# Mark scheme
# June 2003

# GCE

## Electronics

Unit ELE4

**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)
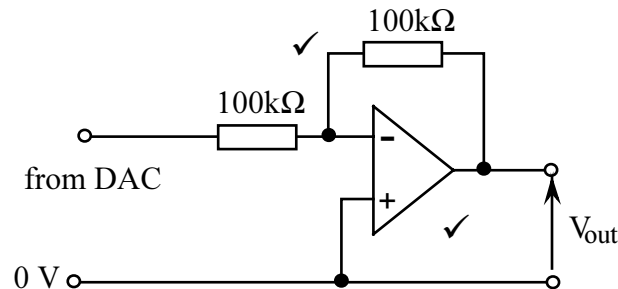


(2 marks)

(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)
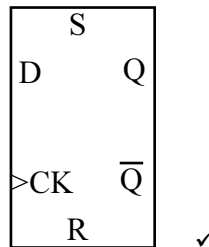


(1 mark)

(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 $47k\Omega$ resistor at the top and two $47k\Omega$ resistors in parallel at the bottom ✓
Combined resistance at bottom is $23.5k\Omega$ ✓
Voltage divided into ratio of 2:1 => voltage at point A = 4V ✓

(3 marks)

(ii) When output is 12V, there are two $47k\Omega$ resistors at the top of the voltage divider and one $47k\Omega$ resistor at the bottom ✓
Combined resistance at top is $23.5k\Omega$ ✓
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° ✓

                                                                    (1 mark)
                                                                    **(Total 18)**


                                                        **(Paper Total 72 marks)**