SOLUTIONS

SINGAPORE POLYTECHNIC
Sample MID-SEMESTER TEST

Module Name: MAPP **Module Code: ET1010**

No.	SOLUTION
	Section A
A1	c
A2	c
A3	d
A4	b
A5	d
A6	a
A7	d
A8	c
A9	a
A10	b
A11	b
A12	b

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2. Lines should be drawn as thick as possible and in bold.
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No.	SOLUTION
	Section B
B1	a) Assuming all LEDs turned ON at one time (- time multiplexed), approximately: $\frac{5-1.8}{330} \times 8 = 77.57mA$

	b)
	`#include <xc.h>`
	`#include "delays.h"`
	`void main(void)`
	`{`
	`  TRISB=0x00;  //Configure PORTB RB3 to RB0 as output`
	`  TRISD=0x00;  // Configure PORTD RD0 to RD7 as output`
	`  while(1)  //repeat`
	`  {`
	`  PORTB=0b00000001;  //enable DIG0`
	`  PORTD=0b00111111;  //display 0`
	`  delay_ms(10);  //delay for a while`
	`  PORTB=0b00000010;  //enable DIG1`
	`  PORTD=0b01111100;  //display 6`
	`  delay_ms(10);  //delay for a while`
	`  PORTB=0b00000100;  //enable DIG2`
	`  PORTD=0b01110011;  //display p`
	`  delay_ms(10);  //delay for a while`
	`  PORTB=0b00001000;  //enable DIG3`
	`  PORTD=0b01101101;  //display S`
	`  delay_ms(10);  //delay for a while`
	`  }`
	`}`

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<table>
<tr><th>No.</th><th>SOLUTION</th></tr>
<tr><td></td><td>Section B</td></tr>
<tr><td>B2</td><td>a) All output pins</td></tr>
<tr><td></td><td>b) Using 8 data bits will make communication faster however too many I/O pins required from microcontroller.</td></tr>
<tr><td></td><td>c)
<table>
<tr><th>Code</th><th>Comments</th><th></th></tr>
<tr><td>void LCD_command (char A) {</td><td></td><td></td></tr>
<tr><td>TRISB = <u>0x00;</u></td><td>// Configure PORTB</td><td></td></tr>
<tr><td>TRISD = <u>0x00;</u></td><td>// Configure PORTD</td><td></td></tr>
<tr><td>……</td><td></td><td></td></tr>
<tr><td><u>PORTBbits.RB2=0;</u></td><td>// Make RS LOW</td><td></td></tr>
<tr><td><u>PORTBbits.RB0=0;</u></td><td>// Make R/W LOW</td><td></td></tr>
<tr><td>delay_us(<u>150</u>);</td><td>// Wait for duration ta</td><td></td></tr>
<tr><td><u>PORTBbits.RB1=1;</u></td><td>// Make E HIGH</td><td></td></tr>
<tr><td>delay_us(<u>100</u>);</td><td>// Wait for duration tc</td><td></td></tr>
<tr><td><u>PORTD=A;</u></td><td>// write command to PORTD</td><td></td></tr>
<tr><td>delay_us(<u>140</u>) ;</td><td>//Wait for duration td</td><td></td></tr>
<tr><td>……</td><td></td><td></td></tr>
<tr><td>}</td><td></td><td></td></tr>
</table></td></tr>
<tr><td></td><td></td></tr>
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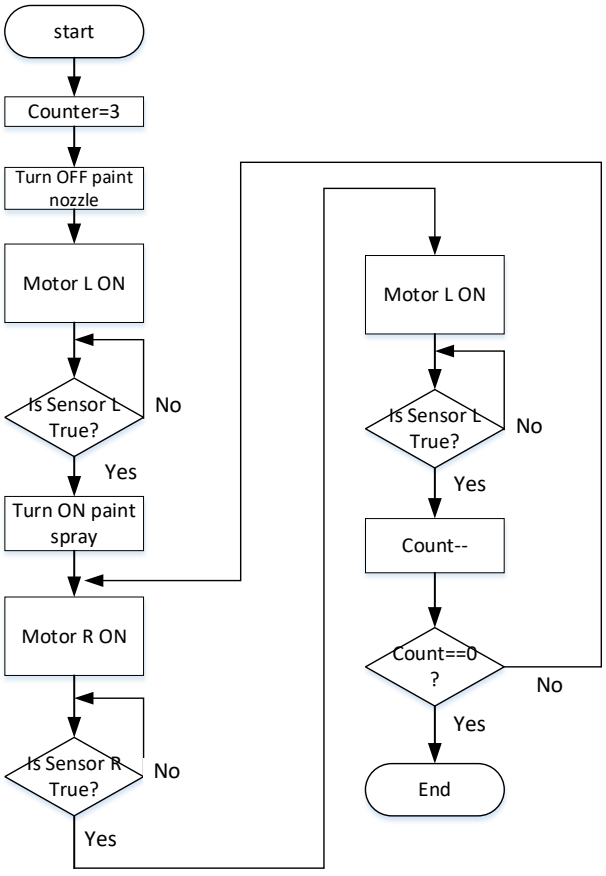
No.	SOLUTION
	Section B
B3	a) In this working environment, optical sensor may be obstructed with spray paint particles over time. It is more suitable to use mechanical limit switch
	b) 2 input pins (for sensors), 3 output pins (2 for motors and one for solenoid)
	c) i) Sensor may be spoiled and unable to detect nozzle. Use timer while running motor to stop motion after a fix period of time even there is no sensor input. ii) Motor may be spoiled. Motor ON signal may not result in motion. Use a motor encoder to track speed and position.
	d)  Note: These are open ended questions to encourage thinking. Student may give different answers, please mark using your professional judgement.

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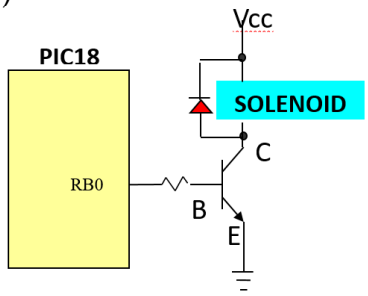
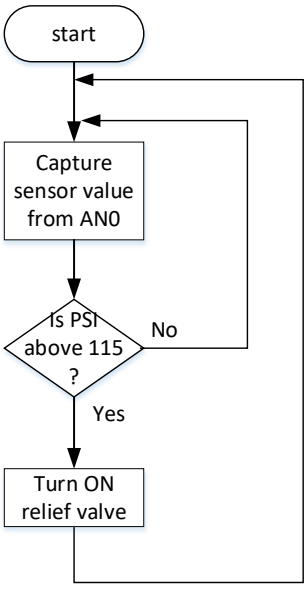
No.	SOLUTION
	Section B
B4	a) $\frac{5}{145} \times 115 = 3.97V$
	b) $\frac{3.97}{5/1023} = 811$ (Equivalent result in other base, like base 2, base 16, etc. is acceptable.)
	c) 
	d) 
	e) The previously calculated 10 bit ADC result for critical pressure no longer applies to the new sensor. Need to update the program for PIC18: Use two equations for two parts of the slope to make accurate conversion. Alternatively, a table can be used.

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