EE 354 **Name_____**
Hour Exam 3 **November 21, 2016**

1. The STM32F407vg has a 12-bit D/A converter which produces an output voltage of 0 to 3 volts. What binary number must be sent to the D/A to get an output of 0.75 volts?

2. An equation in C produces values which range from -4 to +12. We want to scale these values such that if they are sent to the D/A converter the output will be 0 to 3.3 volts. Write the scaling equation (in C) to output this range to the DAC_DHR12R1 register for the D/A.

3. If PA15 is set up as an input bit and PA1 is set up as an output bit, show how to copy PA.15 to PA1 in C.

4. An assembly language subprogram ends with the statement:

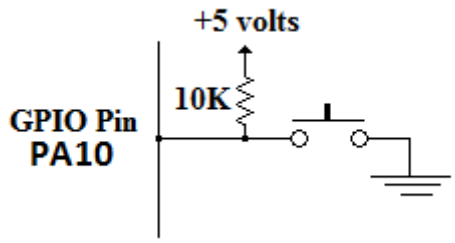
```
mov r15, r14
```

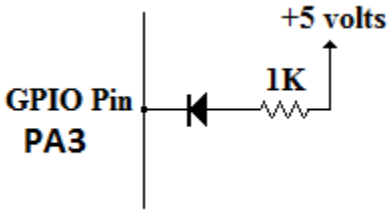
Why is there no return instruction?

5. On the ARM why do the following 2 instructions take the same amount of time to execute?
A) LSL R2, R2, 6; B) LSL R1, R3, 1;

6. Suppose the Baud Rate Register is set at 0x53F and the baud rate is measured with an oscilloscope and found to be 153 baud. What is the clock frequency of the processor.

7. A push button has been connected to PA10 and an LED had been connected to PA3. Write a C program to turn the LED on as long as the push button is closed. Your program should run in a forever loop. You may assume that PA10 is input and PA3 is output.





8. The program below is meant to be an embedded assembly routine titled *Mystery*. Answer the following questions.

A) Write a few sentences explaining what the program does.

```
__asm void Mystery(int x)
  {  MOVS R3, #0;
loop ADDS R3, R3, #1;
     CMP R0, R3;
     BGT loop;
     BX LR;
  };
```

B) How is the parameter *x* used, if it is used at all?

C) Give an example of a C-Statement that could call this subprogram.

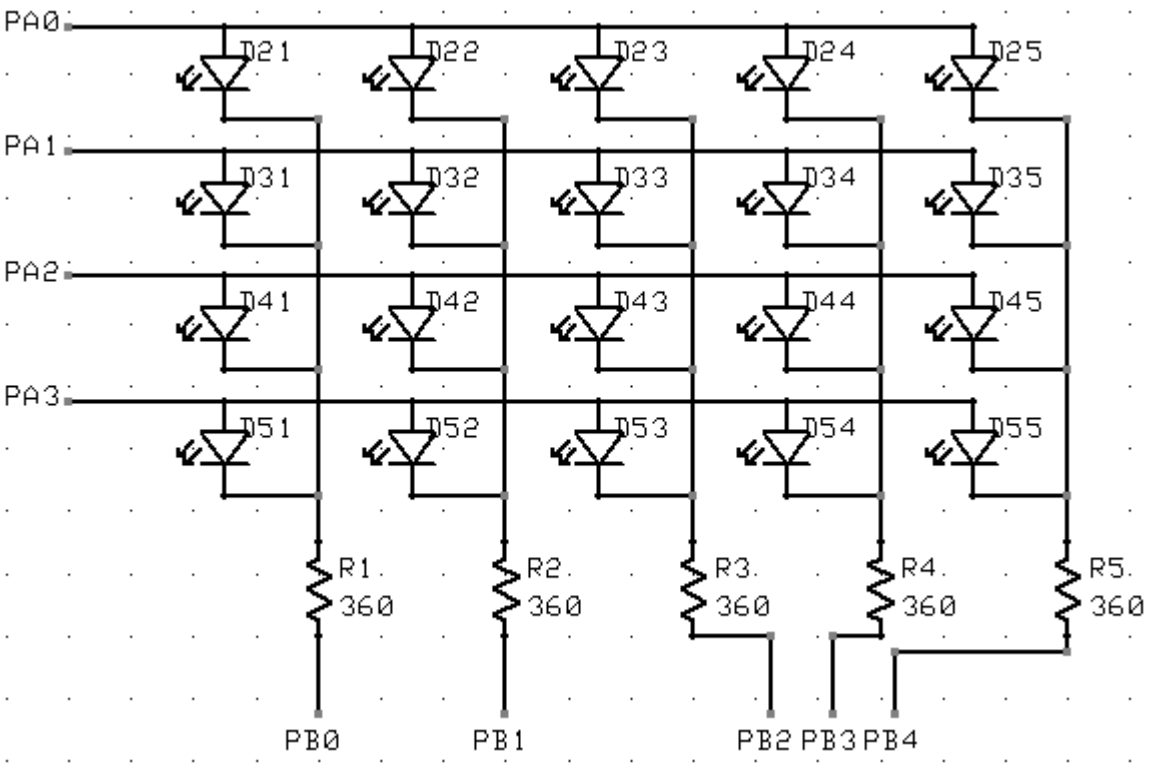
9. An LED matrix is connected to GPIOA and GPIOB as shown in the schematic. Answer the following questions about this schematic: Assume port is at 3.0 volts for a high output and 0.2 volts for a low output and assume that the diodes are ideal and drop 0.7 volts when they are on. In all cases show your work.

A) If PA1 is high and PB2 is low which diode is on and how much current flows through the diode?

B) What is the maximum amount of current than could flow into one of the Port B pins?

C) Is it possible to turn on all of the diodes at the same time? If so, what is the logical state of PA and PB? If not, why not?

D) The resistors are all set at 360 Ω. The STM32F407vg and sink and source 25 ma. What value of resistance would allow this?



10. Answer the questions below about the following program

A. Which pin is used for output?_____

B. How often is the output pin changed?

C. what is the frequency of the output waveform.

D. What is the purpose of line 7?

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E. Why is the flag variable global?

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F. What change can be made to double the frequency of the output?

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```
1   #include "stm32f407vg.h"
2   int flag;
3   int main()
4     {int tmp;
5      RCC_AHB1ENR |= 1;
6      RCC_APB1ENR |= 2;
7      NVICISER0 |= (1 << 29);
8      TIM3_DIER |= 1;
9      TIM3_DIER |= (1 << 6);
10     GPIOA_MODER |= 0x10000;
11     GPIOA_OSPEEDER |= 0xC0000;
12     TIM3_CR1 |= (1 << 7);
13     TIM3_PSC = 15;
14     TIM3_ARR = 1000;
15     TIM3_CR1 |= 1;
16     tmp = 0;
17     while(1)
18       {GPIOA_ODR = tmp;
19        tmp = ~tmp;
20        flag = 1;
21        while(flag == 1);
22        TIM3_CR1 |= 1;
23       }
24    }
25  void TIM3_IRQHandler()
26    {flag = 0;
27     TIM3_SR &= 0xFFFE;
28    }
```