

Last Name (Print): _____

First Name (Print): _____

ID number (Last 4 digits): _____

Section: _____

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Problem	Weight	Score
1	25	
2	25	
3	25	
4	25	
Total	100	

INSTRUCTIONS

1. You have 2 hours to complete this exam.
2. This is a closed book exam. You may use one $8.5'' \times 11''$ note sheet.
3. Relevant excerpts from the microcontroller datasheet are provided in a separate document accompanying the exam.
4. Calculators are allowed.
5. Solve each part of the problem in the space following the question. If you need more space, continue your solution on the reverse side labeling the page with the question number; for example, **Problem 1.2 Continued**. **NO** credit will be given to solutions that do not meet this requirement.
6. **DO NOT REMOVE ANY PAGES FROM THIS EXAM.** Loose papers will not be accepted and a grade of **ZERO** will be assigned.
7. The quality of your analysis and evaluation is as important as your answers. Your reasoning must be precise and clear; your complete English sentences should convey what you are doing. **To receive credit, you must show your work.**

Problem 1: (25 Points)

1. (12 points) Figure 1 shows a C function for assigning functions to the peripheral pins (labeled 1 through 28) of a dsPIC33EP64MC502-I/SP microcontroller.

```
18 void Pin_Setup(void) {  
19     ANSELAbits.ANSA0 = 1;  
20     ANSELAbits.ANSA1 = 0;  
21     ANSELAbits.ANSA4 = 1;  
22  
23     TRISAbits.TRISA0 = 1;  
24     TRISAbits.TRISA1 = 0;  
25     TRISAbits.TRISA2 = 1;  
26     TRISAbits.TRISA3 = 0;  
27     TRISAbits.TRISA4 = 1;  
28 }
```

Figure 1: Code for setting the function of peripheral pins.

- (a) (2 points) Which peripheral pin(s) are used for analog signals?
- (b) (2 points) Which peripheral pin(s) are used for digital input?
- (c) (2 points) Which peripheral pin(s) are used for digital output?
- (d) (6 points) In order to streamline the code in Figure 1, complete lines 32 and 34 in Figure 2 by placing numbers above the dashed lines. To receive partial credit, show the derivation of the register values.

```
31 void Pin_Setup(void) {  
32     ANSELA = 0x_ _ _ _ ;  
33  
34     TRISA = 0x_ _ _ _ ;  
35 }
```

Figure 2: Streamlined code for setting the function of peripheral pins.

2. (13 points) The C code in Figure 3 executes while pin 9 (RA2) is wired to Pin 11 (RB4). There are no other connections to pins 9 and 11.

```
13 int main(void) {  
14     int x, y;  
15  
16     TRISAbits.TRISA2 = 0;  
17     TRISBbits.TRISB4 = 1;  
18  
19     PORTAbits.RA2     = 0;  
20     PORTBbits.RB4     = 1;  
21  
22     x = PORTBbits.RB4;  
23     y = LATBbits.LATB4;  
24  
25     return 0;  
26 }
```

Figure 3: Code for writing and reading a digital signal.

- (a) (3 points) After the code executes, what is the logic state of the signal on pin 9?
- (b) (4 points) After the code executes, what is the value of the integer x ? Justify your answer in one or two short sentences.
- (c) (6 points) After the code executes, what is the value of the integer y ? Justify your answer in one or two short sentences.