	For Examiner's Use	
	Examiner's Initials	
Question	Mark	
1		
2		
3		
4		
5		
6		
TOTAL		

AQA

General Certificate of Secondary Education
June 2011

Design and Technology: 45651
Systems and Control Technology

Unit 1   Written Paper

Wednesday 22 June 2011   9.00 am to 11.00 am

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 book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 120.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.
- Quality of Written Communication will be assessed in Question 6 (b).

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You may use the following information when answering the questions.

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 $MA = \dfrac{\text{Load}}{\text{Effort}}$

Section A

Answer **all** questions.

Question 1   You should spend about 35 minutes on this question.

This question is about the design development of a control system for the interior light in a two door car.

1 (a)   This part of the question is about research.

The layout of a research plan for the car interior light system is shown below.

Complete the diagram below by adding suitable research sources and stating the information that you would hope to find. The materials section has been completed for you.

Existing solutions

A materials catalogue

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

Car Interior Lights

Existing product analysis
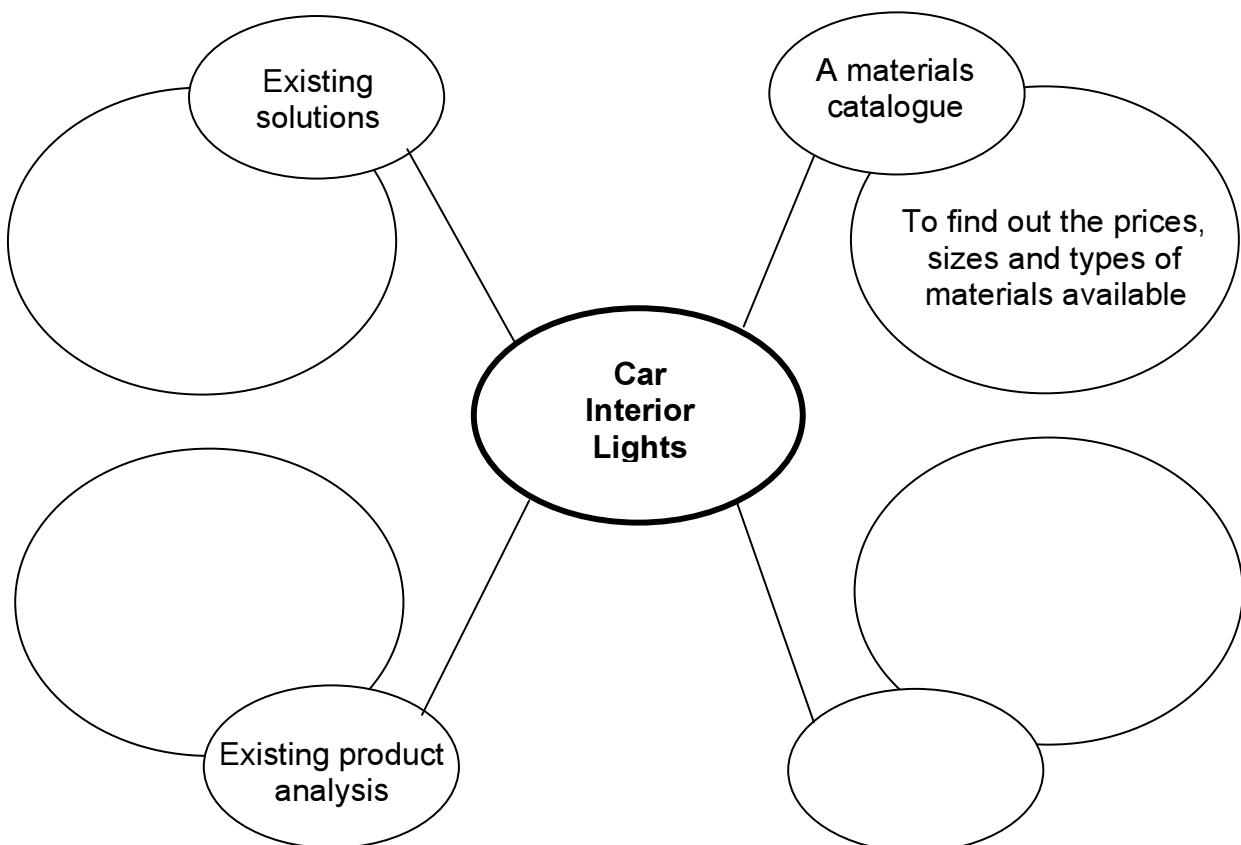
(4 marks)

Question 1 continues on the next page

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1 (b)   The first stage is to produce a Design Specification.

Describe **three** issues which you need to consider before you begin to design the control system for the interior light.

For **each** issue give:

- specification point   *(3 × 2 marks)*
- an explanation.   *(3 × 2 marks)*

An example has been given to help you.

Specification point   *When should the light come on?*
Explanation   *The interior light should only be ON when either car door is open.*

1 Specification point ....

....

Explanation ....

....

2 Specification point ....

....

Explanation ....

....

3 Specification point ....

....

Explanation ....

....

1 (c)   Circle the most suitable switch to detect that the door is open.

Tilt	Key	Micro Switch	Reed Switch

(1 mark)

1 (d)   The light should only come ON when both of the following occur:

- either car door *opens*
- it is *dark*

Door	Open	1	Shut	0
Light Sensor	Light	1	Dark	0

Using only logic gates, design a logic circuit that will operate the interior light correctly.

Marks will be awarded for:

- logic gates symbols   *(3 marks)*
- inputs to gates   *(5 marks)*
- output to light   *(1 mark)*
- neatness.   *(1 mark)*

Light Sensor

Door 1

Door 2

Light ON
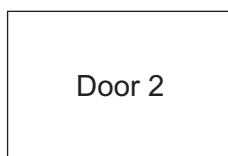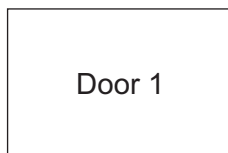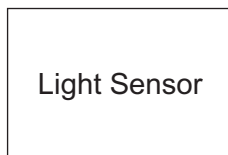
Question 1 continues on the next page

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1 (e) (i) The light should come ON when either door is opened, stay on for 10 seconds and then turn OFF.

Design a system block diagram to show this.

INPUT   PROCESS   OUTPUT

(5 marks)

1 (e) (ii) Describe **three** extra user features that could be added to this simple system.

1 ....

....

2 ....

....

3 ....

....

(3 marks)

35

Section B

Answer **all** questions.

Question 2   You should spend about 20 minutes on this question.

This question is about identifying components and stating if they are analogue or digital.

2 (a)   Give the component name for the following electronic components.

Tick (✓) a box to show whether the component is analogue or digital.
Two boxes have been completed for you.

No.	Component	Component name	Analogue	Digital
1		Thermistor		
2				✓
3				
4				
5				
6				
7				

(12 marks)

Turn over ▶

2 (b)   Circle the method that MP3 players use to store music tracks.

Analogue	Digital	FER	Logic

(1 mark)

2 (c)   Clocks can have either analogue or digital displays to show the time.

2 (c) (i)   Sketch a clock with an analogue display.

(1 mark)

2 (c) (ii) Sketch a clock with a digital display.

(1 mark)

2 (d)   Electronic data can be recorded and stored in either digital or analogue format.

2 (d) (i)   Give **one** advantage of recording data in a digital format.

....

....

....

....

(2 marks)

2 (d) (ii)   Give **one** advantage of recording data in an analogue format.

....

....

....

....

(2 marks)

19

Turn over for the next question

Turn over ▶

Question 3   You should spend about 20 minutes on this question.

This question is about drive systems.

3 (a)   On **each** of the following diagrams, sketch and label suitable drive systems to connect the shafts.

Make sure that the shafts rotate in the correct direction and at the correct speed.

In **each** case name the drive system used.

3 (a) (i)   Two shafts rotating in close proximity, in *opposite* directions, at the *same* speed

500 rpm   500 rpm
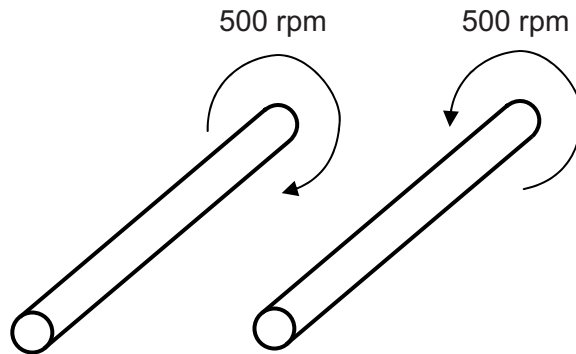
(3 marks)

3 (a) (ii) Name the drive system used.

....

....

(1 mark)

3 (a) (iii) Two shafts rotating a distance apart, in the *same* direction, at the *same* speed

500 rpm   500 rpm
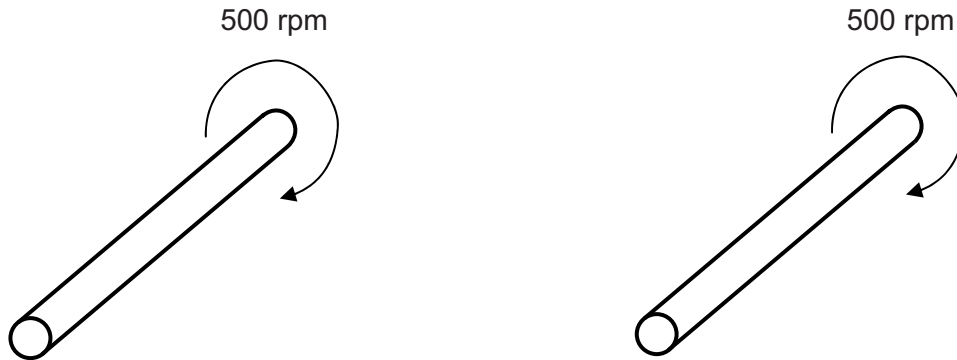
(3 marks)

3 (a) (iv) Name the drive system used.

....

....
(1 mark)

3 (a) (v) Two shafts rotating in close proximity, in *opposite* directions, at *different* speeds

500 rpm   1000 rpm
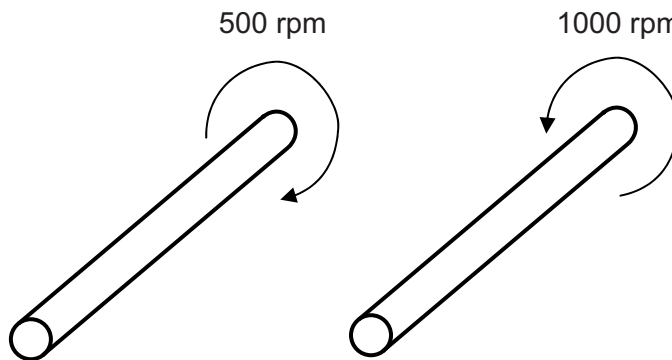
(3 marks)

3 (a) (vi) Name the drive system used.

....

....
(1 mark)

Turn over ▶

3 (a) (vii) Two shafts rotating at 90° to each other, in *opposite* directions, at the *same* speed

Note: The shafts are drawn in 2D to simplify your sketch.

500 rpm

500 rpm
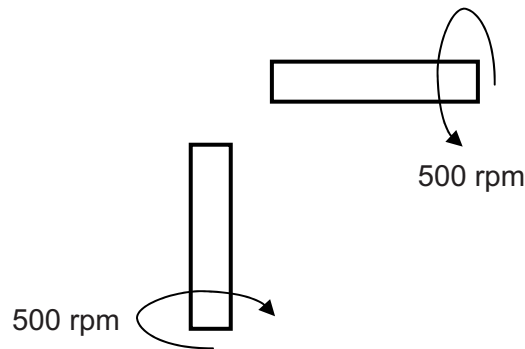
(3 marks)

3 (a) (viii) Name the drive system used.

....

....
(1 mark)

3 (b) Friction can be an advantage or a disadvantage.

3 (b) (i) Give an example and explain why friction can be an *advantage* in a drive system.

....

....

....

....
(2 marks)

3 (b) (ii) Give an example and explain why friction can be a *disadvantage* in a drive system.

....

....

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....
(2 marks)

20

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED**

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Question 4   You should spend about 20 minutes on this question.

This question is about a washing machine control system model.

The washing machine model is made from plywood and has:

- a door that opens and shuts
- a button to start the simulated wash
- a door lock to stop the door opening
- a geared motor to turn the wash drum
- an LED that lights to show that the drum is turning.

4 (a) (i)   Suggest a suitable plastic for the window in the door.

....

....
(1 mark)

4 (a) (ii)   Explain why the plastic you have named is suitable.

....

....

....

....
(2 marks)

4 (a) (iii) Suggest a suitable component to operate the door lock.

....

....
(1 mark)

4 (a) (iv) On the diagram below, show how the door lock component you have named is mounted to the body of the washing machine. Show how the component locks the door.

Marks will be awarded for:

- a component mounted correctly (1 mark)
- a component able to lock the door (1 mark)
- a good quality labelled sketch of the component. (2 marks)

Plan view

Pivot

Door of washing machine
5 mm plywood

Body of washing machine
5 mm plywood
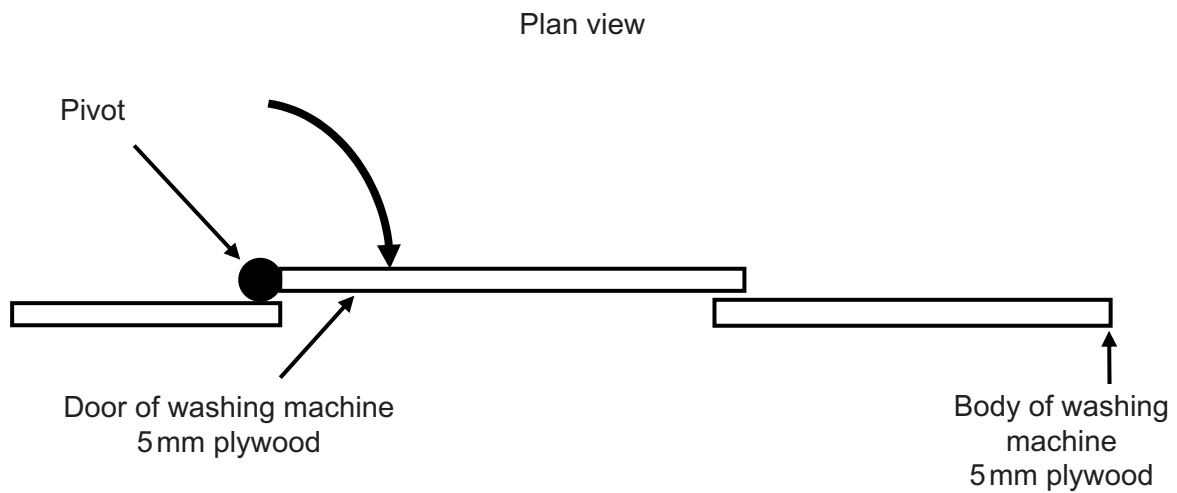
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4 (b) The operation of a temperature control system is as follows:

- the user presses the start button switch to start the wash cycle
- the system checks that the door is shut
- if shut, the door locks
- the LED goes ON
- the motor turns the drum for 30 seconds
- the LED goes OFF
- the door unlocks
- the system waits for the next push of the start button.

Complete the flowchart (opposite) of the program for the micro controller by adding:

- each correct output state of the decision boxes   *(4 marks)*
  (use 1 for Yes and 0 for No)

- each correct connecting line. There are three missing lines.   *(3 marks)*

- the following statements to the correct Process Boxes   *(7 marks)*
    – Lock OPEN
    – LED OFF
    – LED ON
    – Motor ON
    – Lock CLOSE
    – Wait 30 seconds
    – Motor OFF

START

Start button pressed ?

Door shut ?

Wash

Wash

End

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17
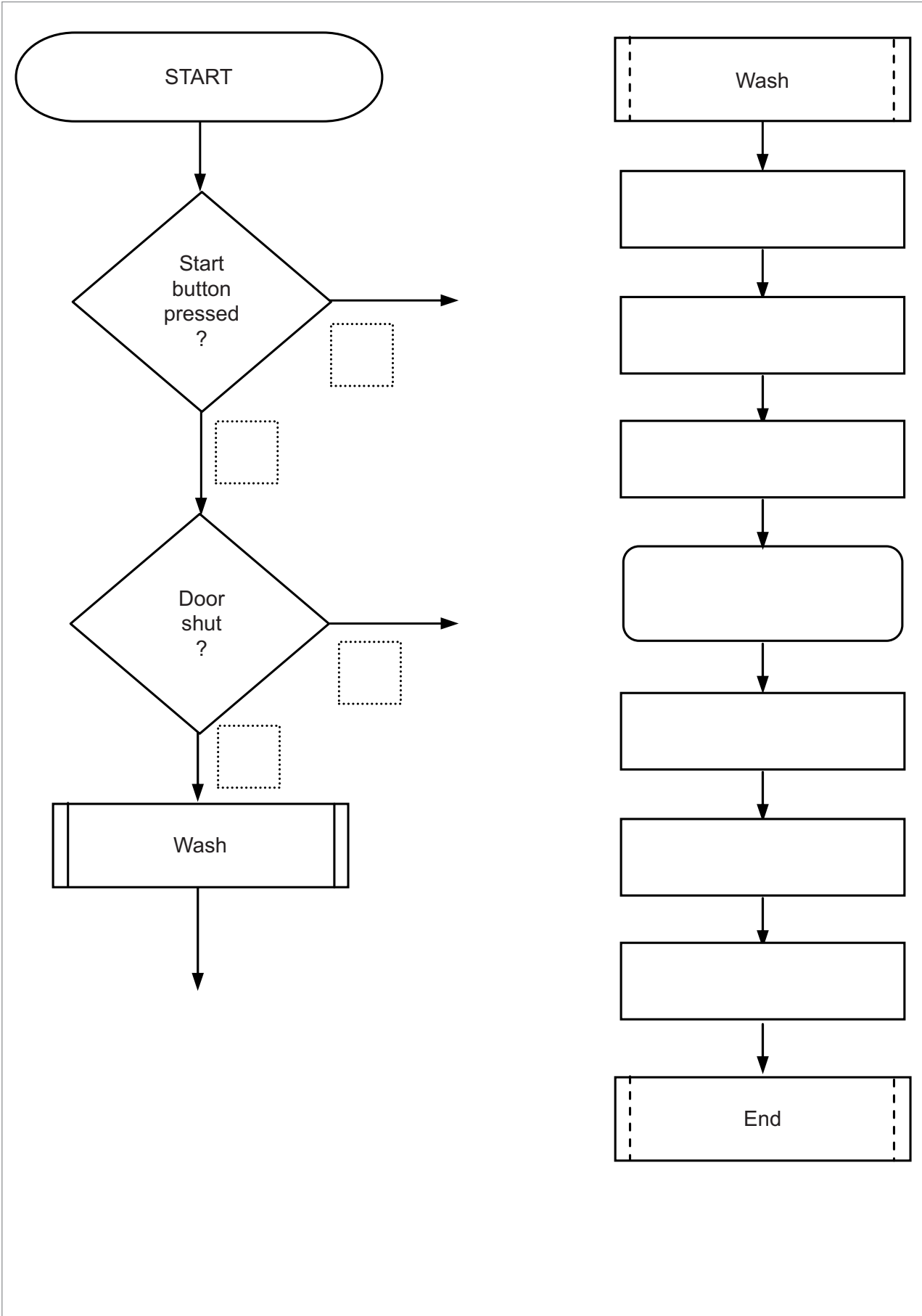
Question 5   You should spend about 15 minutes on this question.

This question is about the Health and Safety and maintenance issues affecting commercial passenger lifts.

5 (a)   Explain **two** safety features that a commercial passenger lift control system should contain.

Give a reason for each feature.

5 (a) (i)   Feature 1 ....

....

(1 mark)

5 (a) (ii)   Reason for Feature 1 ....

....

(1 mark)

5 (a) (iii)   Feature 2 ....

....

(1 mark)

5 (a) (iv)   Reason for Feature 2 ....

....

(1 mark)

5 (b)   Explain **two** maintenance tasks that should be carried out on a commercial passenger lift.

5 (b) (i)   Task 1 ....

....

(1 mark)

5 (b) (ii)   Explanation of task 1 ....

....

....

....

....

(2 marks)

5 (b) (iii)   Task 2 ....

....

(1 mark)

5 (b) (iv)   Explanation of task 2 ....

....

....

....

....

(2 marks)

5 (c)   Explain **one** safety procedure taken when the maintenance is carried out.

5 (c) (i)   Safety procedure ....

....

(1 mark)

5 (c) (ii)   Explanation of safety procedure ....

....

....

....

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(2 marks)

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Turn over ▶

Question 6   You should spend about 10 minutes on this question.

This question is about the design of a system to sense a person standing in a lift doorway.

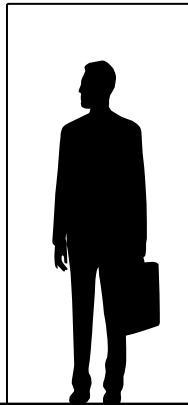The system should be activated without the person touching it.

6 (a)   Add a suitable system to the drawing below.

Your system must show:

- a recognizable system   *(1 mark)*

- the ability to detect a person without being touched   *(1 mark)*

- components well drawn and labelled.   *(1 mark)*

Lift doorway

6 (b)   Describe the full operation of the system opposite and explain why it would be used.

You should

- explain how the system senses a person
- refer to the components that you have drawn
- explain how it is used to improve safety.

You will be tested for quality of written communication in this part of the question.

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(8 marks)

11

END OF QUESTIONS

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