



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2011

Technology and Design

Assessment Unit AS 1

assessing

Product Design and
Systems and Control

[AV111]



THURSDAY 23 JUNE, AFTERNOON

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number on the Answer Booklet provided and on the A3 pro forma answer page.

Answer **all eight** questions in Section A, and both questions in **either** Section B **or** Section C. You are provided with an insert for use with Question 8. Do **not** write your answer on this insert. An A3 pro forma is provided for Question **12(b), (c) and (d)**.

At the conclusion of the examination, attach the A3 pro forma answer page securely to the Answer Booklet with the treasury tag supplied.

INFORMATION FOR CANDIDATES

The total mark for this paper is 80, including a maximum of 4 marks for quality of written communication.

Marks for quality of written communication will be awarded for Questions **8, 9(d), 10(b)(iii), 11(b)(vi) and 12(e)(ii)**.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

All questions do not carry equal weighting.



Section A**Product Design and Practice**

Answer **all** questions in this section.

You are advised to spend approximately **1 hour** on this section.

- 1** Briefly explain what is meant by the following terms:
- toughness
 - hardness
 - elasticity
 - plasticity
- [4]
- 2** A range of finishes is available for products manufactured from metal.
- (i) State **two** main purposes of finishes used on metals. [2]
- (ii) Briefly explain the process of anodising. [2]
- (iii) Briefly explain the process of lacquering. [2]
- 3** Shape memory alloy and light-emitting polymers have a range of characteristics and applications.
- (i) Briefly explain **one** main characteristic associated with shape memory alloy and give **one** specific application. [2]
- (ii) Briefly explain **one** main characteristic associated with light-emitting polymers and give **one** specific application. [2]
- 4** Blow moulding may be used to manufacture bottles, bowls and containers.
- (i) Give **two** main reasons why the blow moulding process may be used to manufacture bottles, bowls and containers. [2]
- (ii) With the aid of an annotated sketch describe the blow moulding process. [4]

- 5 (i) Briefly outline **two** specific characteristics associated with mass production. [2]
- (ii) Briefly outline **two** specific characteristics associated with Flexible Manufacturing Systems (FMS). [2]
- (iii) Briefly outline **one** specific characteristic associated with concurrent engineering. [1]
- 6 A company producing sports racquets uses computer aided design (CAD) and computer aided manufacture (CAM) to create new models of the product.
- (i) Outline **three** main advantages (excluding cost) associated with the use of computer aided design (CAD) for the company. [3]
- (ii) Outline **two** main advantages (excluding cost) associated with the use of computer aided manufacture (CAM) for the company. [2]
- 7 The tolerance of a component and the testing and inspecting of products are terms associated with the design and manufacture of products.
- (i) Briefly explain what is meant by the term tolerance in relation to a component or product. [2]
- (ii) Give **two** main reasons why it is important for a company to test and inspect its products. [2]
- 8 Colour, symmetry and proportion are incorporated by designers into many products.
- With reference to the photograph on the insert of the mobile phone **Fig. 8**:
- (i) Select **two** different examples of colour choice and explain why the designer may have used these colours. [2]
- (ii) Explain how the designer has incorporated symmetry. [1]
- (iii) Explain how the designer has incorporated proportion. [1]
- Quality of written communication [2]

Answer **both** questions in **either** Section B **or** Section C

Section B

Electronic and Microelectronic Control Systems

You are advised to spend approximately **1 hour** on this section.

9 (a) Fig. 9(a) shows a voltage divider circuit.

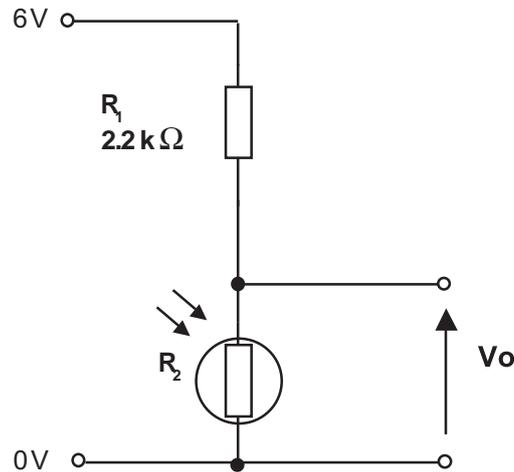


Fig. 9(a)

- (i) Resistor R_1 shown in Fig. 9(a) is taken from the E12 series. State what is meant by the term E12 series. [2]
- (ii) Explain the function of the component R_2 in the voltage divider circuit shown in Fig. 9(a). [2]
- (iii) Calculate V_o if the resistance of R_2 in Fig. 9(a) has a value of $1.8\text{ k}\Omega$. [2]

- (b) LEDs which are designed to work at a forward voltage of 2V and a maximum current of 20mA are to be connected to a 9 Volt supply as shown in Fig. 9(b).

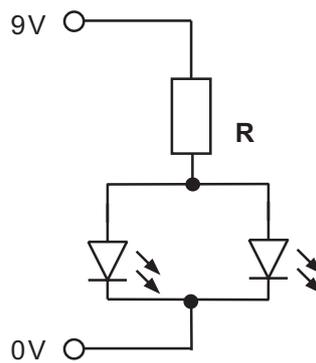


Fig. 9(b)

- (i) Calculate the value of resistance **R** required to allow the LEDs in Fig. 9(b) to function when operating at the maximum current. [3]
- (ii) Calculate the power dissipation in mW, of the resistor **R** in Fig. 9(b) when the maximum current is flowing. [2]
- (c) A voltage divider is to be used in conjunction with a comparator to make a circuit for a nightlight that will automatically switch on an LED when it is dark. Draw a labelled circuit diagram for the nightlight. The circuit should include a means whereby the level of light required to switch on the LED can be adjusted. [6]
- (d) Describe **one** advantage and **one** disadvantage (apart from cost and size) of using a programmable system such as a PIC over a hard wired solution to make the nightlight circuit in (c). [2]
- Quality of written communication [1]

10 (a) A logic gate is shown in Fig. 10(a).

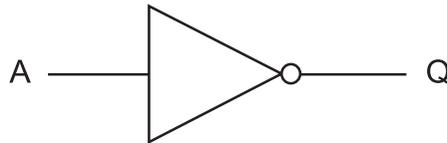


Fig. 10(a)

(i) Name the logic gate shown in Fig. 10(a) and draw its truth table. [2]

(ii) With the aid of circuit diagrams, show how SPST switches can be arranged to provide:

- AND logic
- OR logic.

[2]

(b) A logic circuit that could be used as a simple tamper alarm for a trophy display stand is shown in Fig. 10(b). Sw A is a micro switch which is kept in the closed position as shown when the trophy is resting on it.

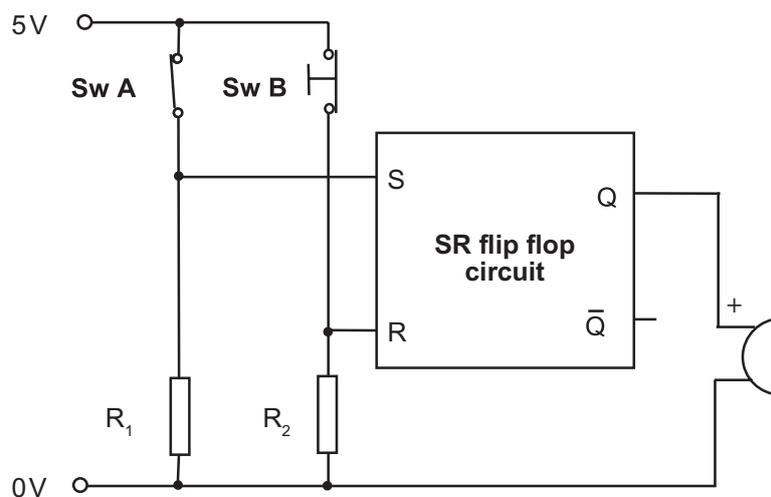


Fig. 10(b)

(i) State the type of logic gate that could be used to make the SR flip flop circuit shown in Fig. 10(b). [1]

(ii) Explain why the resistors R_1 and R_2 are used in conjunction with each of the switches shown in Fig. 10(b). [2]

- (iii) Draw using logic gates, the SR flip flop circuit in **Fig. 10(b)**. Add labels S, R, Q and \bar{Q} and describe the operation of the circuit including how the tamper alarm is reset. [4]

Quality of written communication [1]

- (c) A circuit based on a 555 timer shown in **Fig. 10(c)** is to be used to control the lighting for the trophy display.

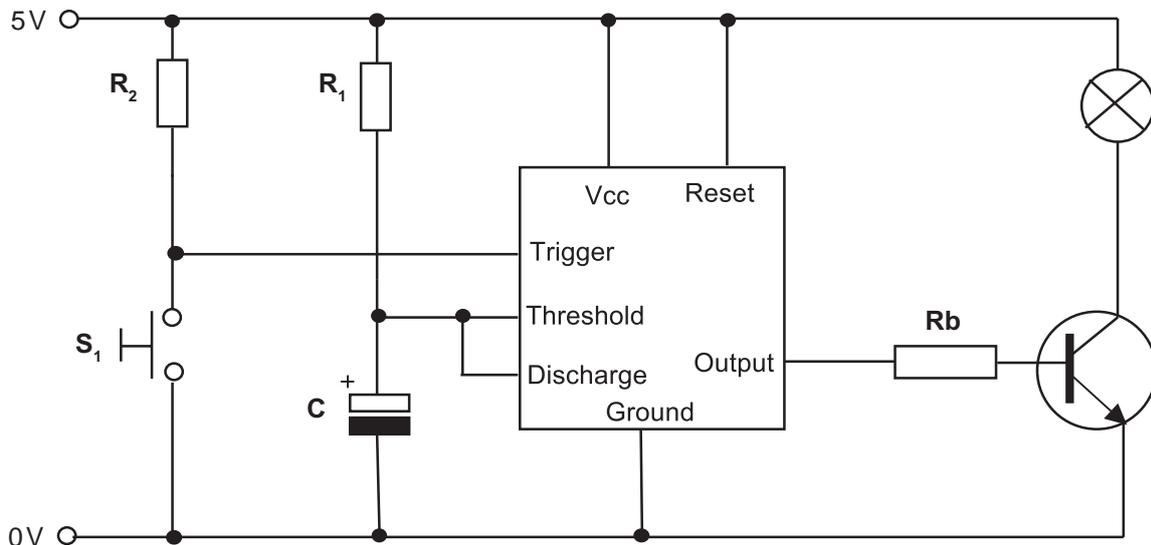


Fig. 10(c)

- (i) The bulb in **Fig. 10(c)** is to be switched on for a period of 20 seconds. If **C** has a value of $100\mu\text{F}$, calculate the value of **R₁** given that $T = 1.1 \times C \times R_1$ where **T** is the time for which the output for the 555 timer remains high. [2]
- (ii) Draw a graph with labelled axes showing output voltage of the 555 timer against time for the circuit in **Fig. 10(c)** when **S₁** is momentarily pressed and released. Also add a label to indicate the time period **T**. [3]
- (iii) The bulb in **Fig. 10(c)** requires 100 mA to operate. If the transistor has a current gain (h_{fe}) of 80 and a V_{be} of 0.7 V, calculate the value of **R_b**. [3]

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Answer **both** questions in **either** Section B **or** Section C

Section C

Mechanical and Pneumatic Control Systems

You are advised to spend approximately **1 hour** on this section.

11 Fig. 11(a) shows a prototype industrial waste bin.

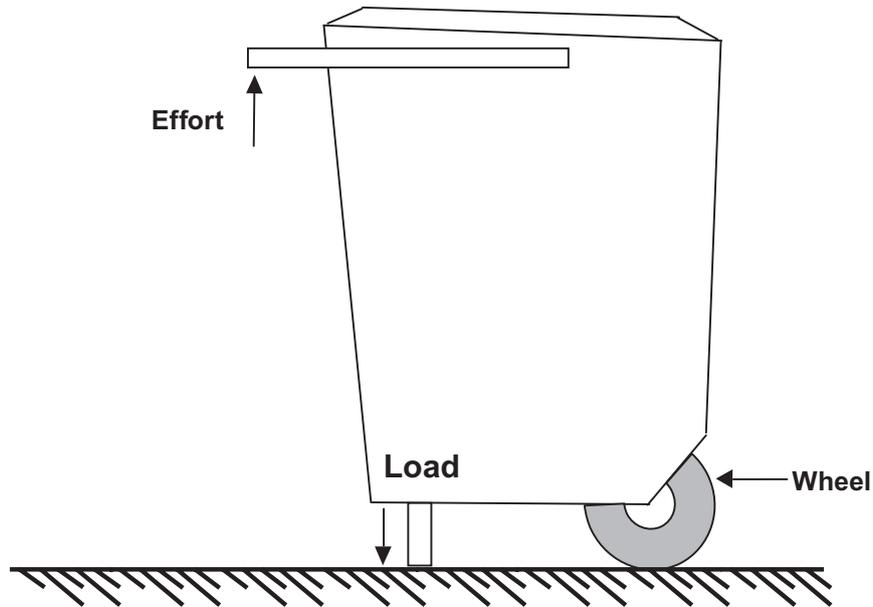


Fig. 11(a)

- (a) (i) The waste bin is an example of a class 2 lever. Briefly describe where the pivot/fulcrum is located when the bin is being moved. [1]
- (ii) Calculate the effort required to move a 600 N load if the mechanical advantage is 3. [2]
- (iii) Calculate the velocity ratio for the waste bin if the distance moved by the load is 40 mm and effort moves 200 mm. [2]

(b) **Fig. 11(b)** shows part of an incomplete industrial waste compacting system.

- (i) State the direction of rotation at **Gear O** if **B** rotates in an anticlockwise direction. [1]
- (ii) Calculate the output speed of **Wormwheel X** if the motor rotates at 480 rev/min. [3]
- (iii) Calculate the number of teeth on **Wormwheel E** if it is expected to rotate at 5 rev/min with the motor rotating at 480 rev/min. [3]
- (iv) Calculate the difference in output speeds between Gears **N** and **D**. [3]
- (v) Using an annotated sketch draw a method which could use the motion provided by **Shaft Z** to make the compactor reciprocate. [2]
- (vi) Name each type of gear from gears **A** to **D** and describe if there is an increase or decrease in transmission speeds between them. Include in your explanation why there is a significant difference in transmission speeds between the worm and wormwheel arrangements in **Fig. 11(b)**. [2]
- Quality of written communication [1]

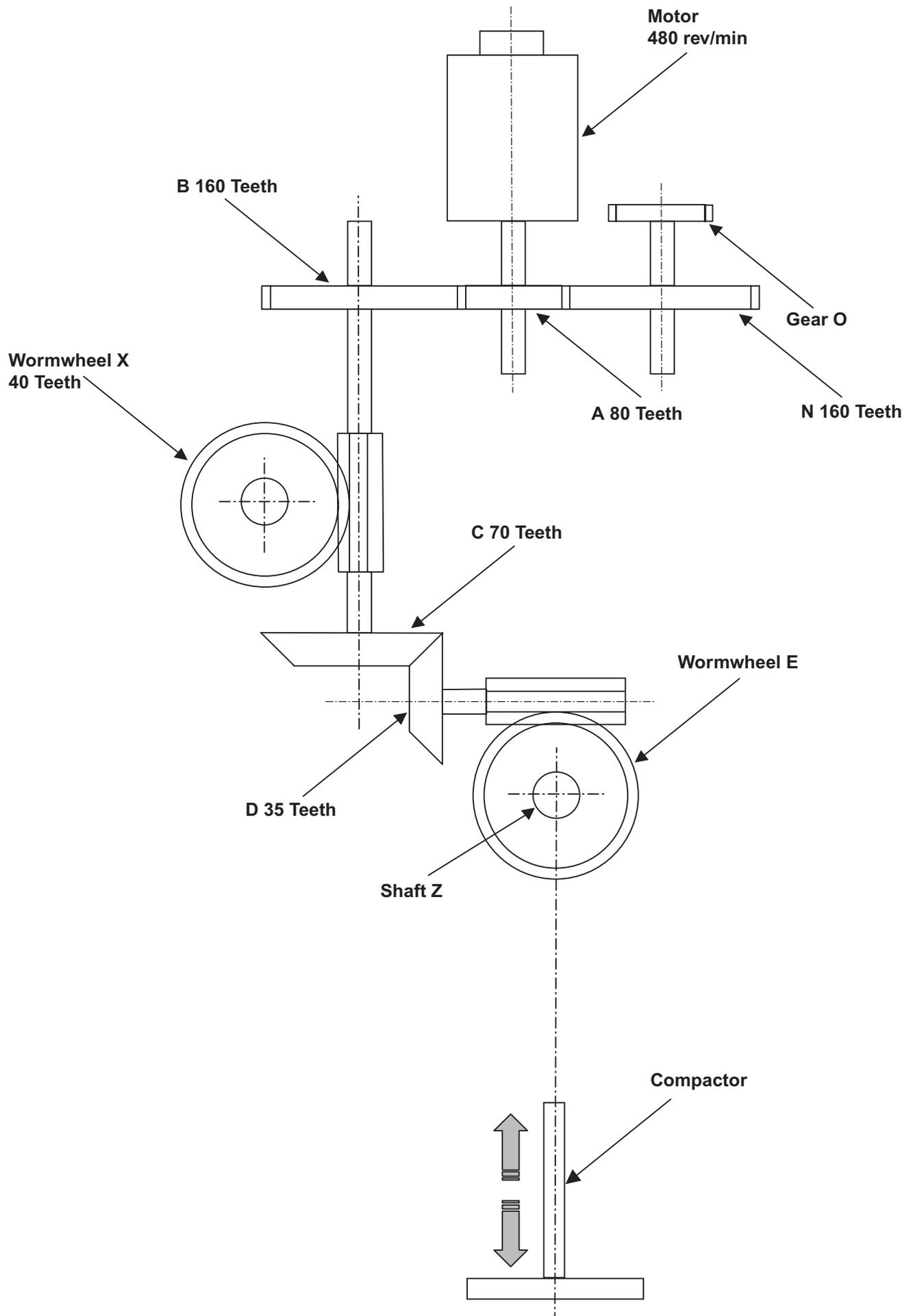


Fig. 11(b)

12 Fig. 12 shows part of an incomplete pneumatic system.

- (a) (i) Name the activation method at **P**. [1]
- (ii) Name the activation method at **R**. [1]
- (iii) Name the activation method at **A**. [1]
- (b) An activation at **P** signals an outstroke on the single acting cylinder. On the pro forma provided (answer number **12(b)**, **(c)** and **(d)**) add an additional component which would allow speed control on the outstroke of the single acting cylinder. [2]
- (c) On the pro forma provided (answer number **12(b)**, **(c)** and **(d)**) develop the circuit enabling a combined activation at **A** and **B** or **C** and **D** to signal the five port valve at **S** for activation. [4]
- (d) On the pro forma provided (answer number **12(b)**, **(c)** and **(d)**) complete the circuit enabling the double acting cylinder to outstroke and instroke automatically once **S** is activated. [5]
- (e) (i) The double acting cylinder is supplied with an air pressure of 0.4 N/mm^2 , has a piston diameter of 60 mm and a piston rod diameter of 6 mm. Calculate the difference in forces produced by the cylinder during the outstroke and instroke. Please assume $\pi = 3.14$. [3]
- (ii) Describe why there is a difference between the forces created during the outstroke and instroke. [2]
- Quality of written communication [1]

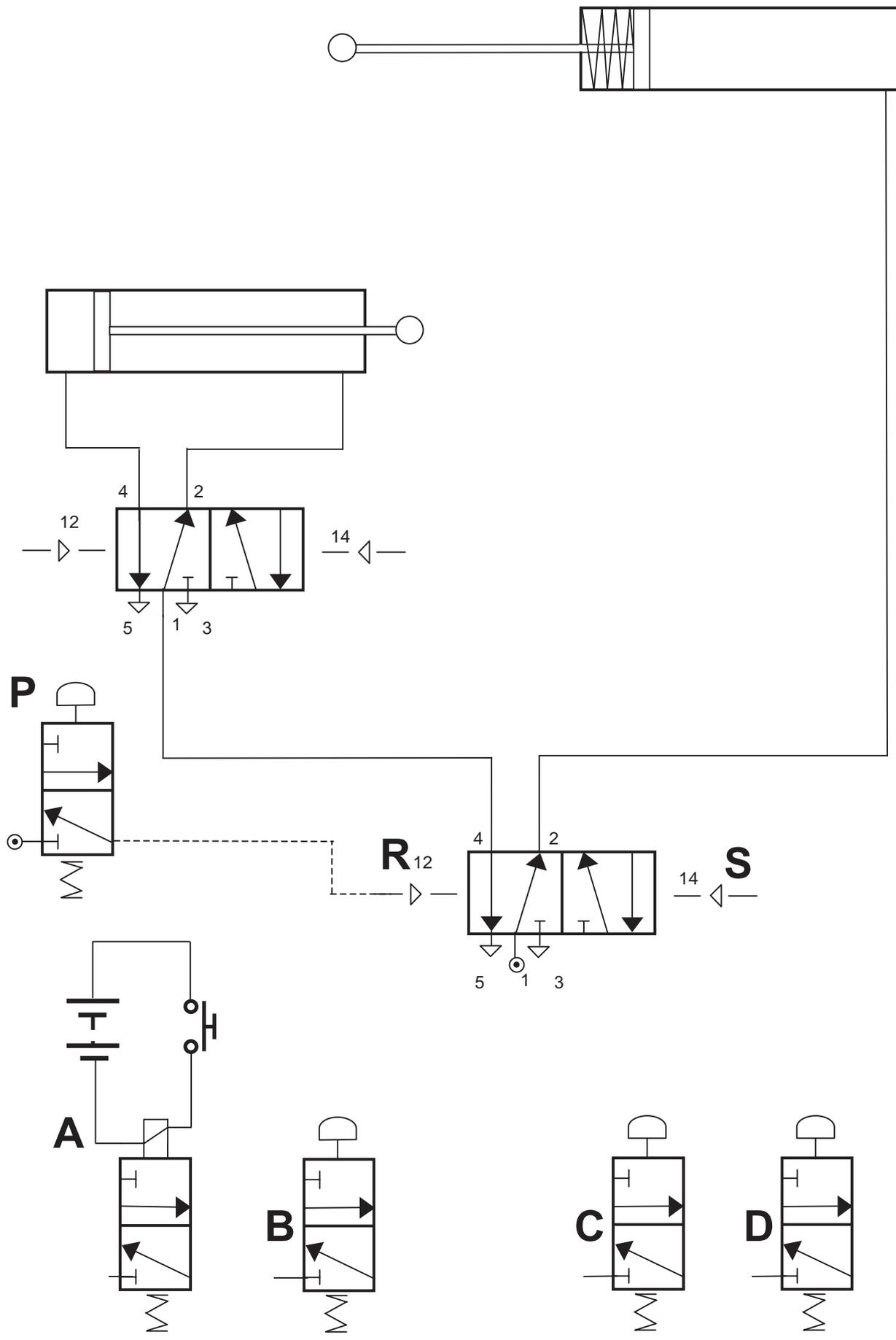
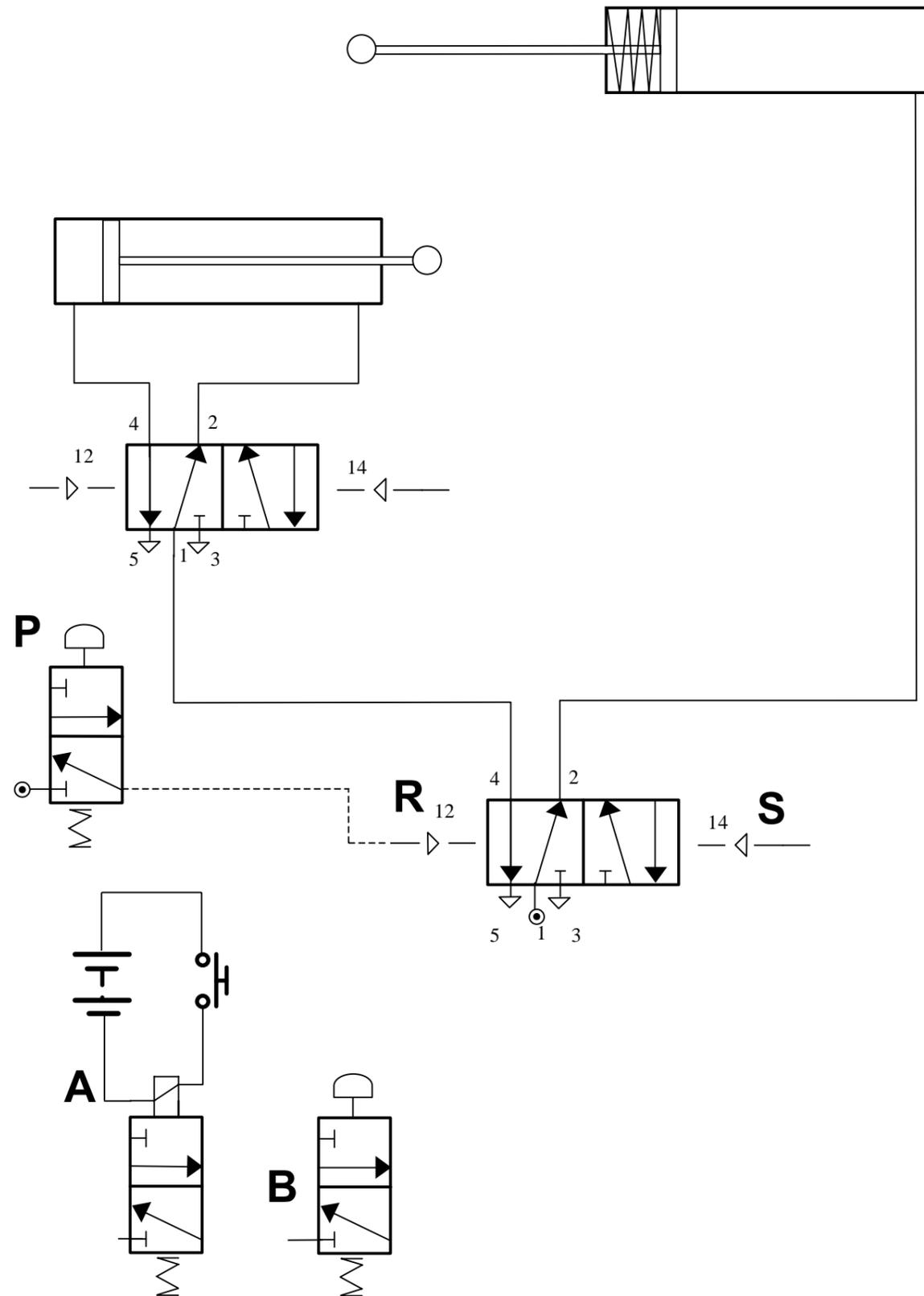


Fig. 12

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Pro forma answer page (answer number 12(b), (c) and (d))

GCE Advanced Subsidiary (AS) Technology and Design
Assessment Unit AS 1 Summer 2011

(for use with Question 8)



Fig. 8

For candidates studying Technology and Design.



