Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2011

Technology and Design

Assessment Unit AS 1

assessing

Product Design and
Systems and Control

[AV111]

AV111

THURSDAY 20 JANUARY, MORNING

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 provided.
Answer **all eight** questions in Section A, and both questions in **either** Section B **or** Section C.
An A3 pro forma is provided for Question **12(a)(iv)**, **(v)**, **(vi)** and **(vii)**.
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 (QWC) will be awarded for Questions **6**, **8**, **9(b)(iii)**, **10(b)(i)**, **11(b)** and **12(a)(iii)**.
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 Before choosing materials for a product a designer needs to consider the physical and mechanical properties required, the manufacturing demands and the effect the environment will have on the product.

(i) Briefly explain what is meant by physical properties and mechanical properties. [2]

(ii) Briefly outline **two** factors relating to manufacturing demands that a designer would need to consider when choosing materials. [2]

(iii) Briefly outline **two** factors relating to the effect of the environment that a designer would need to consider when choosing materials. [2]

2 Wood is supplied in a range of forms.

(i) State **two** different available forms that wood is supplied in. [2]

(ii) Briefly outline **two** main advantages that plywood has in comparison to chipboard. [2]

3 Plastic egg boxes can be manufactured by the process of vacuum forming.

(i) Give **two** main reasons why vacuum forming is a suitable process for the manufacture of these boxes. [2]

(ii) With the aid of an annotated sketch describe the vacuum forming process. [4]

4 Adhesives, nuts, bolts and washers may be used to join materials.

(i) Select from; polyvinyl acetate (PVA), solvent cement or epoxy resin the most suitable adhesive for joining each of the following:

- Plastic to plastic
- Metal to metal
- Wood to wood [3]

(ii) Describe **two** main reasons why you would select a nut, bolt and washer as a joining method for a particular application. [2]

5 Cell production and just-in-time (JIT) are two systems used to organise manufacturing.

(i) Describe **two** main characteristics associated with cell production. [2]

(ii) Describe **two** main characteristics associated with just-in-time (JIT). [2]

6 Quality Control (QC) and Quality Assurance (QA) are widely used procedures in product design and manufacture.

(i) Describe **two** main characteristics associated with Quality Control (QC). [2]

(ii) Describe **two** main characteristics associated with Quality Assurance (QA). [2]

QWC [1]

7 **(i)** Explain what is meant by the term CIM. [2]

(ii) Describe **three** main advantages of using CIM. [3]

8 Scientific advances and changes in fashion can have an influence on the design of products.

With reference to a product of your choice, describe **one** main scientific advancement and **one** main change in fashion and explain how each of these changes have influenced the design of the product. [4]

QWC [1]

Section B

Electronic and Microelectronic Control Systems

Answer both questions in this Section **or** both questions in Section C.

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

9 **(a)** A logic circuit is shown in **Fig. 9(a)**. The logic inputs to the circuit are provided by 3 switches labelled A, B and C.

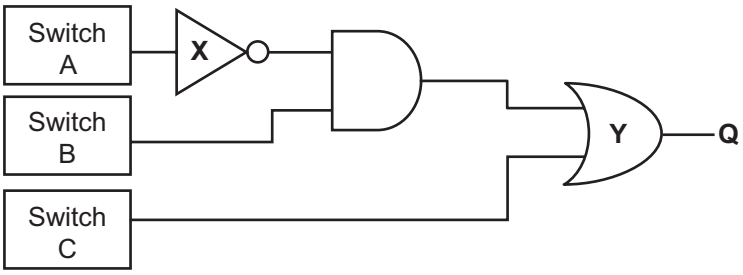

Fig. 9(a)

(i) Name the logic gates labelled **X** and **Y** in **Fig. 9(a)**. [2]

(ii) Switch A in **Fig. 9(a)** is a reed switch. With the aid of an annotated sketch explain how this type of switch operates. [2]

(iii) Switch B in **Fig. 9(a)** is a push to make switch. Show with the aid of an annotated circuit diagram, how this type of switch can be used to provide a logic 1 when pressed and a logic 0 when released. [3]

(iv) Draw a truth table for all input combinations of A, B and C and the corresponding output Q for the logic circuit shown in **Fig. 9(a)**. [4]

(b) The output from the logic circuit shown in **Fig. 9(a)** is to be used to switch on a lamp using a thyristor.

(i) Draw a labelled circuit diagram showing how the output from the logic circuit shown in **Fig. 9(a)** can be used to switch on a lamp operating from a 24 V power supply using a thyristor. The circuit should include a means of resetting the thyristor. [4]

(ii) If the lamp has a resistance of 5 ohms, calculate current flowing through it and the power dissipated by it when the voltage across it is 24 volts. [2]

(iii) Describe **two** safety issues associated with electronic and microelectronic control systems. [2]

QWC [1]

10 (a) A series resistor capacitor (RC) circuit is shown in **Fig. 10(a)**.

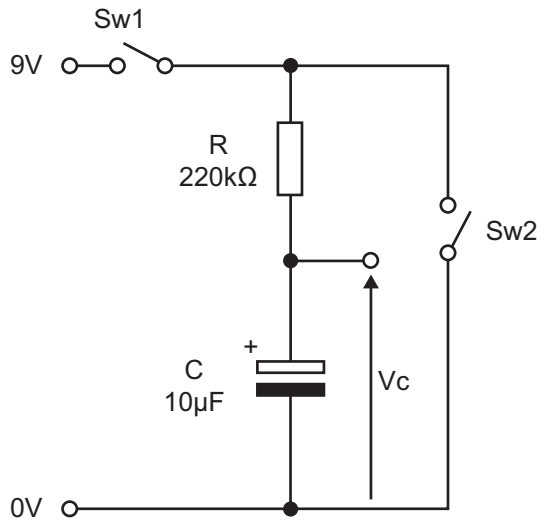

Fig. 10(a)

(i) Explain what is meant by the term time constant. [2]

(ii) Using the component values shown in **Fig. 10(a)** calculate the time constant for the circuit. [1]

(iii) Sketch a graph with labelled axes showing Vc against time when the capacitor in **Fig. 10(a)** is discharging, i.e. when switch Sw1 is opened and Sw2 is closed. [2]

(b) The circuit shown in **Fig. 10(b)** utilises the resistor and capacitor from **Fig. 10(a)**.

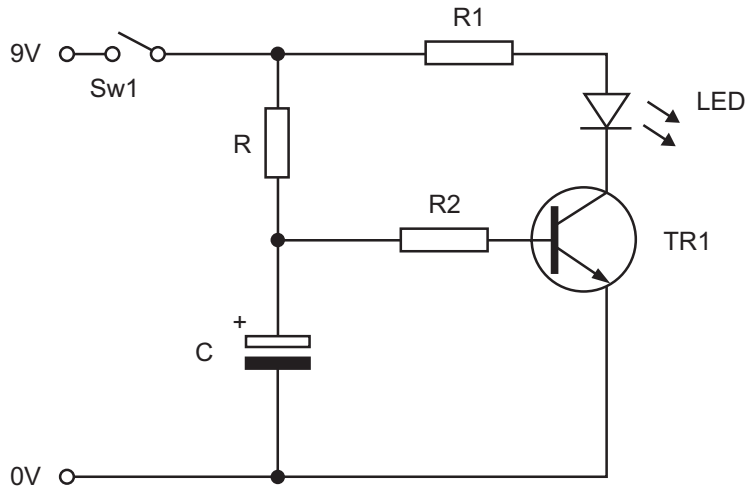

Fig. 10(b)

(i) Explain the operation of the circuit shown in **Fig. 10(b)** after the switch Sw1 is closed. [4]

QWC [1]

(ii) Choose a suitable power rating for the resistor R1 in **Fig. 10(b)** if the current flowing in the LED is 12 mA and the LED forward voltage is 1.8 V. (Assume that resistors with the following power ratings are available; 0.125 W, 0.250 W, 0.5 W and 1 W.) [3]

(iii) Suggest an addition to the circuit which will enable the brightness of the LED in **Fig. 10(b)** to be adjustable. [1]

(iv) The circuit shown in **Fig. 10(b)** is to be modified to enable it to control a 24 volt lamp instead of the LED.

Using an annotated circuit diagram, draw the complete modified circuit stating the purpose of any additional components. [4]

(v) A darlington pair is often used to switch on output devices. State **two** main reasons why this arrangement is used. [2]

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(Section C begins overleaf)

Section C

Mechanical and Pneumatic Control Systems

Answer both questions in this Section **or** both questions in Section B.

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

11 (a) **Fig. 11** shows part of a prototype lifting mechanism.

(i) Round, vee and toothed belts are commonly used on pulleys. Name **one** other belt type. [1]

(ii) State the direction of rotation of the handle if the load is lowered. [1]

(iii) Calculate the velocity ratio between Gear **A** and Pulley **D**. [3]

(iv) Calculate the transmission speed at Sprocket **F** if the handle is rotated at 30 rev/min. [4]

(v) The components in the lifting mechanism are changed to produce an overall velocity ratio of 40. Calculate the effort required to lift the 160 N load if the efficiency of the overall lifting mechanism is 80%. Frictional effects should be neglected. [4]

(vi) Using an annotated sketch explain how a cotter pin may be used to fix the handle to the shaft. [2]

(vii) Briefly explain how the mechanical advantage of the lifting mechanism could be improved without modifying the gear, pulley or sprocket systems. [1]

(b) Following testing a jockey wheel is added to the pulley in the lifting mechanism. Discuss why jockey wheels are used and outline the main differences between fixed and self adjusting jockey wheels. [3]

QWC [1]

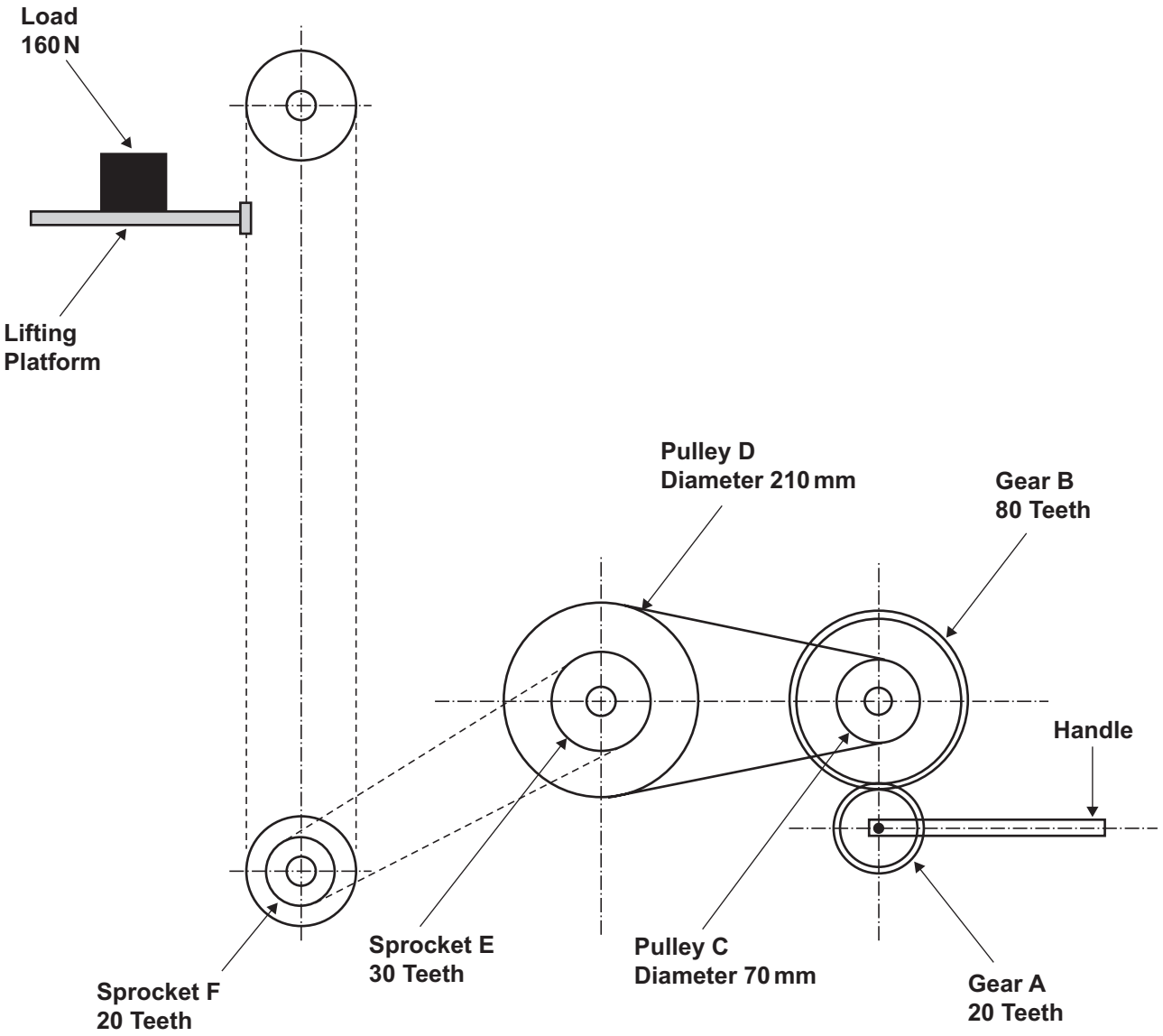

Fig. 11

12 **Fig. 12** shows an incomplete pneumatic circuit used to open and close an air outlet.

(a) Name the following activation methods shown on **Fig. 12**:

(i) Activation method at **X**. [1]

(ii) Activation method at **U**. [1]

(iii) During operation the following problem was detected. Cylinder **A** was found to outstroke in a sluggish manner. Describe why this may happen and how it could be resolved. [2]

QWC [1]

(iv) On the pro forma provided **(answer numbers 12(a)(iv), (v), (vi) and (vii))** complete the circuit enabling three port valve **W** to be operated using an air bleed. [2]

(v) On the pro forma provided **(answer numbers 12(a)(iv), (v), (vi) and (vii))** add an additional component and piping to the circuit to enable cylinder **A** to instroke automatically following an outstroke. [3]

(vi) On the pro forma provided **(answer numbers 12(a)(iv), (v), (vi) and (vii))** complete the circuit to enable cylinder **A** to outstroke when either three port valves **V**, **W** or **X** are activated. [4]

(vii) On the pro forma provided **(answer numbers 12(a)(iv), (v), (vi) and (vii))** add a 3 PV which performs a **NOT** logic function to prevent cylinder **A** from activating. [3]

(b) The double acting cylinder **A** is supplied with an air pressure of 0.4 N/mm^2, has a piston diameter of 50 mm and a piston rod diameter of 8 mm. Calculate the force produced by the cylinder during the instroke. Please assume π = 3.14. [3]

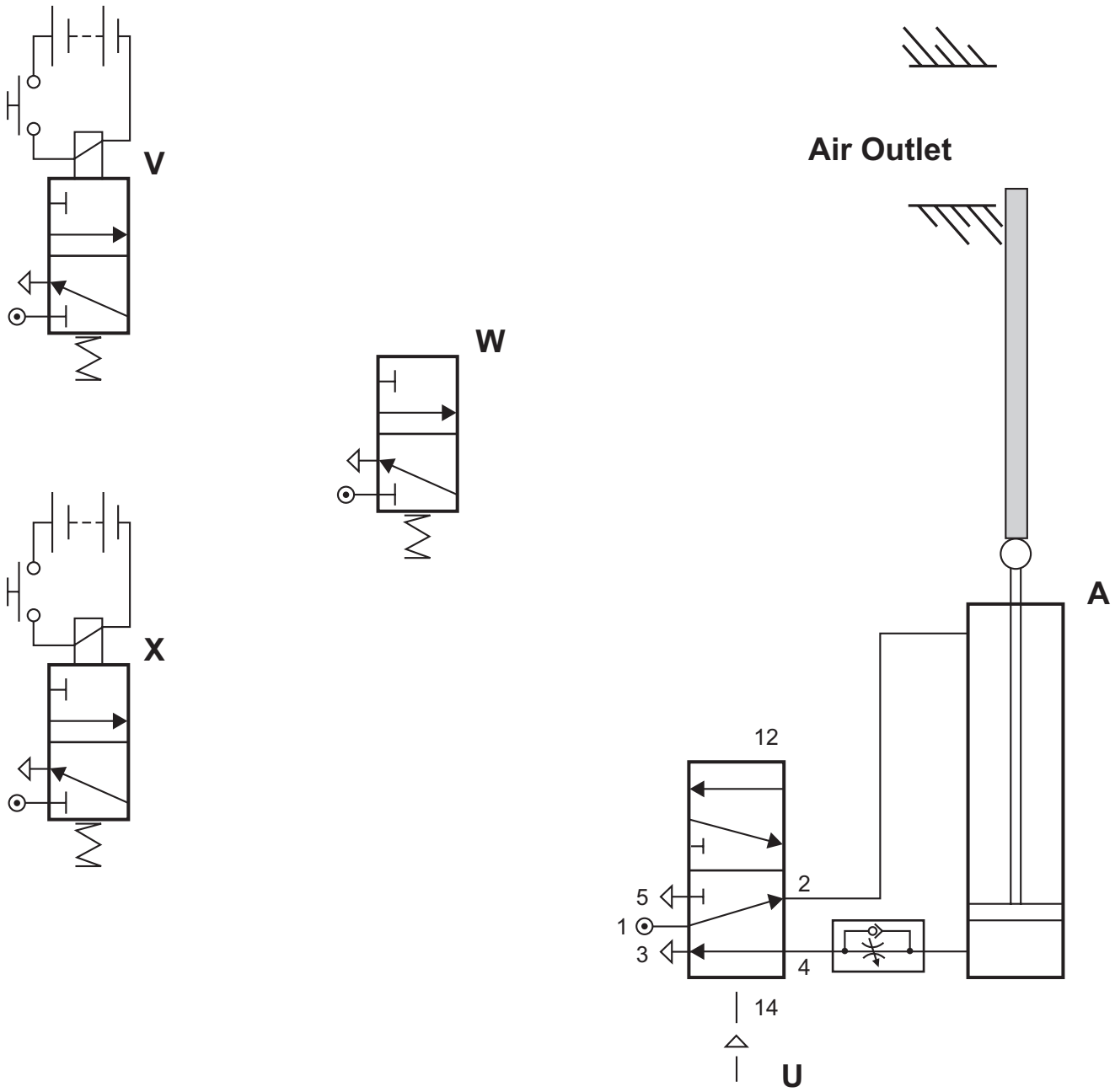

Fig. 12

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