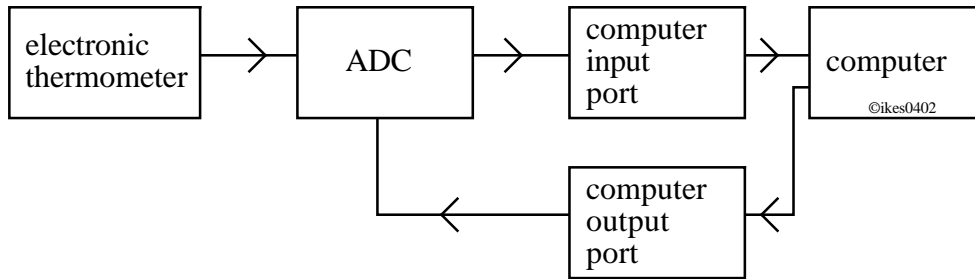
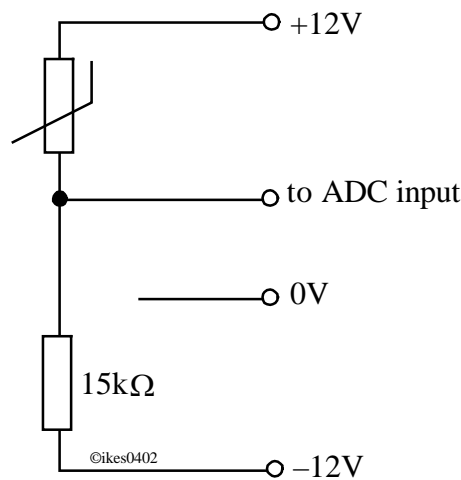


Programming and Interfacing revision.

- 1). As part of her A level Biology coursework a student is investigating how the temperature of a pond varies over a period of a week. She wants to record the temperatures every hour and so designs a computer system to automatically make and record the measurements. The system diagram is shown below.



- (a) The electronic thermometer sensor circuit diagram is shown below.



- (i) When the temperature of the thermistor is 0°C the voltage at the input of the ADC is 0V . Calculate the resistance of the thermistor?
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- (2)
- (ii) If the voltage at the input of the ADC is 2.5V at 25°C , calculate the resistance of the thermistor at this temperature.
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- (2)

- (b) (i) State and explain the purpose of the ADC sub-system.

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(3)

- (ii) Two common ADCs are the flash ADC and the digital ramp ADC. State one example where the use of each would be appropriate.

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(2)

- (iii) State one major advantage of the flash ADC compared with the digital ramp ADC.

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(1)

- (iv) State one major disadvantage of the flash ADC compared with the digital ramp ADC.

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(1)

- (c) The student decides to use an 8-bit digital ramp ADC.

- (i) Explain the meaning of the word *bit*.

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(1)

- (ii) How many different output values are possible from this ADC?

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(1)

- (iii) The output voltage from the thermometer varies from 0V at 0°C to 2.55V at 25.5°C. What is the minimum change in temperature that can be detected by the system?

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(2)

(d) The system diagram for the ADC is shown below.

(i) In the space below draw the circuit diagram for an 8-bit summing amplifier.

(ii) The digital inputs to the summing amplifier are either 0 or 5.0V. If the output voltage from the summing amplifier is -2.5V at a temperature of 25°C , what would be the output voltage at a temperature of 12.8°C ? (3)

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(iii) What digital input (in binary) to the summing amplifier is required to give this output voltage? (1)

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(1)

- (e) (i) Draw below the circuit diagram of an analogue inverter, labelling the input, the output and suitable component values.

- (ii) Why is an analogue inverter needed in this application? (4)

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- (iii) Explain how the complete ADC functions. (1)

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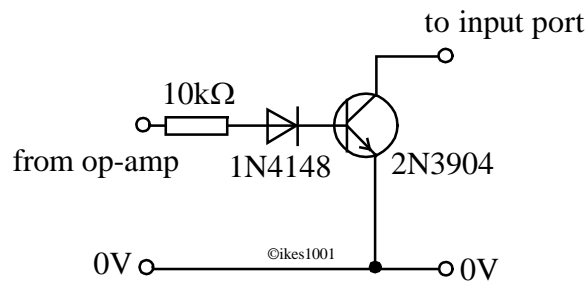
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- (iv) Each input of the input port of the computer has a pull-up resistor and so requires inputs to either be 0V or floating. The output from the op-amp is either +12V or -12V. Explain how the circuit below will interface the output of the op-amp to the input port of the computer. (4)



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(4)

(f) During a conversion by the ADC, the computer *polls* the input port.

(i) Explain what is meant by the term *polled*.

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(2)

(ii) Explain how polling differs from an *Interrupt* system.

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(2)

(iii) The ADC is connected to D6 of the input port which is addressed at &H379.

Explain the function of the QBasic statement:-

X% = INP (&H379) AND 64

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(2)

- (g) (i) List the operations that need to be made by the computer for the ADC to make a conversion.

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(4)

- (ii) Convert this list into a flow diagram.

(4)

- (h) (i) Explain what is meant by the term subroutine.

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(2)

- (ii) The subroutine to for the ADC to make the conversion is shown below. By each line explain its function.

adcstart:

X% = -1

increase:

X% = X% + 1

IF X% > 255 THEN RETURN

OUT (&H378), X%

Y% = INP (&H379) AND 64

IF Y% = 64 THEN RETURN

GOTO increase

- (j) The student wants to make temperature measurements every hour for a week.
 - (i) Calculate how many hours there are in a week.

(9)

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(2)

- (ii) A subroutine called **hour** transfers control to the subroutine **adcstart** every hour. What is the QBasic statement for transferring control to the subroutine **adcstart**

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(2)

- (k) The student decides to store the data in an array named **DATATEMP**.
 - (i) Explain what is meant by the term *array*.

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(2)

