Surname

Other Names

Candidate Signature

AQA

General Certificate of Secondary Education
June 2012

Design and Technology: Systems and Control Technology

45651

Unit 1   Written Paper

Thursday 21 June 2012   1.30 pm to 3.30 pm

For this paper you must have:
- a black pen, a pencil, a ruler, an eraser and a pencil sharpener.

Time allowed
- 2 hours

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this answer book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 120.
- The question in Section A relates to the context referred to in the Preliminary Material that was previously issued.
- You are reminded of the need for good English and clear presentation in your answers. Quality of Written Communication will be assessed in Question 7 (c).

You may need to use one or more of the following formulae when answering questions which include calculations.

Potential Difference $V = I \times R$

Series Resistance $R_T = R_1 + R_2$

Potential Divider $\text{Voltage 1} = \dfrac{R1}{R1 + R2} \times \text{Supply Voltage}$

$\text{Voltage 2} = \dfrac{R2}{R1 + R2} \times \text{Supply Voltage}$

Ratio of Simple Gears $\text{Gear ratio} = \dfrac{\text{Number of teeth on driven gear}}{\text{Number of teeth on driver gear}}$

Velocity Ratio $\text{Velocity ratio} = \dfrac{\text{Diameter of driven pulley}}{\text{Diameter of driver pulley}}$

$\text{Output speed} = \dfrac{\text{Input speed}}{\text{Gear / Velocity ratio}}$

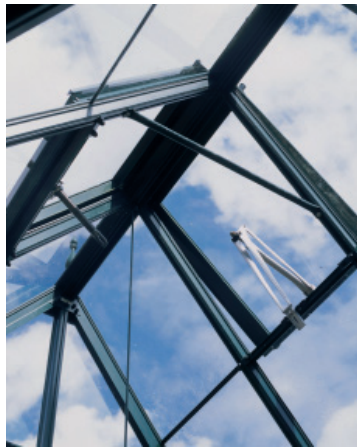Mechanical Advantage $MA = \text{Load / Effort}$

Section A

Answer **all** questions in the spaces provided.

You are advised to spend about 20 minutes on this question.

1   This question is about design processes.

You have been asked to design an automatic vent for a greenhouse.

© GettyImages

The first part of the question is about analysis.

1 (a)   List **two** considerations that you should think about when designing the automatic vent for a greenhouse **and** give a reason why each is important.

An example has been given below.

Example – The likely cost of the whole project so that we are able to sell it at a reasonable price.

Consideration 1 ....

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....

....

Consideration 2 ....

....

....

....

(4 marks)

Question 1 continues on the next page
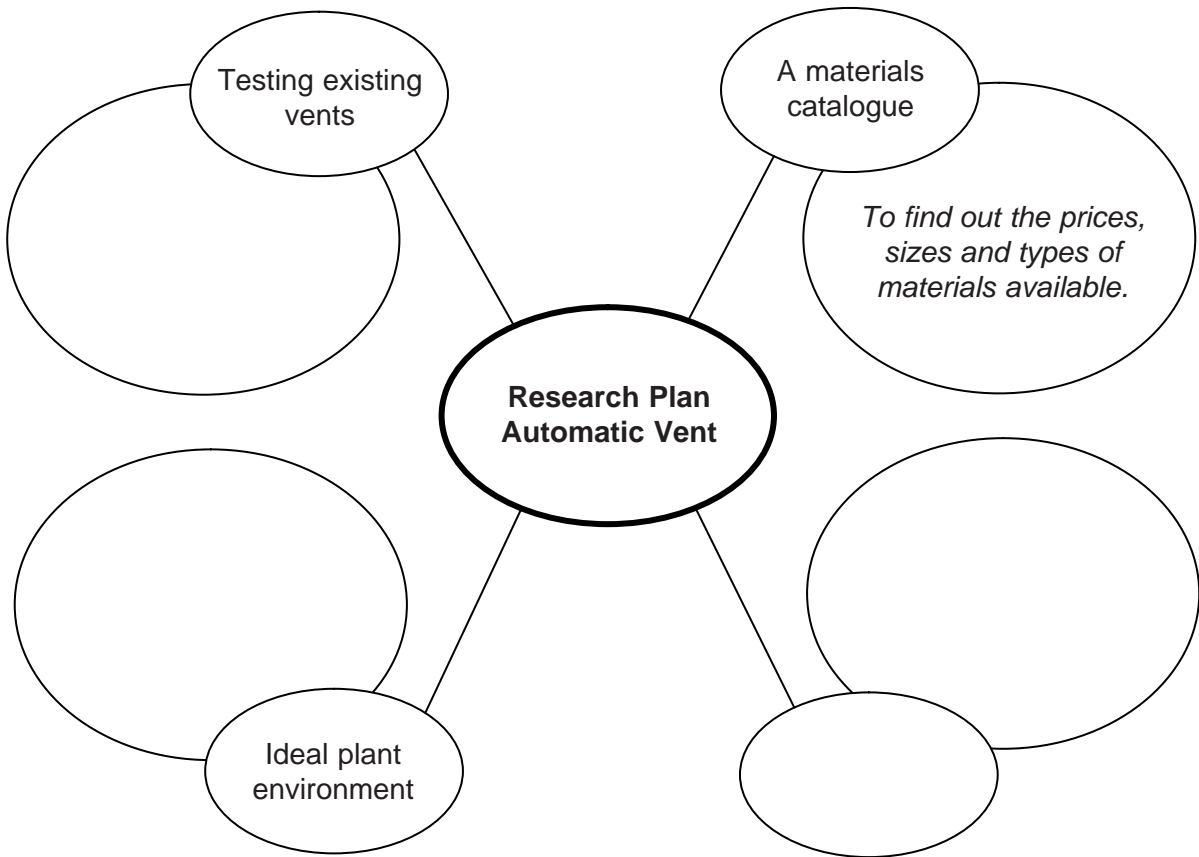
Turn over ▶

The next part of this question is about research.

1 (b) The layout of a research plan for the automatic vent for a greenhouse is shown below.

Complete the diagram below:

- by adding another suitable research source *(1 mark)*

- by stating the information that you would hope to find for each of these research sources. The materials catalogue section has been completed for you.
  (3 x 2 marks)

Testing existing vents

A materials catalogue

To find out the prices, sizes and types of materials available.

Research Plan Automatic Vent

Ideal plant environment

1 (c) Describe how the information from analysis and research may affect the final design.

....

....

....

....
(2 marks)

This part of the question is about design specification.

1 (d) Give **four** design requirements for your automatic vent for a greenhouse and an explanation of each requirement. An example is given below.

Requirement
The vent must open when the temperature is above 25°C.

Explanation
The vent should open to allow the greenhouse to cool to protect the plants.

Requirement 1 ....

....

Explanation 1 ....

....

Requirement 2 ....

....

Explanation 2 ....

....

Requirement 3 ....

....

Explanation 3 ....

....

Requirement 4 ....

....

Explanation 4 ....

....

(8 marks)

21

Turn over ▶

You are advised to spend about 15 minutes on this question.

2 This question is about designing the opening and closing system for an automatic greenhouse vent.

You have been asked to design an automatic vent for a greenhouse which is battery powered and must be able to open **and** close.

Using notes and sketches, add to the diagram of the greenhouse vent on the opposite page a design for the vent mechanism which shows the following features:

- a system that can fully open the vent   *(2 marks)*
- a method of sensing that the vent is fully open   *(2 marks)*
- a system that can fully close the vent   *(2 marks)*
- a method of sensing that the vent is fully closed   *(2 marks)*
- a secure method of attachment to the greenhouse frame   *(2 marks)*
- a suitable power source for the system.   *(3 marks)*

Name the system that you have chosen to use.

....

Greenhouse vent (shown in open position)
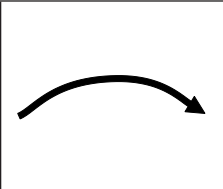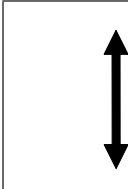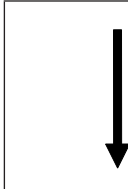
Hinge

Greenhouse
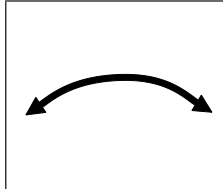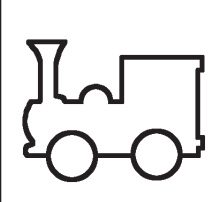frame
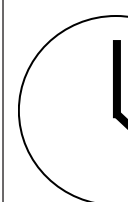
13
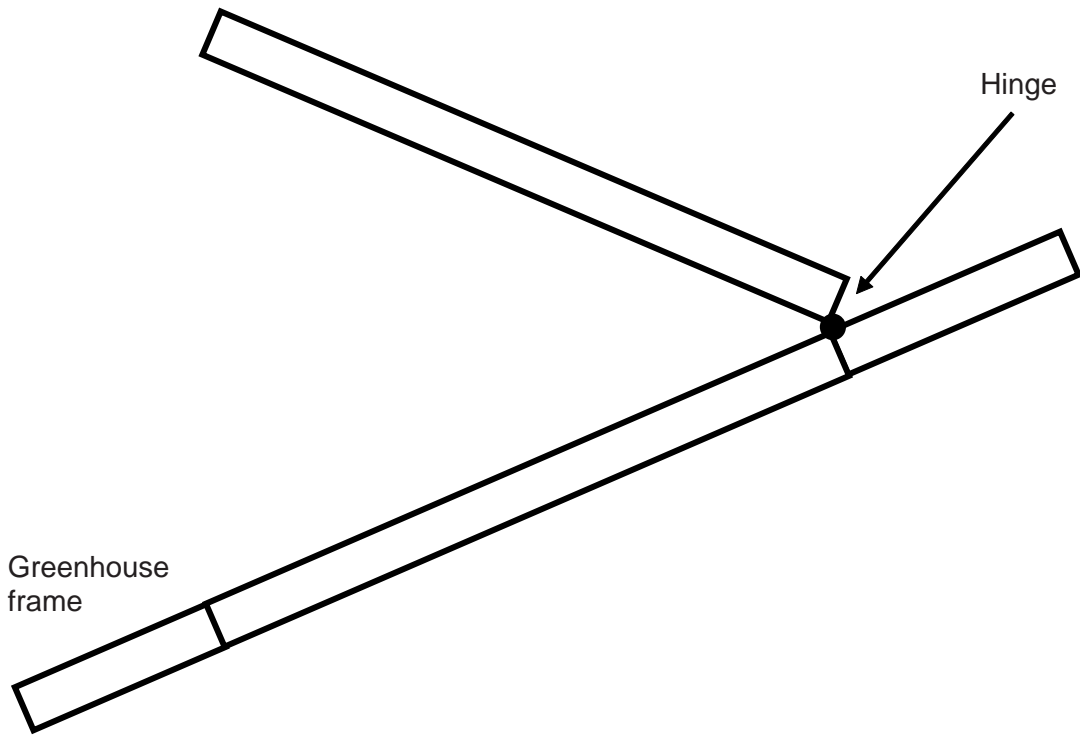
Section B

Answer **all** questions in the spaces provided.

You are advised to spend about 20 minutes on this question.

3   This question is about types of motion and mechanisms.

3 (a)   Draw lines to link each motion description below to the correct arrow symbol.
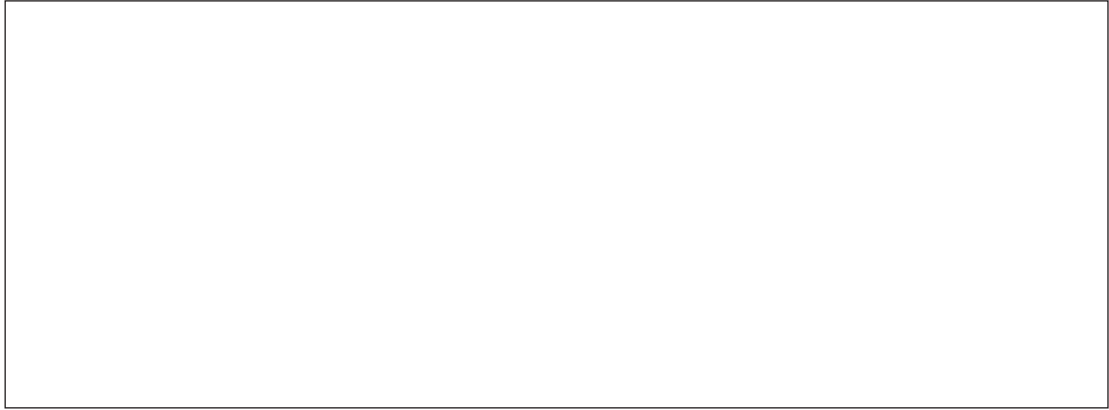
Then draw lines from each arrow symbol to the correct example at the bottom of the page.

Motion
Description

| Oscillating | Linear | Rotary | Reciprocating |

Arrow
Symbols

Examples

| Train | Clock Hands | Windscreen Wiper | Saw |

(6 marks)
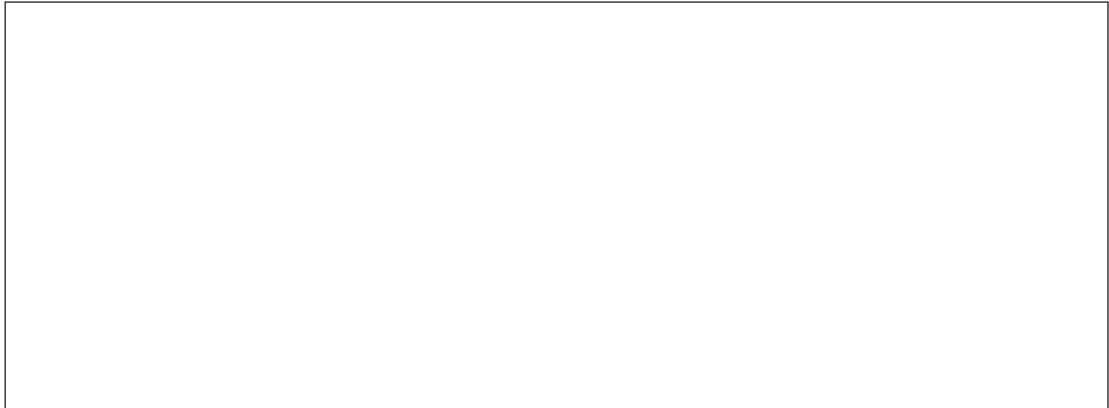
3 (b) Draw and name a mechanism that will change rotary motion into oscillating motion. Label all parts for 4 marks.
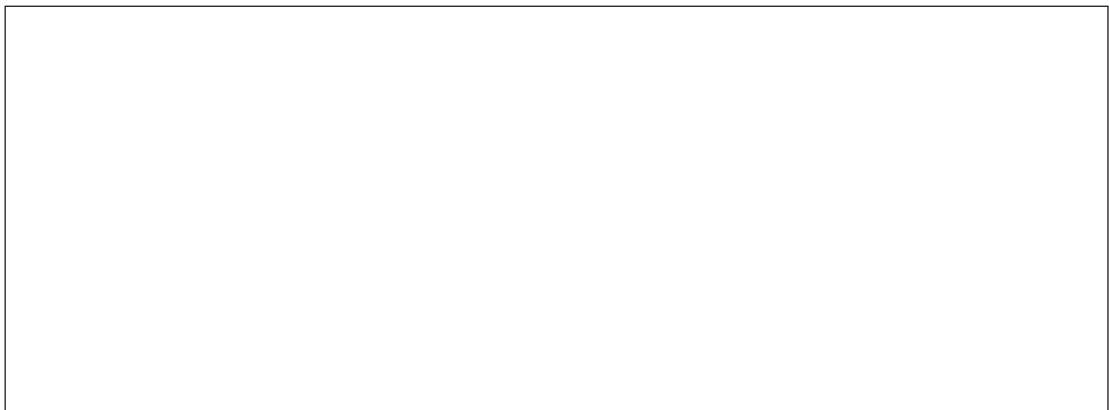
(4 marks)

3 (c) Draw and name a mechanism that will transfer rotary motion through 90°. Label all parts for 4 marks.

(4 marks)

3 (d) Draw and name a mechanism that will increase or decrease the speed of rotation. Label all parts for 4 marks.

(4 marks)

18

Turn over ▶

You are advised to spend about 15 minutes on this question.

4 This question is about a car windscreen wiper system.

4 (a) On the diagram below draw a mechanism that connects the motor to the wipers so that the two wipers move continually in the required motion.

Wiper pivots

Motor output shaft
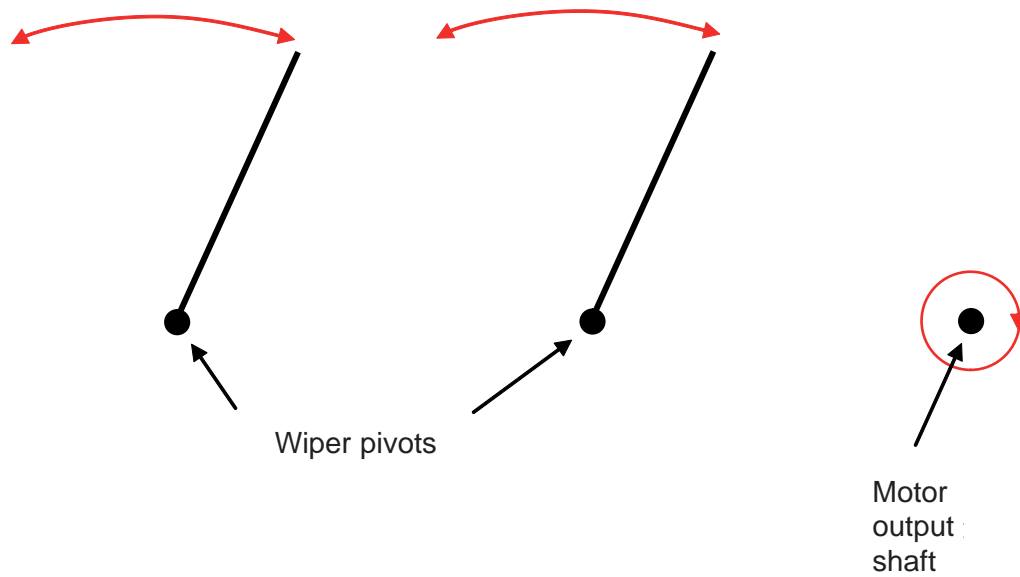
Marks will be awarded for:

- adding labels to the diagram
- moving a wiper
- moving a wiper in correct motion
- moving both wipers in correct motion
- moving both wipers continuously
- drawing neatly in proportion.

(6 marks)

The car windscreen wiper system uses a cam and a switch so that the wipers always stop at the bottom of the windscreen when the driver turns them off.

4 (b)   Design a cam that will ensure that the wipers always stop at the same position.

- The switch should only be operated for a quarter of a turn
- Draw the cam outline between the dotted guide circles

Switch

Shaft

Direction
of rotation
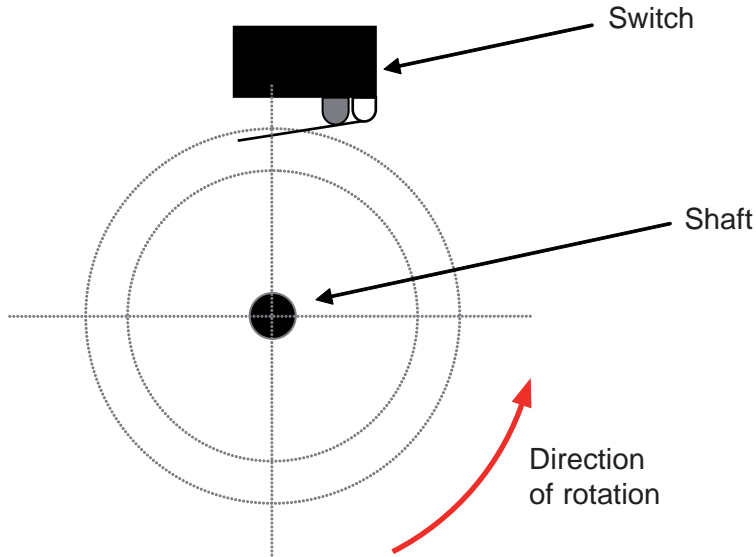
(4 marks)

4 (c)   Name the switch shown above.

....

(1 mark)

4 (d)   On the circuit below connect the motor and both switches to the power supply to ensure that the wipers operate when the Cam switch **or** the Drivers switch is ON. Both switches are shown not operated (OFF).

+12V

Cam switch

M

Driver's switch

0V

(5 marks)

16

Turn over ▶
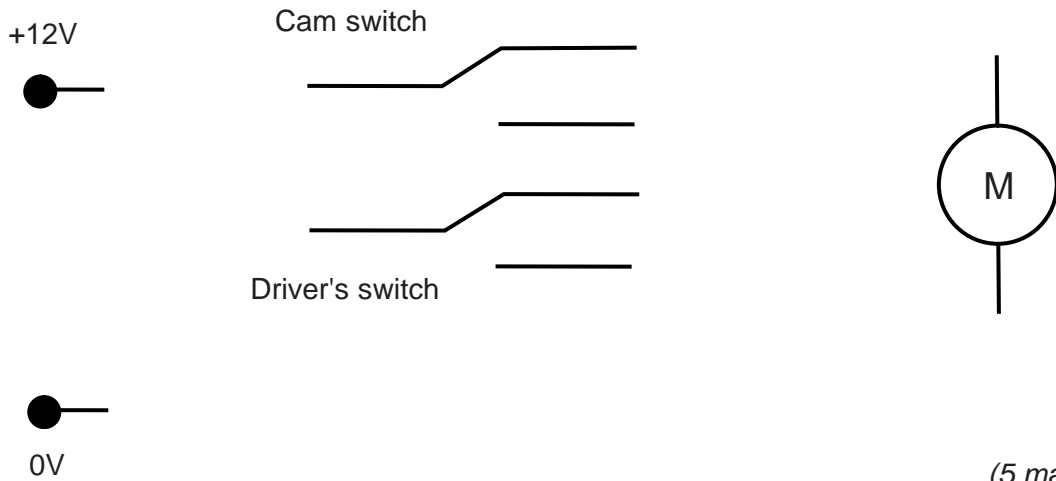
You are advised to spend about 20 minutes on this question.

5 This question is about a simple coffee vending machine.
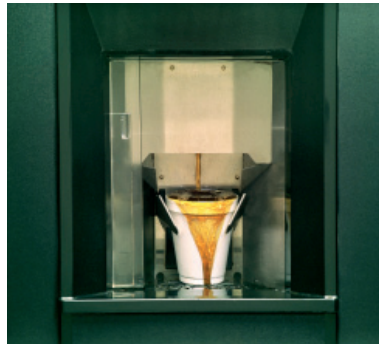
© GettyImages

5 (a) List two Health & Safety requirements for a coffee vending machine.

1 ....

....

2 ....

....

(4 marks)

5 (b) The hot water valve is controlled by the coffee vending machine control system.
Name the most suitable component to operate the valve.

....

(1 mark)

5 (c) The control system is running on a PIC (microcontroller).
On the diagram below show the connections between the PIC and the component that operates the valve (component A).

You should also name any other components used.

Vs

Component
A

From PIC

V0
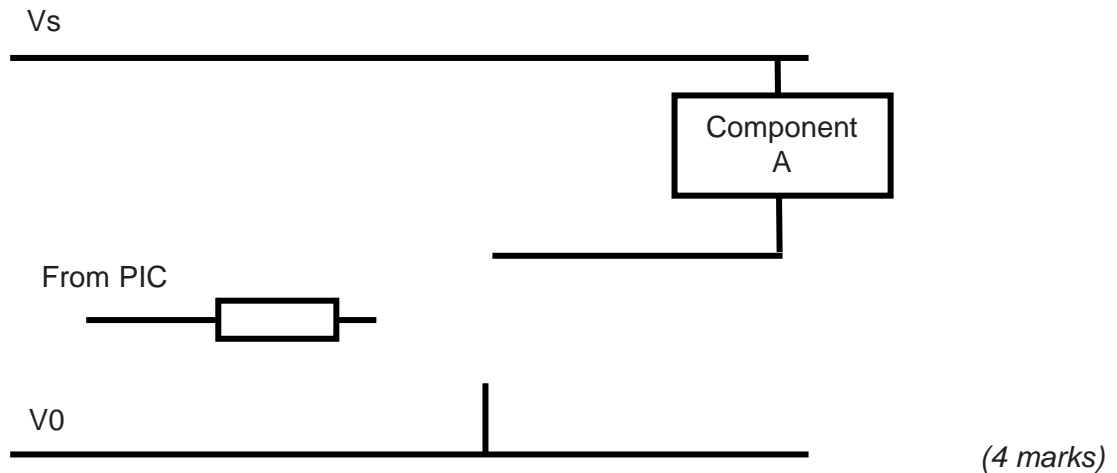
(4 marks)

5 (d) (i)   The coffee vending machine operates as follows.

The machine waits for the customer to insert a 50p coin and then drops a cup.

Draw a simple flowchart to show how this would be represented.

START
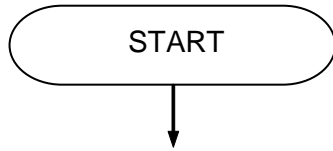
(3 marks)

5 (d) (ii)   If the customer presses the Sugar button the machine adds sugar.

Draw a simple flowchart to show how this would be represented.

(4 marks)

Question 5 continues on the next page

Turn over ▶

5 (d) (iii) The vend subroutine is shown below.
Describe the operation of the subroutine.

Vend

Valve ON

Wait 5 seconds

Valve OFF

Return

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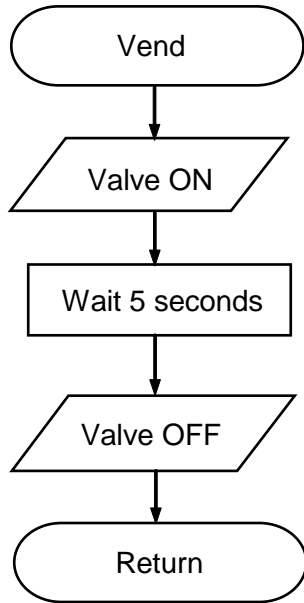
(3 marks)

5 (d) (iv) Explain the advantage of using subroutines in complex programs.

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(2 marks)
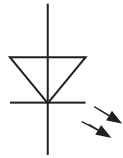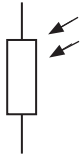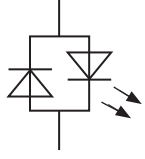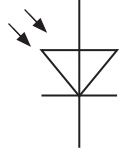
21

You are advised to spend about 15 minutes on this question.

6 This question is about components.

6 (a) Identify the following component symbols.

Symbol	Component Name

(6 marks)

Question 6 continues on the next page

Turn over ▶

6 (b)   Calculate the value of the total resistance of the following resistors in series.

4K7   10K

Formula ....

....
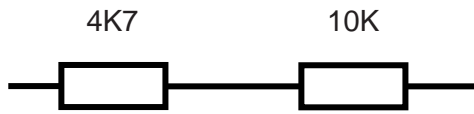
Calculation ....

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....

....

....

Answer ....

....

(4 marks)

6 (c)   Name this component.

Symbol	Photo

....

....

(2 marks)

6 (d) The circuit below is a light sensor.

The resistance of the LDR is 5KΩ and the resistance of the fixed resistor is 10KΩ.

Calculate the output voltage (V2) when Vs is 9 Volts.
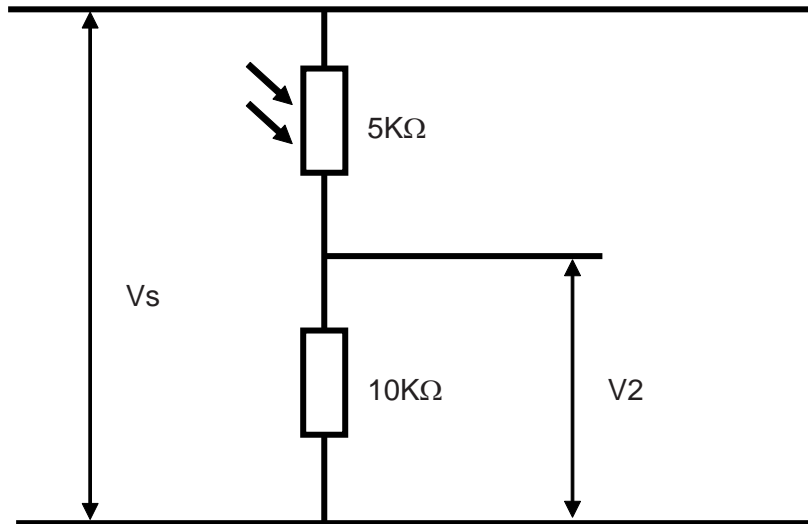
Formula ....

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Calculation ....

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Answer ....

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(4 marks)

16

Turn over ▶
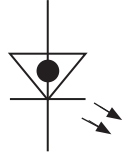
You are advised to spend about 15 minutes on this question.

7 This question is about fault finding on printed circuit boards.

7 (a) Tick the box below the joint that has been correctly soldered.
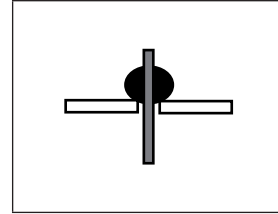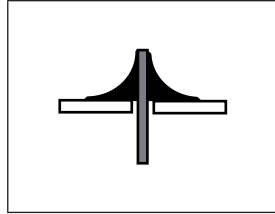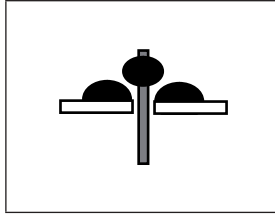
(1 mark)

7 (b) Name two different types of electronic test equipment.

Type 1 ....

....

Type 2 ....

....

(2 marks)

7 (c) Describe how to find faults in a printed circuit board.

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(8 marks)

7 (d) Describe two possible problems of shipping faulty goods to customers.

Problem 1 ....

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Problem 2 ....

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....

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(4 marks)

15

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED