Surname				Other	Names			
Centre Nur	nber				Candidate Number			
Candidate Signature								

For Examiner's Use

ASSESSMENT and QUALIFICATIONS ALLIANCE

Monday 9 June 2008 1.30 pm to 3.30 pm

General Certificate of Secondary Education

(SYSTEMS AND CONTROL TECHNOLOGY)

#### For this paper you must have:

**DESIGN AND TECHNOLOGY** 

• a pen, a pencil, a ruler, an eraser and a pencil sharpener.

Time allowed: 2 hours

#### Instructions

June 2008

Written Paper

**Higher Tier** 

- Use black ink or black ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer seven questions. Answer all the questions from Section A. Answer one question from Section B.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- · Show the working of your calculations.

#### Information

- The maximum mark for this paper is 125.
- The marks for questions are shown in brackets.
- A list of formulae and other information, which you may wish to use in your answers, is provided on page 2.
- All dimensions are given in millimetres unless otherwise stated.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use						
Question	Mark	Question	Mark			
1		5				
2		6				
3		7				
4		8				
Total (Column 1)						
Total (Column 2) —						
TOTAL						
Examine	Examiner's Initials					



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You may use the following information when answering the questions.					
Pneumatics	Force = Pressure	Force = Pressure × Area			
Ratio of Simple Gears	Gear Ratio = <u>Num</u> Num	ber of teeth on driven gear ber of teeth on driver gear			
Velocity Ratio	Velocity Ratio = $\frac{D}{D}$	Velocity Ratio = Diameter of driven pulley Diameter of driver pulley			
	Output speed = $\frac{1}{Ge}$	Output speed = Input speed Gear/Velocity ratio			
Forces	Moments = Force	Moments = Force × Distance			
	Sum of clockwise m	noments = sum of anti-clockwise moments			
Series Resistance	$R_{T} = R_{1} + R_{2} + R_{3}$				
Parallel Resistance	$\frac{1}{R_{T}} = \frac{1}{R_{1}} + \frac{1}{R_{2}} \text{ OR}$	$\frac{1}{R_{T}} = \frac{1}{R_{1}} + \frac{1}{R_{2}} \text{ OR } R_{T} = \frac{R_{1} \times R_{2}}{R_{1} + R_{2}}$			
Potential Difference	V=I × R	$V = I \times R$			
Transistors	Current Gain = $\frac{Cc}{E}$	Current Gain = Collector Current Base Current			
Amplifier Gain	Av = Change in ou Change in inp	Av = Change in output voltage Change in input voltage			
Area of circle = $\pi$ r <sup>2</sup>	<i>π</i> = 3.142				
Resistor Colour Code		E12 Resistor preferred values			
ColourNumberBlack0Brown1Red2Orange3Yellow4Green5Blue6Violet7Grey8White9	Number of Zeros 0 00 000 0,000 00,000 000,000 0,000,00	10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and decades thereafter.			







# SECTION A

Answer **all** questions in this section.

1 This question is about the design process.

The owner of the theme park has asked you to design an Automated Mascot to welcome visitors to the theme park.

(Automate - control or operate automatically)

#### 1 (a) Analysis

List **two** factors that you should think about when designing the Automated Mascot and give a reason why each is important. An example has been given.

Example:

Factor – The likely cost of the whole project.

Reason – So that it can be built at a reasonable price.

Factor 1
Reason 1
Factor 2
Reason 2
(4 marks)



## 1 (b) Research

The layout of a research plan for the Automated Mascot is shown below.

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





1	(d)	Design Specification
		Give four design requirements for your Automated Mascot.
		Example
		Function
		Requirement The Mascot must welcome visitors.
		ExplanationBy waving.
		Appearance
		Requirement
		Explanation
		Materials
		Requirement
		Explanation
		Safety
		Requirement
		Explanation
		Durability
		Requirement
		Explanation







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Study the information given in your **Design Specification** from Question 1.

Use this information to sketch **two** different design ideas for an Automated Mascot for the theme park.

You must show:

- function
- appearance
- materials
- safety
- durability
- which parts move.

Marks will also be awarded for:

- quality of sketches
- quality of notes.

#### Idea 1

(6 marks)



(2 marks) (2 marks)

Evaluation of <b>Idea 1</b>	
Explain how your design meets the requirements of the specification.	
Function	
Appearance	
Materials	
Safety	
Durability	
	(5 marks
	(6 marks
Evaluation of Idea 2	
Explain how your design meets the requirements of the specification.	
Function	
Appearance	
Materials	
Safety	
Durability	
	(5 marks
	Turn ove





3 This question is about developing the system using mechanisms or pneumatics. Choose one of your ideas for development.

Tick the box to show which idea you would choose.

Idea 1

3 (a) It was decided that the Automated Mascot should have an electronic sensor to start the movement when a visitor approached it.

> Using notes and sketches, show clearly how an electronic sensing device could detect a visitor.

Only show the 'sensing input' system for detecting the visitor.

Marks will be awarded for:

- a suitable electronic system to detect a visitor
- quality of sketches and notes describing the operation.

**3** (b) Using notes and sketches, show clearly details of the system that moves the Automated Mascot.

Note:

- the mascot should move continuously
- you should show details of the mechanism and motor or pneumatic cylinder and valve(s)
- show only the moving part of the mascot
- show the paths of all movement.

Marks will be awarded for:

- suitable system to move part of the mascot (10 marks)
- quality of notes and sketches describing the operation. (2 marks)

Note – if using pneumatic valves, do **not** draw pneumatic symbols. Use labelled boxes for the valves.



#### Turn over ►



4 This question is about programming PICs to run a roller-coaster loading station.

When the operator presses the button, Car 1 rolls onto the ride and, once it is clear, Car 2 rolls into Position A.



The whole process is controlled using a Peripheral Interface Controller (PIC) chip. The loading track is on a slight slope so that the cars roll forward when their brake is lowered.

The Sensor is ON when there is a car above it.

The Sensor should be checked before Brake 2 is lowered.

A 10 second delay is required to allow Car 1 to move away before Car 2 rolls forward. The process is a Repeatable/Continuous Operation.

On page 14 write a sequence of instructions that would act as the control program for the above roller-coaster loading system.

Operational instructions to be used.

Brake 1	ON	(UP)
	OFF	(DOWN)
Brake 2	ON	(UP)
	OFF	(DOWN)
Sensor	ON	
	OFF	
Operator Button	ON	
	OFF	



Assume that the cars are in the position in the diagram on the previous page and that both Brakes are UP at the start.

Marks will be awarded for:

•	correct sequence	(6 marks)
•	correct use of the sensor	(2 marks)
•	correct use of a delay	(2 marks)
•	continuous operation.	(2 marks)

## Question 4 continues on the next page



Turn over ►

14							
Answer on this page. You may answer using written instructions <b>or</b> as a flow chart.							
Written Instructions	Flow Chart						
		START					
		¥					

19			
20			
21			
22			



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Turn over ►

5 This question is about logic and operating a moving target.

A stall holder gives a prize if the customer knocks down all three targets.



Targets

### In this system

- three push switches operate the system
- there is a push switch attached to each target
- the bulb should only come ON when all three targets are knocked down.

Input	State	Output
Push Switch	Target Down	1
F USH SWITCH	Target Up	0
Dulh	ON	1
מוטם	OFF	0

**5** (a) Using **two** logic gates, construct a circuit in the space opposite to join the three push switches to the bulb. Each logic gate should have two inputs.

Marks will be awarded for:

•	logic gates symbols	(2 marks)
•	inputs to gates	(4 marks)
•	output to bulb	(1 mark)
•	quality of drawing.	(1 mark)







Turn over ►

5 (b) Design a system to stand the target back up automatically when the operator resets the game. Draw a mechanical or pneumatic system in Space B that will stand the target back up. The system will need to allow the target to fall when hit. Note: the side view of only one target is shown opposite, which is in the down position the target will remain upright against the stop some of the detail of the target has been omitted for clarity. Marks will be awarded for: a system able to lift the target to the vertical (3 marks) (3 marks) a system able to allow the target to fall when hit a suitable mounting of the system (1 mark) the quality of notes describing the operation. (4 marks) Notes describing the operation ..... ..... ..... .....







6	This	This question is about health and safety issues for a roller-coaster system.		
6	(a)	List <b>three</b> risks that an error in the roller-coaster system could cause.		
			(3 marks)	
6	(b)	List <b>two</b> safety checks the operator should do every morning before the public use the ride.	. ,	
			(2 marks)	
6	(c)	Suggest how passengers could escape safely from the carriage if the ric at the top.	de stops	
			(2 marks)	
6	(d)	State <b>two</b> regular maintenance operations for the roller-coaster.		
		1		
		۷	(2 marks)	



6	(e)	State <b>two</b> procedures that would ensure the safety of the passengers whilst on the ride.	
		1	
		2	
		2	
		END OF SECTION A QUESTIONS	
		Turn over for Section B questions	
		Turn over ►	



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## SECTION B

Answer either Question 7 (below) about mechanisms

or Question 8 (page 25) about pneumatics.

Do **not** answer both questions.

# EITHER

- 7 This question is about a mechanism for a bat in a ghost train.
- 7 (a) Draw a cam mechanism in **Box A** opposite that will make the bat move up and down continuously.

Note:

- the bat should stay down for half a revolution and then rise up and lower back down
- the bat is drawn at its lowest position
- use the rotary motion of the motor shaft to turn the mechanism.









Do not answer Question 8 if you have answered Question 7.

# OR

- 8 This question is about a pneumatic system for a bat in a ghost train.
- 8 (a) Design a pneumatic system that will make the bat move up and down continuously.

Note:

- the bat should move continuously
- the bat is drawn at its highest position.

















