

SURNAME:

REASON

FORENAME(S):

AARON

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold the flap over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners cannot read more illegible script or have it typed and the expense of typing will be 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.**

List the numbers of the questions you have attempted	Office Use
1	10
2	$3\frac{1}{2}$
3	3
4	2
5	9
6	4
	$3\frac{1}{2}$
	$\times 2$
Total	63%

$$\begin{array}{r} 10 \\ 31\frac{1}{2} \\ 3 \\ 2 \\ 9. \\ 4 \\ \hline 31\frac{1}{2} \end{array}$$

1.

a) RETURN - returns from the current Subroutine Setting Program Counter (PC) to Top of Stack (TOS)

2. 2

b) SLEEP - Sets the microcontroller to Sleep mode, which stops all logic and stops and resets the Watchdog timer

2
2

c) ADDLW - Adds a literal to the W register.

Given K, an 8 bit number, it will add ~~it~~ it to the value inside the working register and store the final value back in W

2
2

d) BCF F, b - ~~bit clears~~ bit clear f - given a file address, f, set a given bit, b, to 0. The final value is at f.

2
2

e) DECF - Decrement file. Given a file address f, decrement the value at that address. also, given d, destination, if d=0 store the final value in W, otherwise if d=1 store in file address. If the final value = 0, Z bit is set

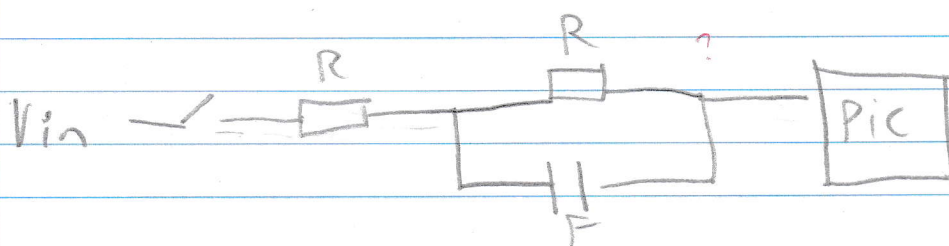
2
2

10.

2.

Method 1.

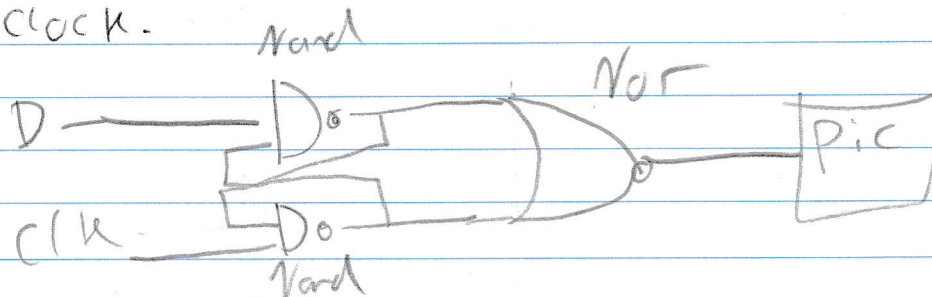
One method would be to use a capacitor which would only allow ~~current to flow after~~ ~~current to flow after~~ a sufficient amount of current to flow after 3-5 time constants (depending on target voltage for a high slope) which provides enough time for the switch to have stopped bouncing.

 $2\frac{1}{2}$ $2\frac{1}{2}$ 

Method 2.

Another method is to use a ~~Schmitt~~ ~~Schmitt~~ ~~Trigger~~ ~~Trigger~~.

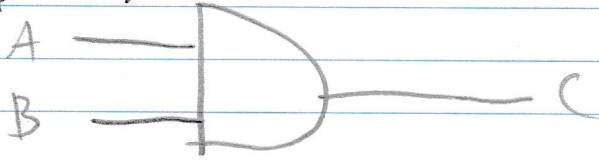
Another method would be to use a D type flip flop. This ~~requires~~ ~~requires~~ ~~requires~~ precise timing to ~~flip the value~~ ~~through bouncing~~ ~~as~~ this requires precise timing to flip the value, thus making it unlikely for a bounce to change the value stored. To change the value the voltage must be set high or low across D on the rising edge of the clock.



1.

 $3\frac{1}{2}$

3) AND Gate:



truth table:

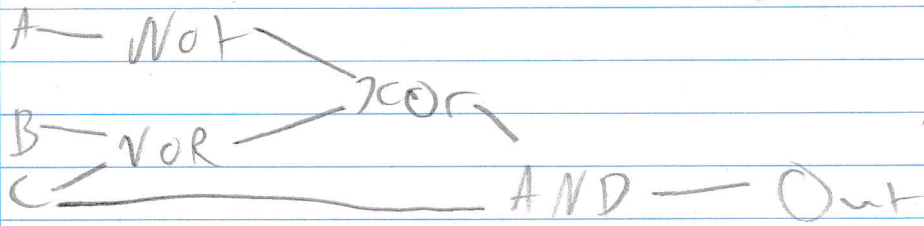
A	B	C
0	0	0
1	0	0
0	1	0
1	1	1

3

3

4)

a)



$$\text{Out} = \text{AND}(C, \text{XOR}(\neg A, \text{NOR}(B, C)))$$

$$\text{XOR} = \begin{array}{cc} a & b \\ 0 & 0 \\ 1 & 0 \\ 0 & 1 \\ 1 & 1 \end{array}$$

$$\text{NOR} = \begin{array}{cc} a & b \\ 0 & 1 \\ 1 & 0 \\ 0 & 1 \\ 1 & 0 \end{array}$$

A	B	C	Out
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

is $C=0$ $\text{Out}=0$ as AND is the single gate with C and another value

$$001 \rightarrow \text{NOR}(0,1)=0, \text{XOR}(1,0)=1, \text{AND}(1,1)=1$$

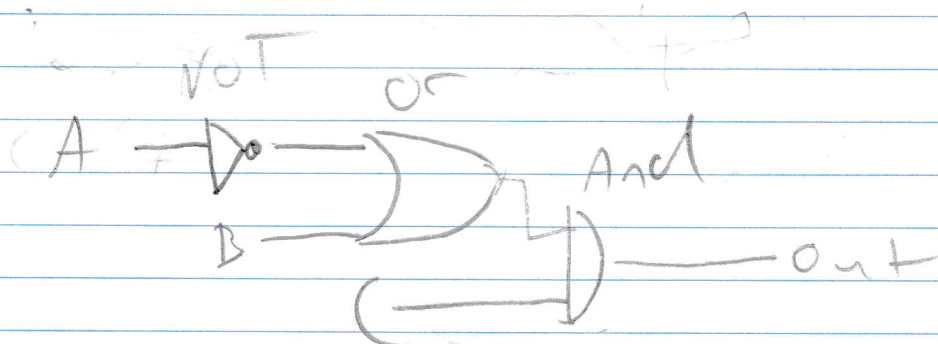
$$011 \rightarrow \text{NOR}(1,1)=0, \text{XOR}(1,0)=1, \text{AND}(1,1)=1$$

$$101 \rightarrow \text{NOR}(0,1)=0, \text{XOR}(0,0)=0, \text{AND}(0,1)=0$$

$$111 \rightarrow \text{NOR}(1,1)=0, \text{XOR}(0,1)=1, \text{AND}(1,1)=1$$

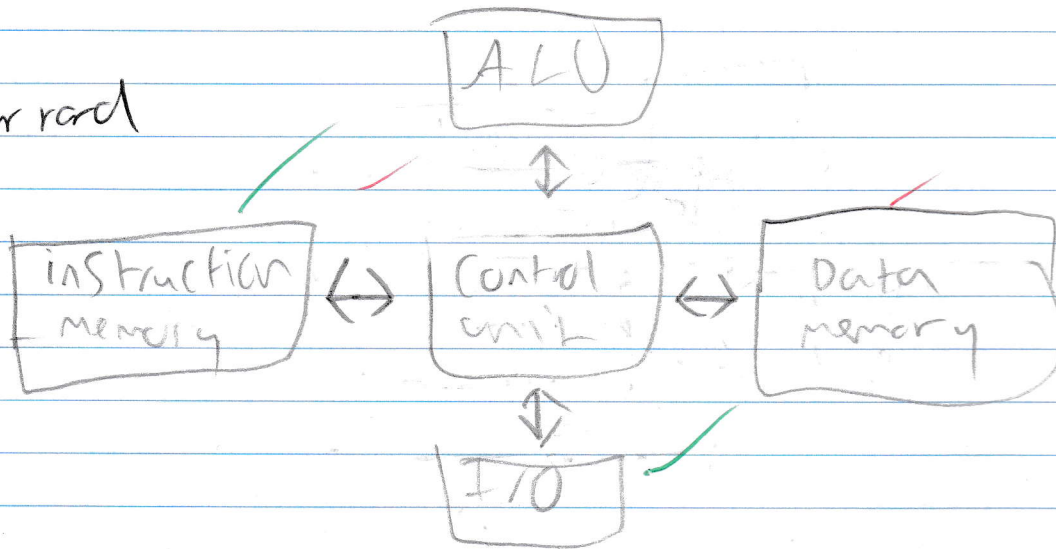
4)

b) a)



5)

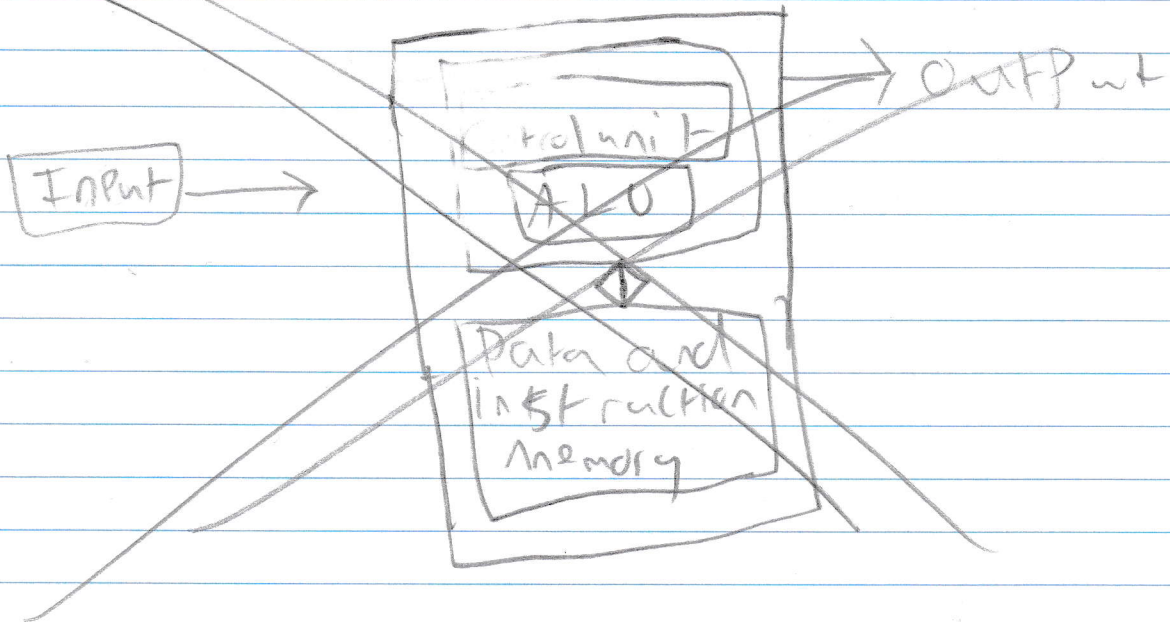
Harvard



4

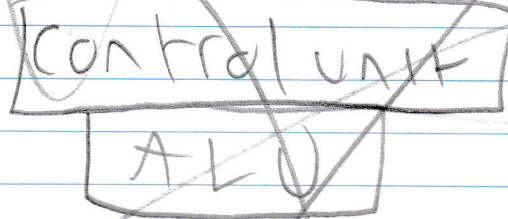
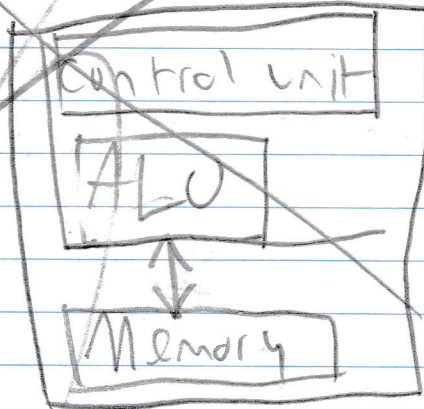
4.

~~Von Neumann~~

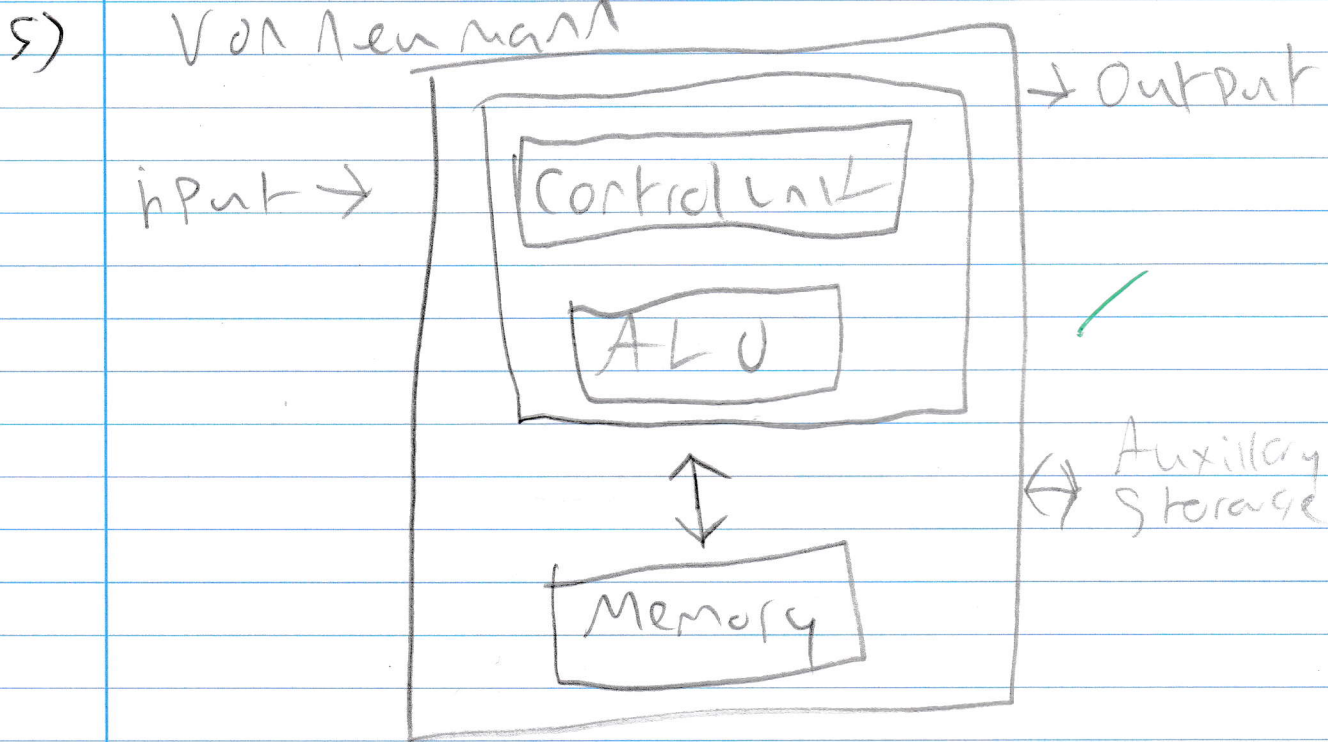


5) Von Neumann

input



Memory



Advantages :

Harvard :

as the instructions and data memory are separate, this allows for parallel execution of fetching and decoding, allowing for faster processing than the sequential fetch-decode of von neumann.

Von Neuman.

Von neuman is a simpler system than harvard as there is only one memory bank. This makes it better suited to ~~more~~ general computing devices like laptops or phones.

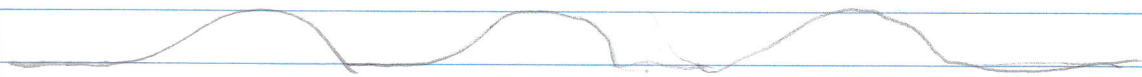
- 6) PWM produces an alternating high and low output voltage at a predetermined ~~frequency~~ duty cycle (how long it is high or low, aka frequency). This property can be used to charge and discharge a capacitor to produce varying levels of output depending on the duty cycle. In this case, a longer duty cycle will produce a higher peak value, but lower frequency in our analogue output

An example of how the results would look are as followed

PWM Signal:



Capacitor based circuit output



As shown, the output voltage produces an analogue signal due to its variance over time.