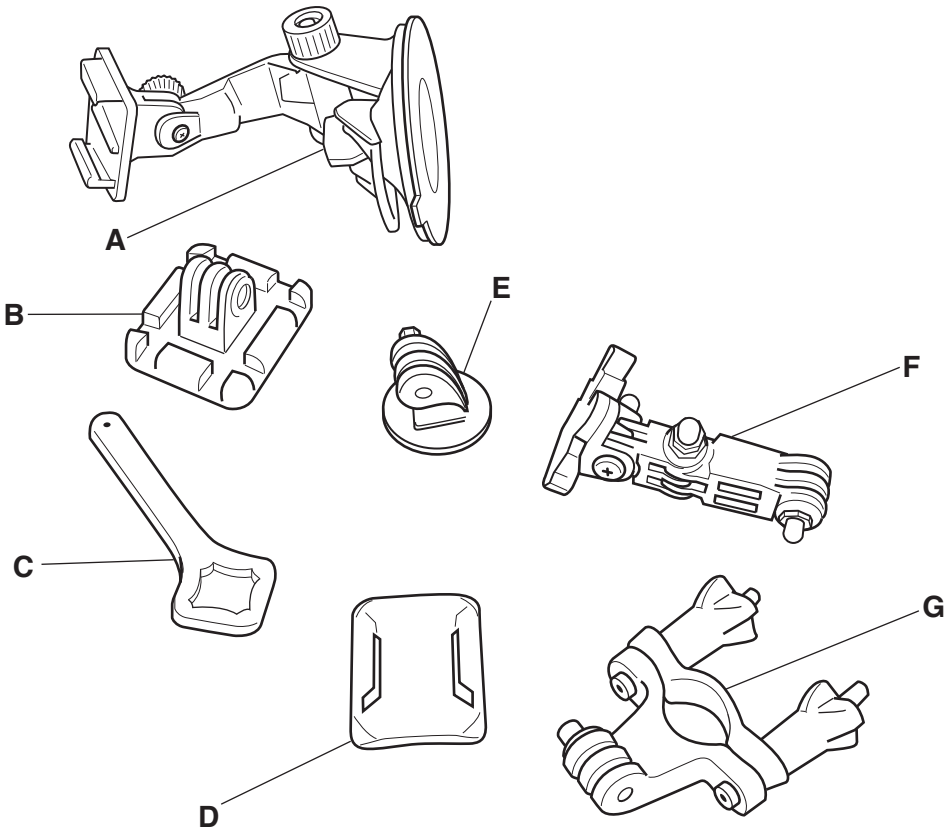

Fig. 2

Write the correct letter, **A B C D E F G**, to show which fitting would be the most suitable for mounting the camera shown in Fig. 1 in each situation given in the table below.

One has been completed for you.

Letter	Situation
E	Glued permanently to a flat surface
	On a flat piece of wood using elastic bands
	Internally on a car windscreen
	On a long round pole for use at arm's length
	On a flat surface but adjustable for different angles

[4]

(d) The cameras are expensive to buy.

State **one** way of safely retaining the camera if the fitting fails during use.

.....

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

(e) A manufacturer wishes to make a hard-shell carrying case for the camera and fittings.

Use sketches and notes to design a hard-shell carrying case for a camera and fittings.

Your design must:

- include all materials used
- show all design features.

[4]

(f)* Explain how designers of electrical products can reduce the development time of a product. Use specific examples of modern computer controlled technology in your answer.

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..... **[6]**

SECTION B

Answer **all** the questions.

You are advised to spend 50 minutes on this section.

17 Fig. 3 shows a design for a pneumatic riveting machine that will rivet together two pieces of steel strip. Cylinder **A** clamps the work in position and cylinder **B** closes the rivet.
The machine will complete one riveting operation each time the start control is operated.

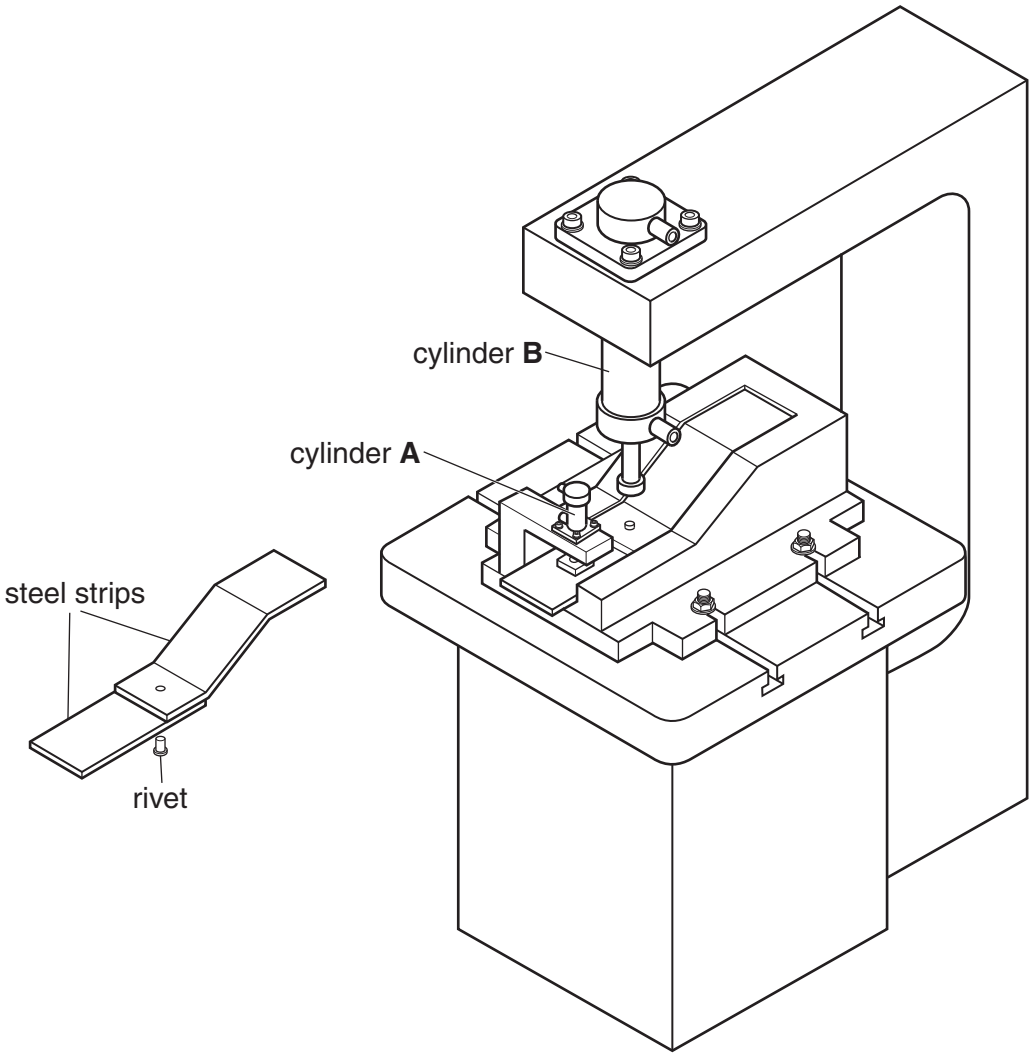


Fig. 3

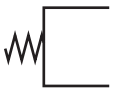
(a) (i) State the correct name for the movement produced by a pneumatic cylinder.

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

(ii) Each riveting operation will require both cylinders to outstroke and instroke.
State the sequence that will be needed, starting with **A+**.

A+ ..... **[1]**

(b) The table below shows some of the items that could be used in the pneumatic circuit. Complete the table by drawing the missing symbol and adding the missing names.

Name	Symbol
A pressure source	
B	
C	

[1]

[1]

[2]

(c) Fig. 4 shows one possible pneumatic circuit that would be suitable for riveting.

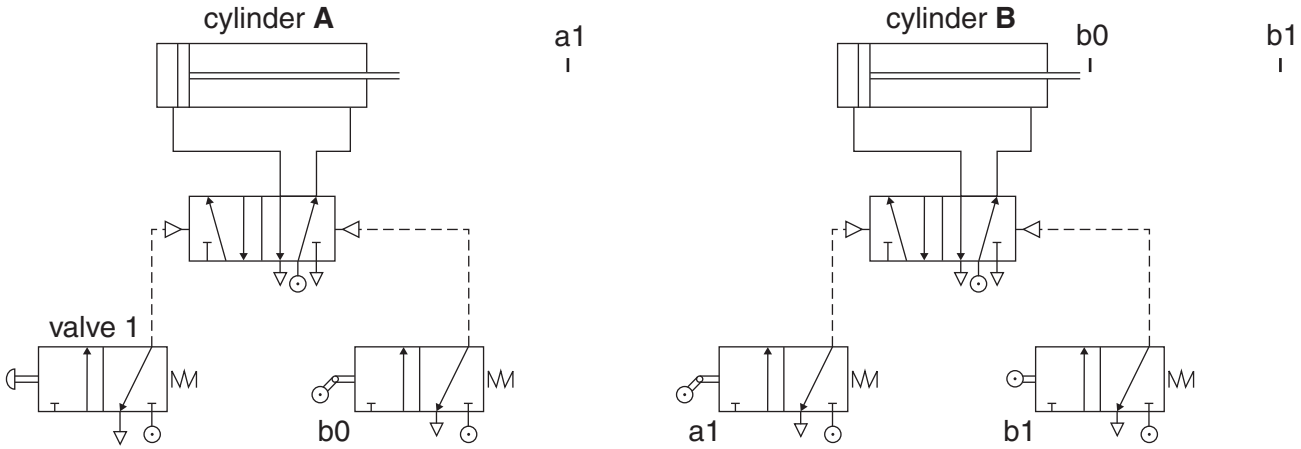


Fig. 4

(i) The statements in boxes 1 to 6 describe how the circuit works.

1 signal from a1 causes cylinder **B** to outstroke	**2** cylinder **A** instrokes	**3** cylinder **B** instrokes and activates valve b0
4 cylinder **A** outstrokes and operates valve a1	**5** valve 1 is operated to start the sequence	**6** valve b1 is operated by outstroked cylinder **B**

In the boxes below place the number from the statements in the correct order for the circuit to operate. The first one has been completed for you.

[4]

(ii) Another method of controlling the circuit would be to use microswitches and solenoid valves.
Give **two** benefits of using this method.

1 .....

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2 .....

.....

[2]

(iii) Complete the circuit in Fig. 5 to show how the speed of the piston in cylinder **B** can be controlled by restricting the exhaust air on both instroke and outstroke.

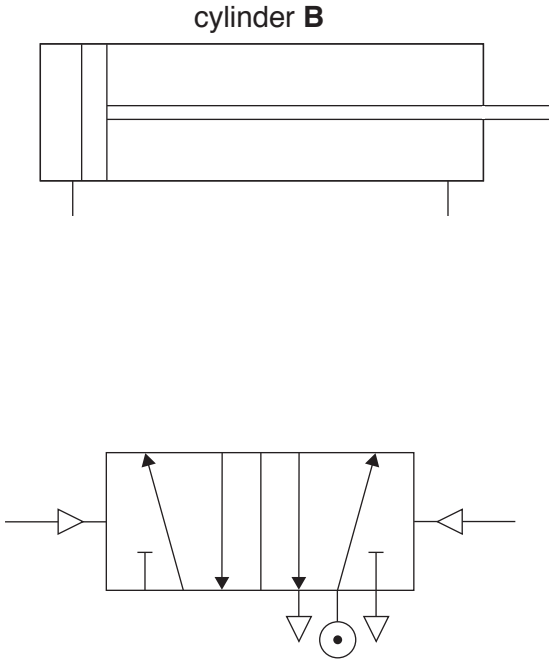

Fig. 5

[3]

18 **(a)** A method of starting the riveting sequence is needed to ensure that the hands of the operator are in a safe position.

(i) Name the logic function that should be applied to ensure that the operator is safe when the circuits operates.

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

(ii) Describe how the logic function named in **(i)** can be used to ensure safety.

.....

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

(iii) Draw on Fig. 6 to indicate a suitable position for the start control components.

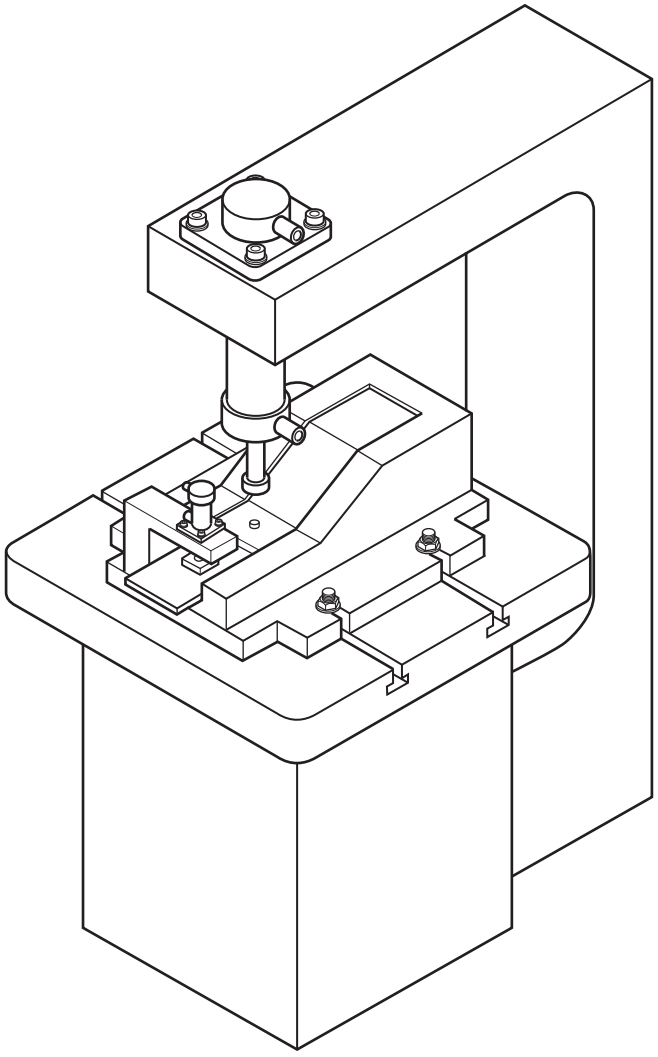

Fig. 6 **[2]**

(b) A counter is needed to show how many riveting operations have been completed. Fig. 7 shows two methods of sensing when cylinder **B** is fully outstroked.

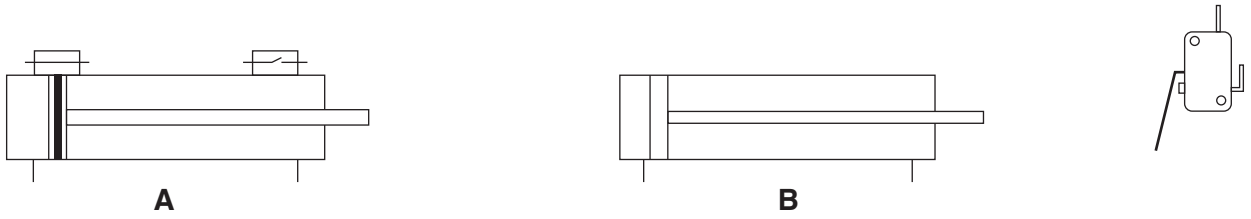

Fig. 7

(i) Explain why the reed switch cylinder may be a better choice than an electrical limit switch for the sensing device.

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..... **[3]**

(ii) Fig. 8 shows the components chosen for the counter.

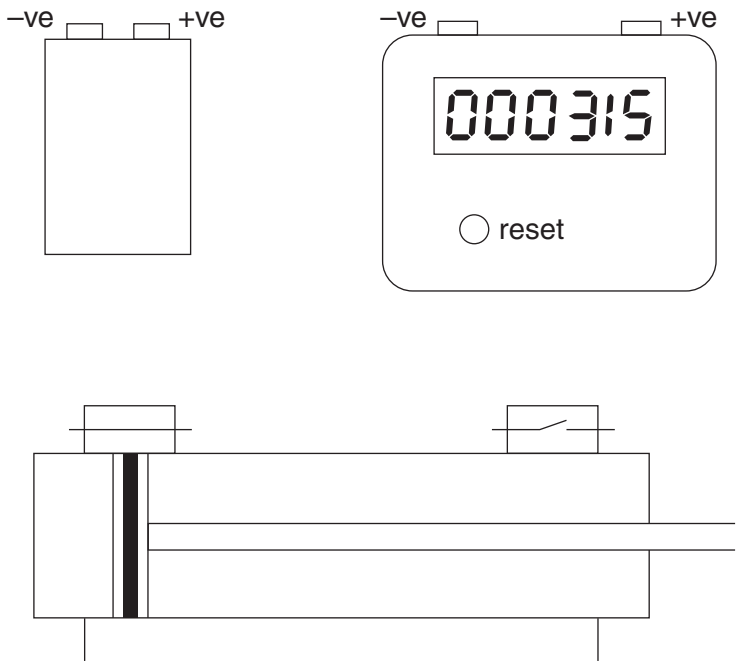

Fig. 8

Add connections that will send a signal to the counter each time cylinder **B** fully outstrokes. **[3]**

(c) Fig. 9 shows the clamping device that uses cylinder **A** to hold parts in position ready for riveting. It is found to get in the way when placing the parts on the machine, slowing down the operation.

Draw an improved design for the clamp that will allow easy access while placing the parts.

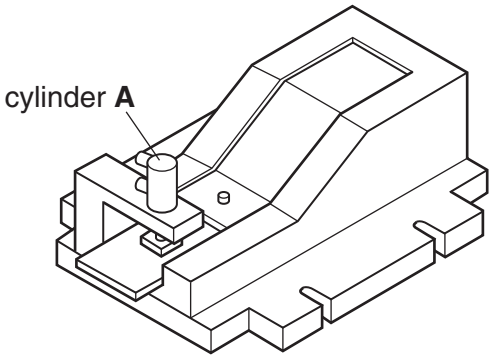

Fig. 9

[4]

19 **(a)** Fig. 10 shows the circuit for the riveting machine constructed using a prototype system.

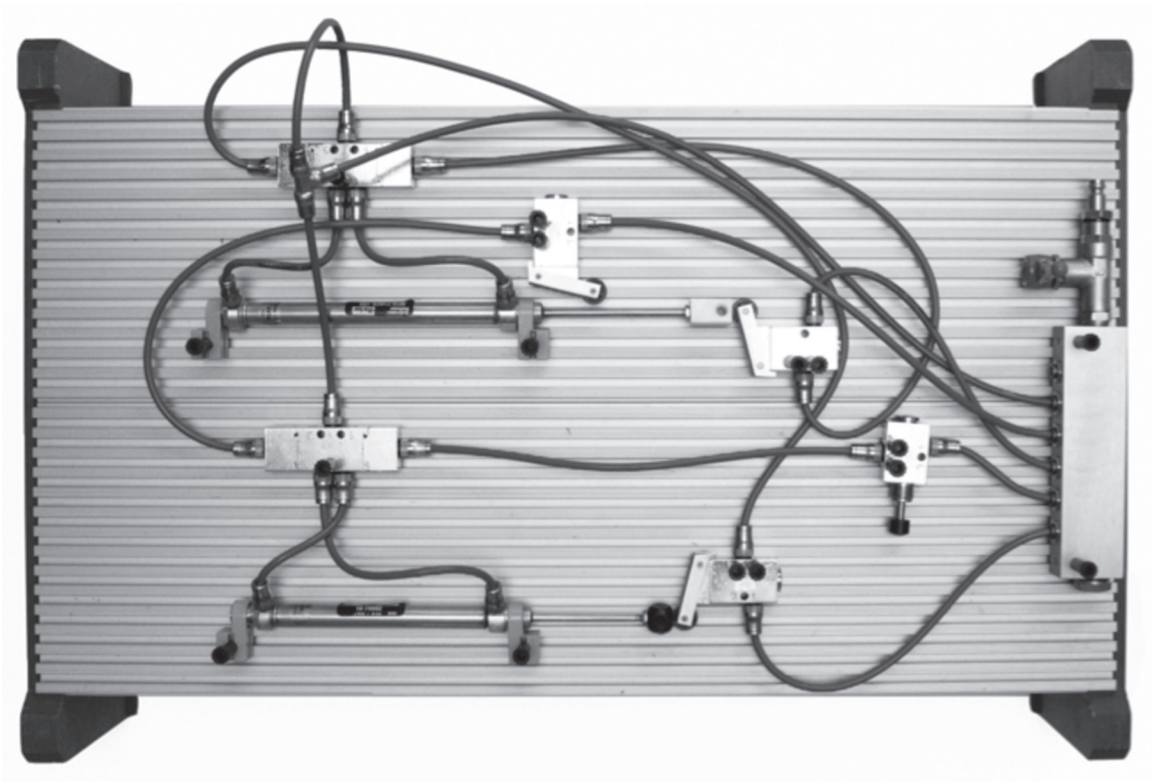

Fig. 10

(i) Explain why a prototype system is normally used when designing pneumatic circuits.

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

(ii) Give **two** benefits of using a CAD simulation software rather than real components.

1 .....

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2 .....

.....

[2]

(iii) Components used in pneumatic circuits often use standard parts and sizes.
Give **two** reasons for using standard parts when designing.

1 .....

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2 .....

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[2]

(b) Cylinder **B** has a diameter of 30 mm. The pressure regulator is set to 5 bar.

Calculate the force that will be produced.

Use the formulae $F = P \times A$ 1 bar = 0.1 N/mm^2

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..... **[3]**

Question 19 (c)* begins on page 16

(c)* Discuss the safety aspects that should be considered by manufacturers of pneumatic equipment.

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..... **[6]**

END OF QUESTION PAPER