ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Design and Technology

Systems & Control Technology
Unit SCT1

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Quality of Written Communication

The following marks are allocated to the quality of the candidate's written communication. Make a separate assessment of the candidate's overall ability as demonstrated across the paper using the criteria given below.

Performance Criteria	Marks
The candidate will express complex ideas extremely clearly and fluently. Sentences and paragraphs will follow on from one another smoothly and logically. Arguments will be consistently relevant and well structured. There will be few, if any, errors of grammar, punctuation and spelling.	4
The candidate will express moderately complex ideas clearly and reasonably fluently, through well-lined sentences and paragraphs. Arguments will be generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling.	3
The candidate will express straightforward ideas clearly, if not always fluently. Sentences and paragraphs may not always be well connected. Arguments may sometimes stray from the point or be weakly presented. There may be some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.	2
The candidate will express simple ideas clearly, but may be imprecise and awkward in dealing with complex or subtle concepts. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling may be noticeable and intrusive, suggesting weaknesses in these areas.	1

NB This mark scheme is intended as a guide to the type of answer expected but is not intended to be exhaustive or prescriptive. If candidates offer other answers which are equally valid **they must be given full credit.**

Many responses at this level are assessed according to the **quality** of the work rather than the number of points included. The following level descriptors are intended to be a guide when assessing the quality of a candidate's response.

The candidate has a basic but possibly confused grasp of the issues.
Few correct examples are given to illustrate points made. Description may be unclear.

(low mark range)

The candidate has some knowledge but there will be less clarity of understanding.
Some correct examples given to illustrate points made. Description better but unclear or confused in parts.

(mid mark range)

The candidate has a thorough understanding of the issues and has provided relevant examples to support the knowledge shown. This candidate's answer shows clear evidence of understanding.

(high mark range)

Question 1

(a) Potential divider – LDR, resistor and centre tapping (3 marks)
LDR correctly positioned. (1 mark)

(b) Any suitable method of driving the motor in two directions. E.g. relay reversing circuit, transistor bridge driver, L293D IC etc. Full marks can only be gained by showing how the LDR is connected/controls the motor reversing circuit. (10 marks)
Correct symbols and clarity of diagram. (2 marks)

(c) Any six valid responses relating to two methods of producing permanent circuit boards. (2 x 3 marks)

E.g.
Stripboard
Etch-resistant pen on copper clad board
Rub-down transfers on copper clad board
Photo-etch printed circuit board production process
Milling of copper clad board using CNC milling machine

(d) Suitable calculations to show requirement for 3:1 Gear Ratio, created from a 40/20 x 30/20 compound gearbox. (4 marks)
Annotated sketch of above compound gearbox. (2 marks)

(e) Circumference = π x d = 3/14 x 50 = 157mm (2 marks)
Linear speed mm/min = 157mm x 100rpm = 15700 mm/min (1 mark)
Linear speed in m/min = 15700/1000 = 15.7 m/min (1 mark)
Linear speed in m/s = 15.7/60 = 0.26 m/s (2 marks)

(f) Any three valid responses for each type of motor. (6 marks)

E.g.
Stepper motors are more expensive than DC motors
Stepper motors require complex drive circuitry
Stepper motors move precise distances each pulse
Stepper motors can lose steps at high step speeds
Stepper motors cannot rotate as fast as DC motors.
DC motors have backlash in the gearboxes
DC motors are difficult to stop instantaneously
DC motors are electrically 'noisy'.

Total 40 marks

Question 2

(a) Suitable sketch of worm and worm wheel. (3 marks)

Any two valid responses for the use of a worm and worm wheel in this application. (2 x 2 marks)

E.g.
Reference to high hear ratio giving compact gearbox.
Reference to fact that worm wheel cannot drive the worm i.e. safety feature.
Reference to the need for lubrication of the gearbox.
Quality of sketch. (1 mark)

(b) Gear Ratio = Worm wheel : Worm (1) = 40:1 (1 mark)
Output speed = Input speed x Gear Ratio (1 mark)
Output speed = 200 rpm x (1/40) (1 mark)
Output speed = 5 rpm (1 mark)

(c) Any two valid methods of transmitting rotary motion through 90º. E.g. Bevel gears, Mitre Gears, Pulley and (Round) Belt, etc. (2 x 4 marks)
Quality of sketches. (2 x 1 mark)

(d) Any three valid safety obligations with regard to the operation of the lift. (3 x 2 marks)

E.g.
The lift should not descend uncontrolled in the event of a power failure.
The lift should be able to carry the stated weight with a suitable factor of safety
The control buttons of the lift should be clear and simple to operate.
The doors should have sensors so they cannot trap passengers.
Etc.

Total 28 marks

uestion 3

(a) Suitable annotated sketch of a crank and slider mechanism. (3 marks)
Indication that distance moved by slider is related to the distance from the centre of the crank to the con-rod pivot point. (1 mark)
Indication of pivot point between con-rod and slider to give reciprocating motion. (1 mark)
Clarity of sketch. (1 mark)

(b) Any appropriate comparisons or contrasts, with explanation, between the two systems. (6 marks)

E.g.
Solenoids can produce reciprocating motion directly.
There are no pivot points to wear in a solenoid.
It is difficult to get solenoids to extend after retracting.
There is a very small movement from the solenoid plunger.
A linkage would be required to amplify the movement of the solenoid.

Crank and sliders can generate a large reciprocating motion.
The motor driving the crank will need a gearbox.
A solenoid would be more expensive than a motor for a crank and slider.

(c) Any suitable mechanical/electrical/electro-mechanical method of sensing rotations. (3 marks)
Clarity of sketch. (1 mark)

(d) Any suitable method of counting 50 revolutions of the crank then stopping the crank. E.g. mechanical, electro-mechanical, electronic, electro-pneumatic etc. (10 marks)
Clarity of diagram. (2 marks)

Total 28 marks

Question 4

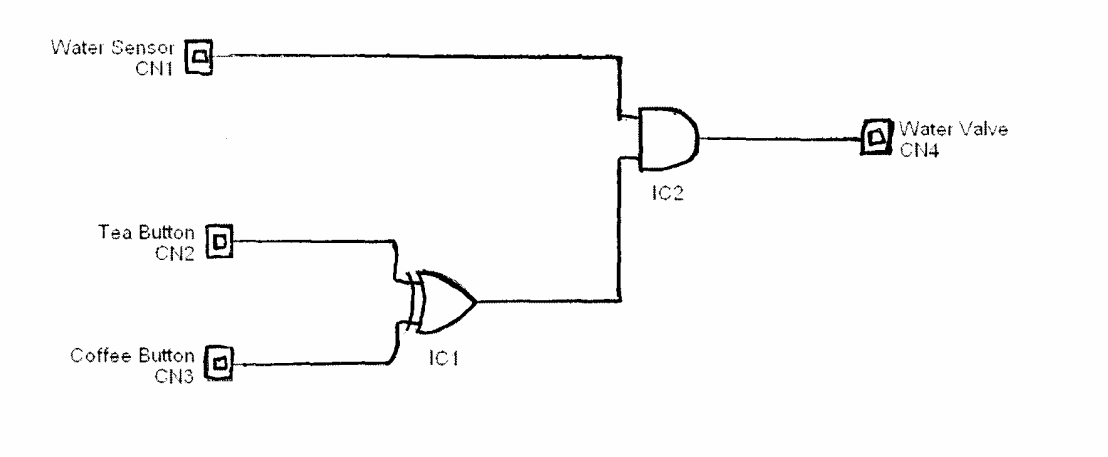
(a) Suitable truth table for above circuit (8 marks)

E.g.

Water Sensor	Tea Button	Coffee Button	Water Valve
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

(b) Any suitable electronic logic circuit. (Simpler Circuit shown below)

E.g.



Water sensor	(1 mark)
Tea button	(1 mark)
Coffee button	(1 mark)
2-input AND gate	(1 mark)
2-input XOR gate	(1 mark)
Output from XOR gate connected to AND gate	(1 mark)
Output from AND gate marked as valve	(1 mark)
Clarity of logic diagram	(1 mark)

(c) Any four valid points for each prototyping system (2 x 4 marks)

E.g. Breadboard
Requires 'real' components
Time consuming to wire up complex circuits
Fault finding can be difficult on large circuits
Relatively low-cost method of prototyping.
Gives an indication of the size of the finished circuit
Gives a better idea of what the end product will look like

E.g. Circuit Simulation Software

Does not require the purchase of 'real' components
Requires expensive computer hardware to operate
Fault finding easier to undertake than on Breadboard
Simulation of components only as good as the parameters built into the software.

(d) Any valid description of making a logical decision within a control system. (4 marks)

E.g. Series/Parallel Switches, Pneumatic Valves, Computer Simulation etc. **Total 28 marks**