ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCE

Electronics

Unit ELE4

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Registered address: Addleshaw Booth & Co., Sovereign House, PO Box 8, Sovereign Street, Leeds LS1 1HQ
Kathleen Tattersall: *Director General*

ELE4 – Electronic Control Systems

1 (a) (i) data in ROM cannot be changed, data in RAM can be✓
ROM retains data after power is removed, Ram looses data✓ etc.

max (1 mark)

(ii) basic input and output instructions ✓
basic operating system commands ✓
any sensible response

(2 marks)

(b) (i) A bus is a collection of wires along which data is sent and received and to which each section of the microcomputer system is connected ✓

(1 mark)

(ii) Buses are used to reduce the number of connection routes needed ✓

(1 mark)

(iii) To enable data to pass to and from the microprocessor (or RAM etc) ✓

(1 mark)

(c) (i) Memory mapped ports are decoded as memory addresses and accessed as memory elements ✓

(1 mark)

(ii) I/O mapping has its own separate control line (or commands) to indicate an address is an I/O port. ✓
I/O mapping does not take up memory allocation (addresses) ✓

(2 marks)

(Total 9)

2 (a) (i) a, b, c, d, g ✓

(1 mark)

(ii) D_0, D_1, D_2, D_3 and D_6 ✓
i.e. 01001111 (or 79_{10}) ✓
giving 4F ✓

(3 marks)

(b) (i) 60mA ✓

(1 mark)

(ii) **5 LEDs => 5 x 1.9 = 9.5V** ✓
voltage across R approx. **15 - 9.5 = 5.5V** ✓
=> R = 5.5 / 0.06 = 91.7Ω ✓

max (2 marks)

(iii) **Power = V x I = 5.5 x 0.06** ✓
=>**Power = 0.33W** (accept 0.5 or 1W) ✓

(2 marks)

(Total 9)

3 (a) (i) Digital to Analogue Conversion ✓

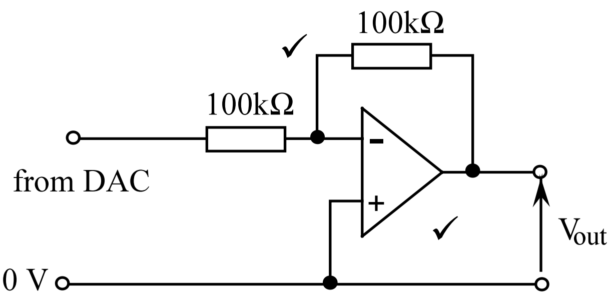
(1 mark)

(ii) 12.75V / 255 ✓

=> change in output for a change of 1 in the input is 0.05V (50mV) ✓

(2 marks)

(iii)



(2 marks)

(b) (i) **start:** is a label ✓

(1 mark)

(ii) sends the integer variable **N%** to the output port 378_{16} ✓

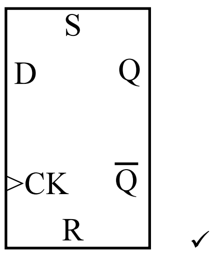
(1 mark)

(c) Enter a number greater than 255 or less than 0 ✓ ✓

(2 marks)

(Total 9)

4 (a) (i)



(1 mark)

(ii) whatever value is put on D is transferred to Q ✓

only on the rising edge of the clock pulse ✓

(2 marks)

(b) (i) three possible output states ✓

0, 1, high impedance ✓

(2 marks)

(ii) to isolate the outputs from the two 4 bit latches ✓

(1 mark)

(c) (i) Neural networks have lots of very basic processors whereas a PC has a few complex processors ✓

data is stored through a neural network, whereas a PC stores it centrally ✓

(2 marks)

(ii) justified reason e.g. No, because ANNs only predictive and are not able to do accurate measurements ✓

(1 mark)

(Total 9)

5 (a) (i) Whole system built in a single IC ✓

PICs have separate instruction bus ✓

(appropriate and sensible response)

max (1 mark)

(ii) Sensible answer e.g. cheap and very versatile ✓

(1 mark)

(b) Closed loop when system monitors the output and uses state of output to control the input (feedback) ✓ eg.
Filling with water requires the amount of water to be monitored and stopped at the required amount - could not do by time because of variation in water pressure ✓
Heating could not be done by time because of variation in input water temp ✓

max (2 marks)

(c) (i) Negative feedback is where information from the output is used to adjust the input so that the output remains steady ✓

(1 mark)

(ii) If the speed is too fast the input drive to the motor will be reduced and vice versa if the speed is too slow ✓

(1 mark)

(d) (i) thermistor ✓

(1 mark)

(ii) thermistor is part of a voltage divider circuit which produces a voltage dependent upon the temperature of the thermistor. ✓
The op-amp compares this voltage with that from the PIC/AVR and produces a low output when the voltage from the voltage divider exceeds that from the PIC/AVR ✓

(2 marks)

(Total 9)

6 (a) To clean up the pulses,(restoring the logic levels and sharp rise and fall times) ✓

(1 mark)

(b) (i) When the output is at 0V, the voltage divider connected to point A consists of a 47kΩ resistor at the top and two 47kΩ resistors in parallel at the bottom ✓
Combined resistance at bottom is 23.5kΩ ✓
Voltage divided into ratio of 2:1 => voltage at point A = 4V ✓

(3 marks)

(ii) When output is 12V, there are two 47kΩ resistors at the top of the voltage divider and one 47kΩ resistor at the bottom ✓
Combined resistance at top is 23.5kΩ ✓
Voltage divided into ratio of 1:2 => voltage at point A = 8V ✓

(3 marks)

(iii) Op-amp has a very large open loop voltage gain so acts as a comparator ✓
When the input rises above 8V, the inverting input to the op-amp is greater than the non-inverting input, so the output goes to 0V ✓
Similarly when the input voltage goes below 4V when the output is at 12V ✓

max (2 marks)

(Total 9)

7 (a) MOSFET or transistor with coils in drain/collector circuit. ✓
Input to gate or base (with series resistor) ✓
Protection diode for MOSFET/transistor correctly placed ✓

(3 marks)

(b) (i) A 4 pole stepper motor rotates 7.5^{o} as each successive coil is energised, so with four coils energised in sequence it rotates 30^{o} ✓

(1 mark)

(ii) Reverse the sequence ✓
so that D_3 is energised first, then D_2, then D_1 then finally D_0 ✓

(2 marks)

(iii) Alter the value of the **pause** ✓

(1 mark)

(c) (i) **OUT(&H378)**, is command to write what follows to the parallel port and **4** corresponds to making the bit D_2 logic 1 ✓

(1 mark)

(ii)

OUT(&H378), 1
GOSUB waitabit
OUT(&H378), 2
GOSUB waitabit
OUT(&H378), 4
GOSUB waitabit
OUT(&H378), 8
STOP ✓ ✓ ✓ ✓

(4 marks)

(d) (i) Polled is when the computer monitors a port by regularly reading its value ✓

(1 mark)

(ii) Interrupt; the computer performs other operations until an external device generates a signal, upon which the computer will stop what it is doing and service the interrupting device. It does not therefore need to continuously monitor the device unlike with polling. ✓

(1 mark)

(iii) Make the motor rotate one step at a time ✓
Read in the value of port (&H379) and examine bit 5 ✓
Repeat this until bit 5 is high, tube A is then aligned with the pipe ✓

(3 marks)

(e) It would be very difficult to make a conventional motor accurately rotate 30^{o} ✓

(1 mark)

(Total 18)

(Paper Total 72 marks)