

Friday 23 May 2014 – 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



Candidate forename		Candidate surname	
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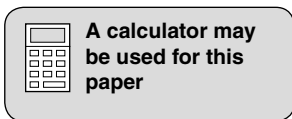
Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- 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 in Section A **and** Section B.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.
- Do **not** write in the bar codes.
- Show all working out for calculations.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with an asterisk (*).
- The number of marks for each question is given in brackets [] at the end of the question or part question.
- Dimensions are in millimetres unless stated otherwise.
- The total number of marks for this paper is **80**.
- This document consists of **20** pages. Any blank pages are indicated.



Section A

Answer **all** questions.

You are advised to spend 40 minutes on this section.

In questions 1–5 **circle** your answer.

- 1** Using natural gas central heating contributes to:
- (a) Carbon credits
 - (b) Improving your loft insulation
 - (c) Global warming
 - (d) Carbon dioxide reduction [1]
- 2** For maximum efficiency, wind turbines should face:
- (a) Directly into the wind
 - (b) South
 - (c) Sideways on to the wind
 - (d) Towards the sun [1]
- 3** The Forest Stewardship Council:
- (a) Manufactures wooden patio furniture
 - (b) Promotes the responsible management of the world's forests
 - (c) Issues tree preservation orders
 - (d) Encourages people to use wood-burning stoves [1]
- 4** The Eco-footprint of a product is:
- (a) Easy to clean off floors
 - (b) How much carbon dioxide is caused by the production and use of the product
 - (c) Information about how to return a faulty product
 - (d) How much it costs the consumer to buy [1]

- 5 Secondary recycling of an electronic product means:
- (a) Re-using the materials in different products
 - (b) Dumping the waste in a landfill site
 - (c) Using a product twice before throwing it away
 - (d) Donating the item to a charity shop [1]

6 Which of the 6Rs describes choosing not to buy a product?
..... [1]

7 State the name of a smart material.
..... [1]

8 Give **one** reason why electronic waste may be harmful to humans.
..... [1]

9 Give **one** method of gathering anthropometric data.
..... [1]

10 Complete the following to give the meaning of the abbreviation LCA.
L C Analysis [1]

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

Tick (✓) the box to show your answer.

	True	False	
11 Carbon offsetting means moving your e-waste to another country	<input type="checkbox"/>	<input type="checkbox"/>	[1]
12 Workers in a sweatshop are well paid	<input type="checkbox"/>	<input type="checkbox"/>	[1]
13 LED lamps are energy efficient	<input type="checkbox"/>	<input type="checkbox"/>	[1]
14 NiMH cells contain mercury	<input type="checkbox"/>	<input type="checkbox"/>	[1]
15 CFC means Chloro Fluoro Carbon	<input type="checkbox"/>	<input type="checkbox"/>	[1]

16 Fig. 1 shows a garden watering controller.

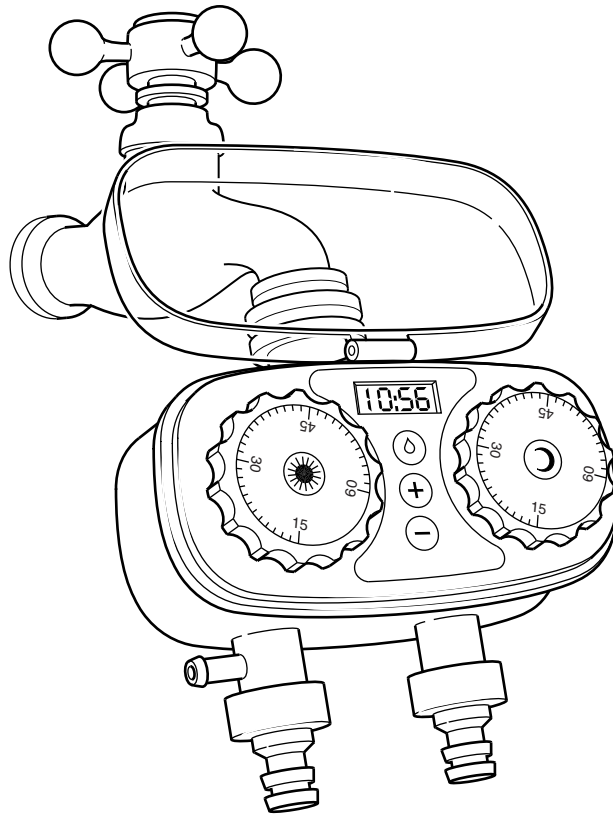


Fig. 1

(a) Identify **three** design features of the garden watering controller shown in Fig. 1.

- 1
 - 2
 - 3
- [3]**

(b) The garden watering controller is powered by four AA alkaline cells.

Give **two** environmentally friendly improvements that could be made to this power system.

- 1
 -
 - 2
 -
- [2]**

(c) Identify **one** sustainable method of disposing of AA alkaline cells.

- **[1]**

(d) The garden watering controller is supplied in clear plastic packaging.

Give **two** reasons why the manufacturer may have chosen to use clear plastic packaging.

1

.....

2

.....

[2]

(e) Explain the disadvantages to the environment of using plastic packaging.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

(f) Use sketches and notes to show **three** pieces of information which could be found on the product packaging.

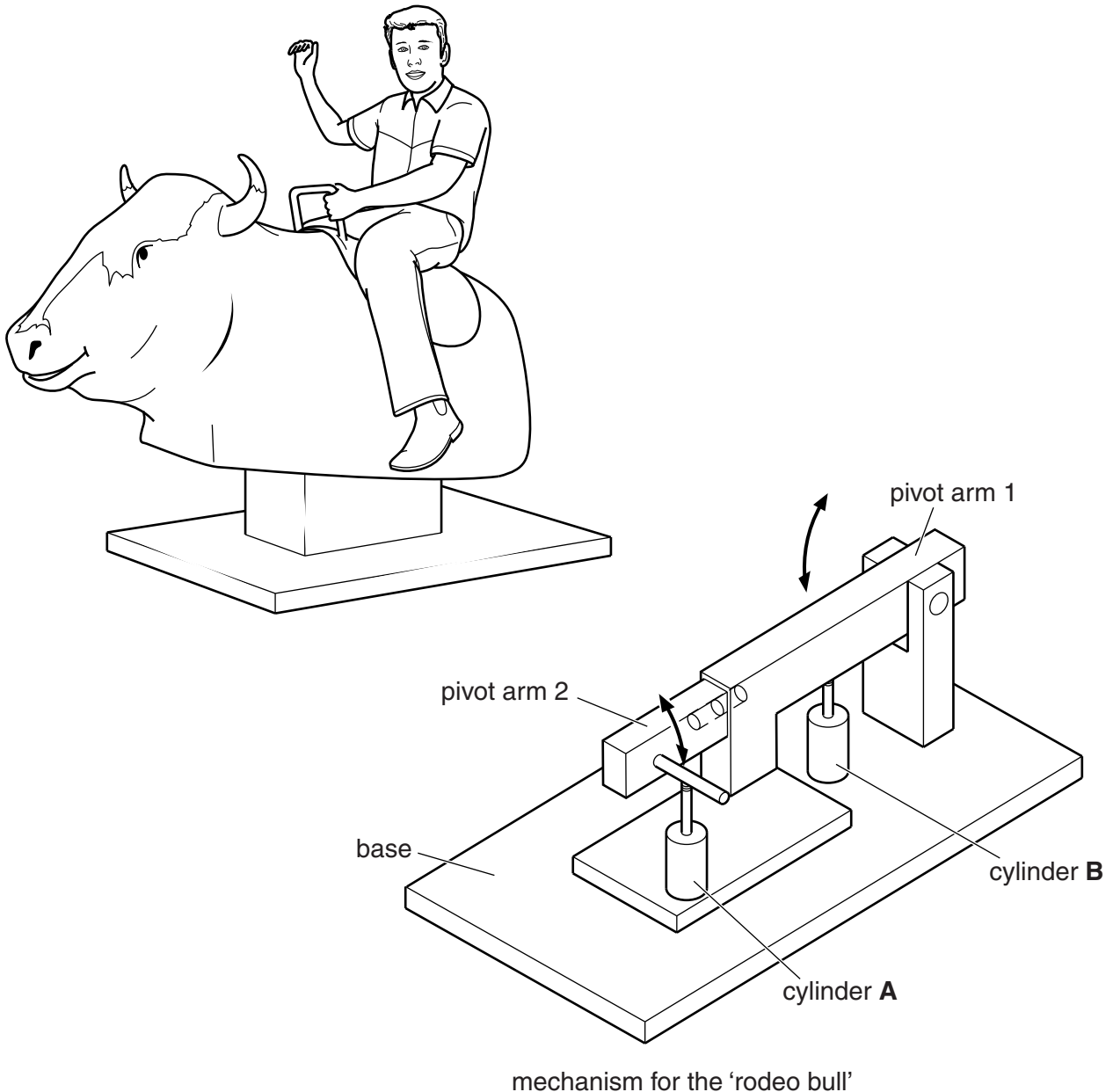
[3]

Section B

Answer **all** questions.

You are advised to spend 50 minutes on this section.


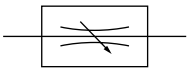
- 17 Fig. 2 shows an incomplete pneumatically controlled 'rodeo bull' fairground ride. The pneumatically controlled 'rodeo bull' uses cylinders **A** and **B** to create movement.



mechanism for the 'rodeo bull'

Fig. 2

- (a) The table below shows the name and symbol for some of the components used in the pneumatic circuit.
Complete the table by drawing in the missing symbols and adding the missing names.

Component name	Component symbol	
A exhaust		[1]
B		[1]
C		[2]
D double acting cylinder with adjustable cushioning		[2]

- (b) Fig. 3 shows a combined filter/drain valve, regulator and gauge, with its symbol.

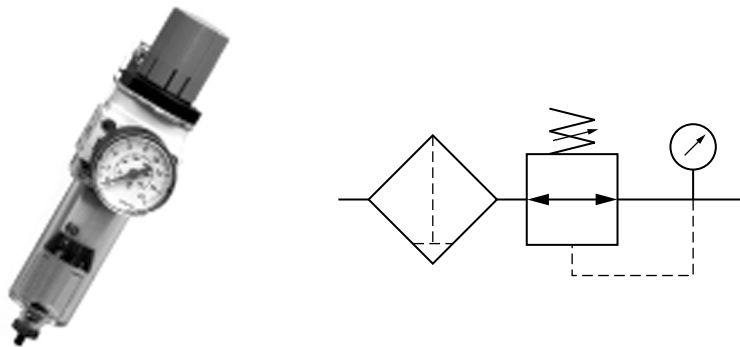


Fig. 3

Describe the function of each part of this component in a pneumatic circuit.

- (i) Filter [1]
 [1]
- (ii) Regulator [1]
 [1]
- (iii) Gauge [1]
 [1]

(c) Explain why the combined filter/drain valve, regulator and gauge is placed directly after the compressor in a pneumatic circuit.

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

(d) Regular safety inspections on pneumatic compressors should be carried out. Receiver tanks are required by law to have these inspections.

Give **three** areas of a pneumatic compressor and receiver that will be included in an inspection.

1
2
3 [3]

[Total: 15]

- 18** Fig. 4 shows a test circuit to control the cylinders on the 'rodeo bull'. To comply with health and safety requirements, it must be possible to control the instroke and outstroke speed of the cylinders.

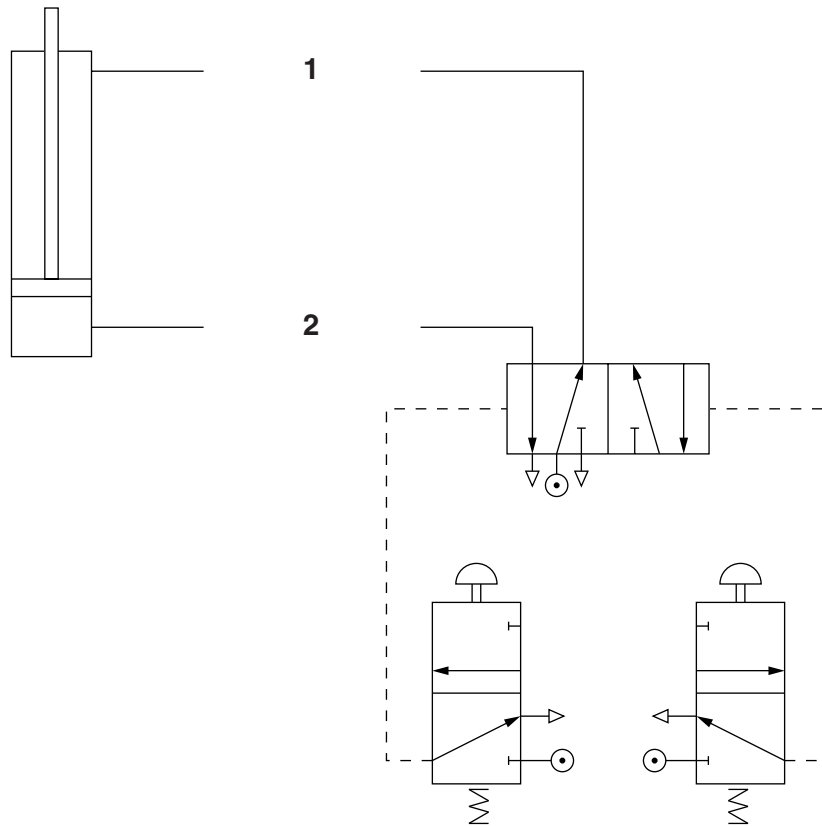


Fig. 4

- (a) (i)** Name the component that should be inserted at positions **1** and **2** on Fig. 4.
 [1]
- (ii)** Describe how the component is used to control instroke and outstroke speed.

 [2]

(b) Fig. 5 shows a reed switch cylinder used at the development stage of the circuit shown in Fig. 4.

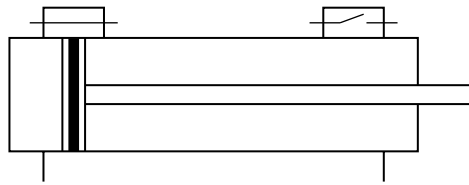


Fig. 5

(i) Tests are carried out when reed switch cylinders are manufactured to ensure that they operate correctly.
Use sketches and notes to show a simple test that can be used to check that the reed switches are operating correctly.

[3]

(ii) A programmable logic controller (PLC) could be used to provide different levels of difficulty for the 'rodeo bull'.
Describe how the electronic signals from the PLC could be used to activate pneumatic cylinders.

.....

.....

..... [2]

(c) The 'rodeo bull' can be ridden by anybody above the age of sixteen. Health and safety rules require the installation of an emergency stop button which can be operated by the rider.

(i) List **three** specification points required for the design and installation of the emergency stop button for the rider. Consideration should be given to ergonomic details.

- 1
- 2
- 3

[3]

(ii) There must also be a second emergency stop button for the operator to press if needed. Fig. 6 shows two buttons connected to a shuttle valve.

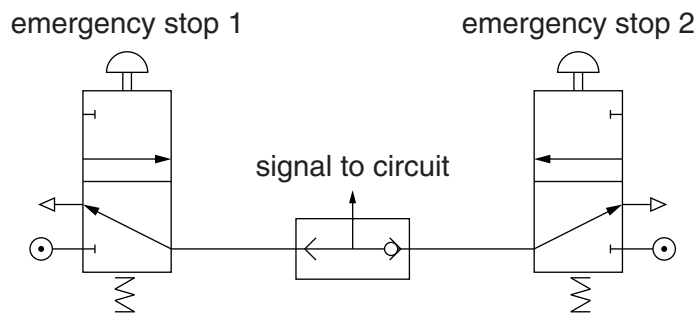


Fig. 6

Explain how the shuttle valve will allow either emergency button to send a signal to stop the ride.

-
-
-
- [3]

(iii) The emergency stop buttons could be electronic switches. Give **one** benefit of using electronic switches instead of pneumatic valves.

-
- [1]

[Total: 15]

19 The circuit to operate cylinders **A** and **B** in the sequence **A+** / **B+** / **B-** / **A-** is shown in Fig. 7.

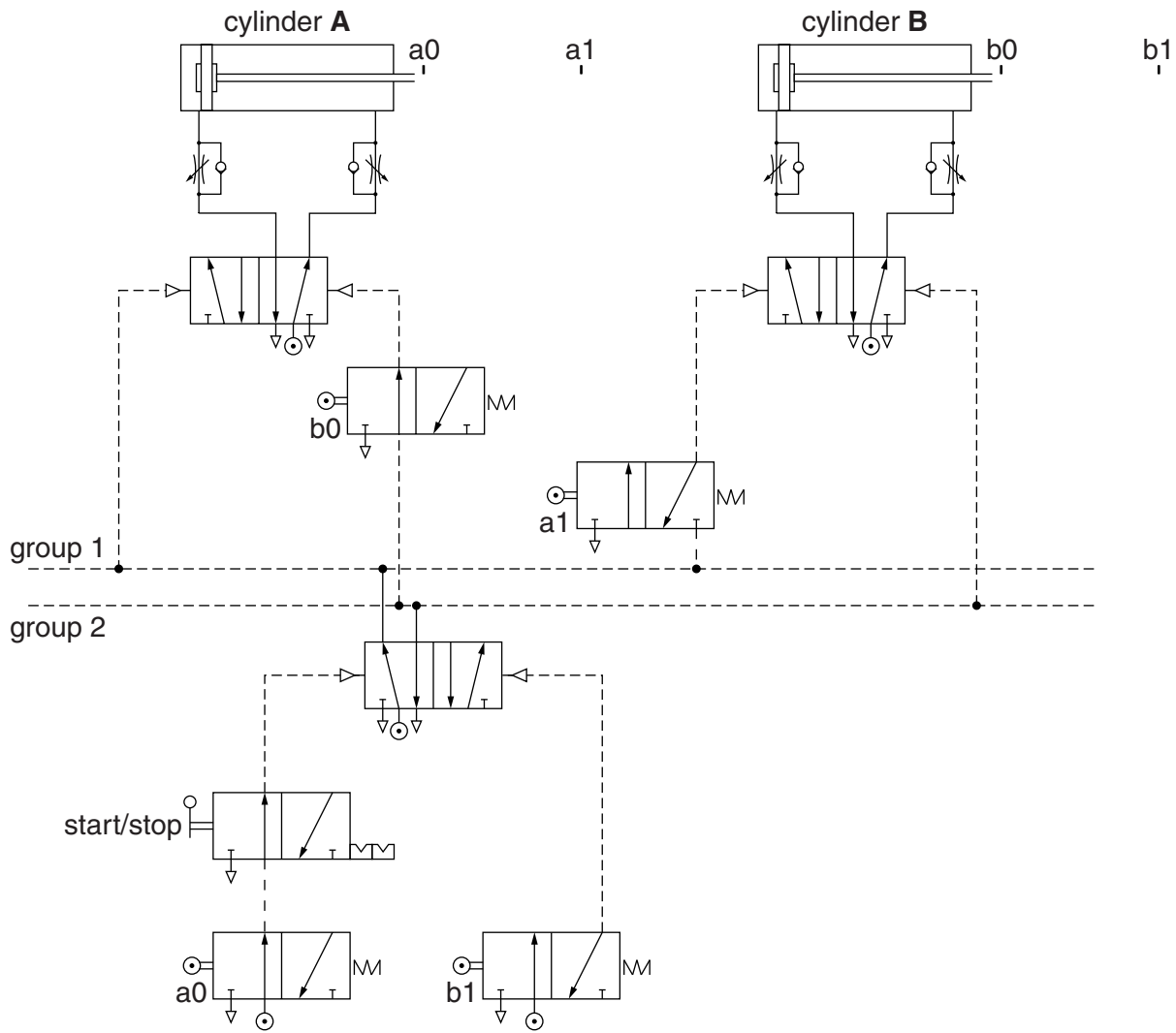


Fig. 7

(a) Explain why the designer of the circuit must use the two air group system shown rather than a single air supply.

.....

.....

.....

.....

.....

..... [2]

(b) The force required for either cylinder to lift the 'rodeo bull' and a person sitting on it is 2000 Newtons.

The pressure supplied by the system is 2.5 N/mm².

Calculate the diameter of the cylinder required to lift the 'rodeo bull' and the person sitting on it.

Use the formula $F = P \times A$

.....

.....

.....

..... [3]

(c) Fig. 8 shows the movement of pivot arm 1 which takes place when cylinder **B** is outstroked.

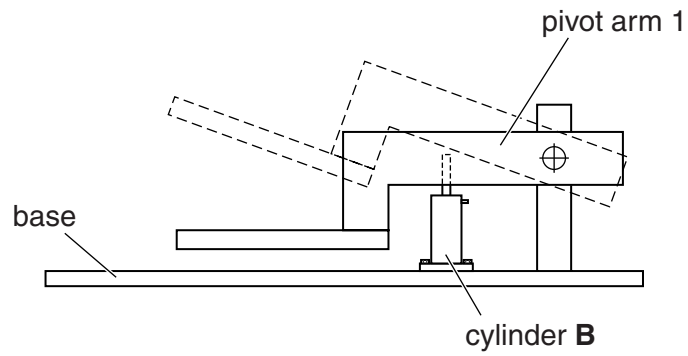


Fig. 8

The piston rod must make a positive connection to pivot arm 1 on both the outstroke and instroke.

Draw a design for a connector that will:

- attach to the piston rod
- attach to pivot arm 1
- allow cylinder **B** to be bolted firmly to the base.

[4]

17
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