



Complete, fold and seal
(see note 2 below)

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FORENAME(S): CAITLIN BETH

Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners may require legible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.

1	Student Number	2306892
2	Title of Examination Paper	MICROS PERIPHERALS AND INTERFACES
3	Module Code	ACDA4004
4	Date and Time of Examination	08/01/2025 9:00 - 11:00am
5	Examination Venue	SWANSEA 307
6	Seat Number	-

7	Number of Answer Books handed in	
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List the numbers of the questions you have attempted	Office Use
1	9
2	9
3	3
4	10
5	9
6	5
	45
	x2
Total	90%

9
9
3
10
9
5

45.

1a) RETURN - Return from subroutine. ✓

return to start (from subroutine) without moving the address. ✗ ?

11

1b) SLEEP - Sleep state. ✓

Set into low power idle 'sleep' state. No other instructions acted upon during this state BUT microcontroller remains powered on. ✓

2

2

1c) ADDLW - Add Literal and WREG. ✓

Perform mathematical addition of the given literal value (k) and the value held in the working register (WREG). ✓

2

2

1d) BCF F, b - Bit clear file

Clear bit of a given index (b) in the addressed file register (F). Clearing the bit will set it 'low' i.e. logic 0. ✓

2

2

1e) DECF - Decrement F

Decrement the value held in the addressed file register (F) by the value 1. ✓

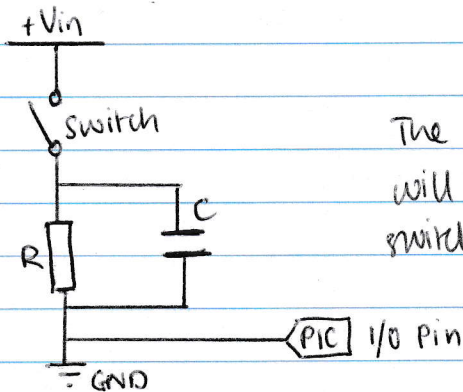
2

2

9

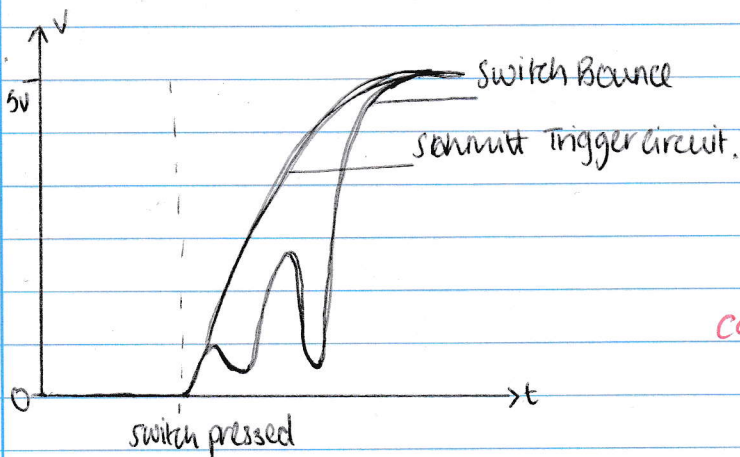
2)

The first hardware based solution to reduce the incidence of switch bounce is by adding a capacitor to the circuit. Since this forms an RC (Resistor - Capacitor) filter, there will be a delay on the signal from the switch to the PIC I/O pin. Since switch bounce is the rapid on/off motion due to the mechanical switch parts - but only exists for the first milliseconds - the added capacitor will stop the effect. An example circuit is given below.

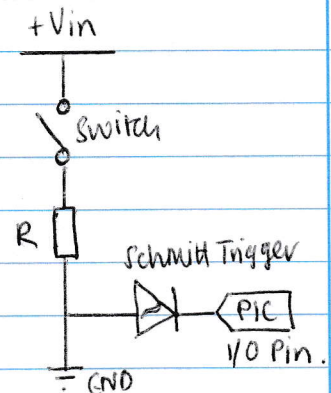


The resistor (R) and capacitor (C) values will be determined by the severity of the switch bounce and the circuit voltage.

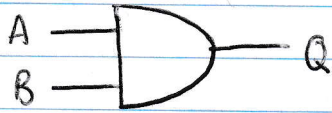
The second hardware based solution is to use a schmitt trigger. This is a particular type of diode which has a variety of uses - but in this case it will be used for signal conditioning (smoothing). The effect of this hardware addition and the circuit diagram are shown below.



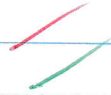
cap?



As can be seen in the graph above, the 'switch bounce' circuit will have a few peaks between the point of the switch being pressed and the input to the PIC pin reaching +5V. Alternatively, there is a single smooth rise when the schmitt trigger is used; it reaches +5V input in one smooth curve from 0V (at the point of the switch being pressed).

3) AND : $A \cdot B$ 

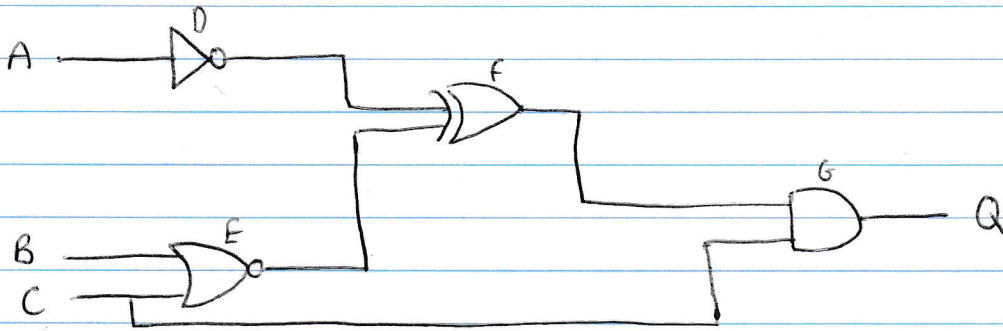
A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1



3

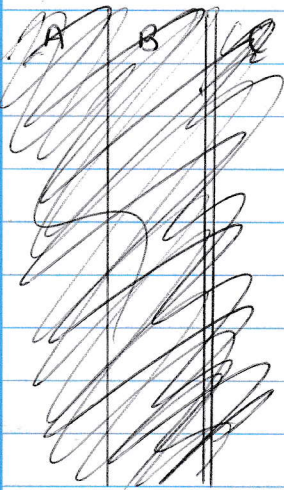
3

4a)



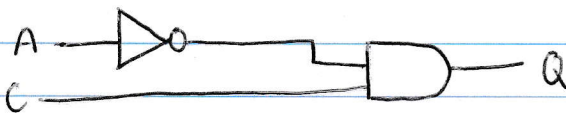
A	B	C	D	E	F	G	Q
0	0	0	1	1	0	0	0
0	0	1	1	0	1	1	1
0	1	0	1	0	1	0	0
0	1	1	1	0	1	1	1
1	0	0	0	1	1	0	0
1	0	1	0	0	0	0	0
1	1	0	0	0	0	0	0
1	1	1	0	0	0	0	0

4b)



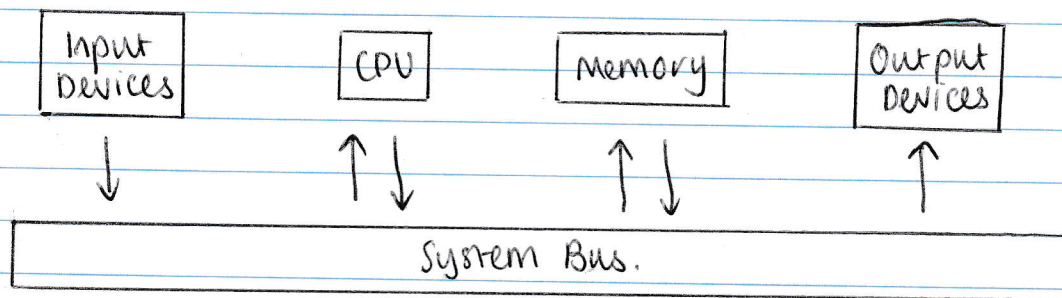
A	B	C	Q
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

The same result would be produced by $\bar{A} \cdot C$

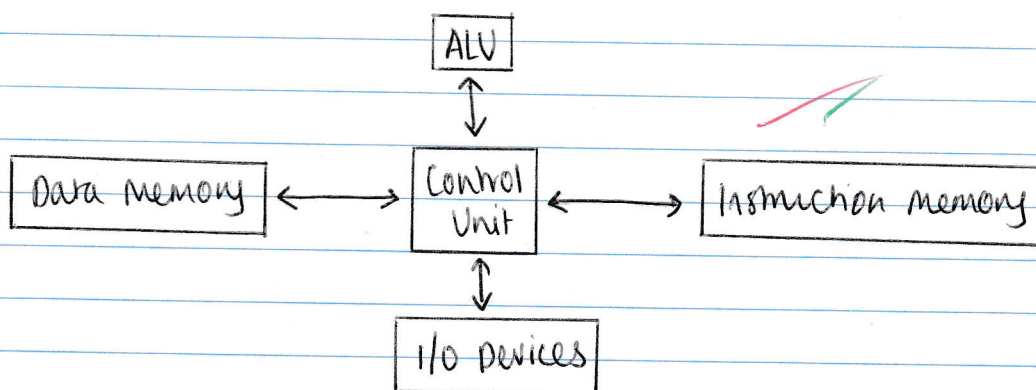


5)

Von Neumann has the advantage (over Harvard) as it's more flexible and less complex. The architecture is shown below.



Harvard has the advantage (over Von Neumann) as data and instructions have separate buses and memory allocation - instead of being shared in a Von Neumann. This means Harvard usually operates faster. The architecture is shown below.

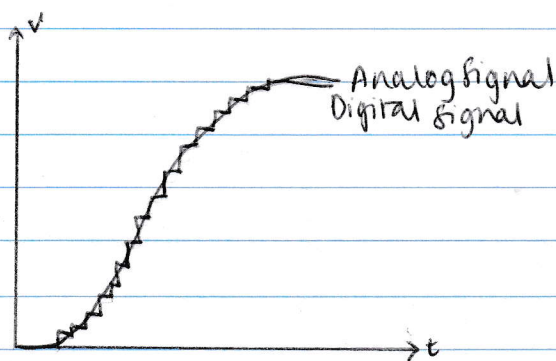


6)

DAC Principles

DAC stands for digital to analog converter - a device or system which converts a digital signal to an analog signal. This is a useful tool for applications such as driving analog devices - such as a motor - from a microcontroller output pin, which is digital. Digital signals can be synthesised to become analog by taking small squared pulses of a resolution sufficient for the analog signal control.

As an example, a sine wave and a digital stepped-square wave are compared on the graph below.



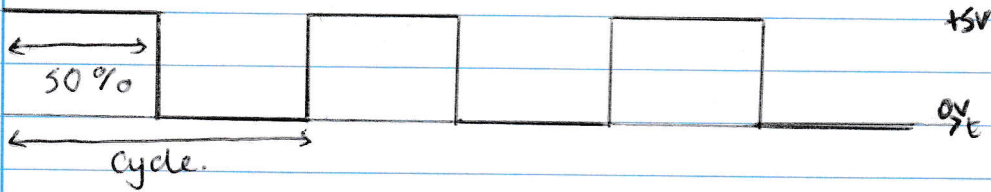
The accuracy of the DAC is determined by the number of input bits, for example you may have an 8-bit DAC with 8 input bits. The accuracy of the DAC, defined as the resolution, is also affected by the total voltage - as shown in the equation below.

$$\text{Resolution} = \frac{V_{\text{max}}}{(2^n - 1)} \quad \text{where } n \text{ is the number of input bits.}$$

PWM Principles

PWM stands for pulse width modulation - a digital signal technique that allows it to be converted to an analog signal. PWM involves the transmission of on/off 'pulsed' square waves. In a cycle, there is a period of time 'on' and then 'off'. The time 'on' is denoted by the duty cycle, which gives the percentage of time within a cycle that the signal is 'on'. An 'on' signal will be a high such as +5V (logic 1) and an 'off' signal will be a low 0V (logic 0) on the microcontroller pin.

A diagram of a PWM signal with a 50% duty cycle is shown below.



DAC using PWM

We can see from 'PWM principles' that the PWM technique produces the small squared pulses required for a DAC. This means that a PWM signal can be used to power an analog device directly or be incorporated into a more complex DAC system.

Taking the example of a motor - which requires an analog signal - we can use a PWM signal to power it. By programming the microcontroller with the cycle length (using the PIC timer TMRO) and the duty cycle, we can turn the motor. The cycle length ~~must~~ be adjusted to match that of the motor - the resolution must be accurate enough. With this in place, the duty cycle can then be adjusted to change the speed of the motor. A large duty cycle will cause it to spin quickly whereas a small duty cycle will cause it to spin more slowly.

Hence, it is shown that a PWM digital signal can be used as a simple DAC.

Smoothing?

3
+ 0
+ 2

5