(5) Question 1. \( A_5 = 10100101 = -128+32+4+1 = -128+37 = -91 \)

(5) Question 2. 0-9 is one decimal digital, and 0-3 is \( \frac{3}{4} \) of a decimal digit.
Part a) This system implements \( \frac{4}{3} \) decimal digits.
Part b) \( 2^{16}=65536 \) and \( 2^{15}=32768 \). So, 40,000 alternatives would require at least 16 ADC bits.

(5) Question 3. For the overflow (V) bit, convert both to signed and add -1+1=0. Since it fits, V=0.
For the carry (C) bit, convert both to unsigned and add 255+1=256. Since it doesn’t fit, C=1.
Since the result is zero, Z=1.

(5) Question 4. This interface works because the LED current of 1 mA is less than the maximum output current of the 9S12, which is 1.6 mA. The current in the LED is controlled by the resistor. When the LED is on, there will be 1.9 V across the LED, so there will be 4.9-1.9= 3V across the resistor. To get an LED current of 1mA, set \( R = (4.9-1.9)/1mA = 3 \text{ k}\Omega \).

(10) Question 5. The return address of $403C is pushed on the stack big endian, then the value of Register A is pushed $0A. SP points to the top
\[ \text{SP} -> \quad \$3FFD \quad \$0A \]
\[ \quad \$3FFE \quad 40 \]
\[ \quad \$3FFF \quad 3C \]

(10) Question 6. The first three cycles fetch the entire instruction, the next two cycles fetch the 16-bit data at memory $0812.

<table>
<thead>
<tr>
<th>R/W</th>
<th>Addr</th>
<th>Data</th>
<th>Changes to D,X,Y,S,PC,IR,EAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>$5000</td>
<td>$B3</td>
<td>IR=$B3, PC=$5001</td>
</tr>
<tr>
<td>R</td>
<td>$5001</td>
<td>$08</td>
<td>PC=$5002</td>
</tr>
<tr>
<td>R</td>
<td>$5002</td>
<td>$12</td>
<td>EAR=$0812, PC=$5003</td>
</tr>
<tr>
<td>R</td>
<td>$0812</td>
<td>$00</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>$0813</td>
<td>$00</td>
<td>(RegD is not changed)</td>
</tr>
</tbody>
</table>

(10) Question 7. We use a 10k\( \Omega \) pull-up resistor to implement a negative logic switch interface.

(10) Question 8
```assembly
ldd Sg       ;needs 16-bit reg
cpd #100     ;needs signed branch
bit skip     ;skip if Sg<100
bclr PTT,#$03
skip
```

(10) Question 9
```assembly
ReadPorts ;solution to Question 9
ldab PTT ; ? , ? , ? , ? , , , PT3,PT2,PT1,PT0
lslb
lslb
lslb
lslb
lslb ;PT3,PT2,PT1,PT0, 0 , 0 , 0 , 0
ldaa PTP ; , ?, ?, ?, ?, , , , PP3,PP2,PP1,PP0
anda #$0F ; 0 , 0 , 0 , 0 , PP3,PP2,PP1,PP0
aba ;PT3,PT2,PT1,PT0,PP3,PP2,PP1,PP0
rts
```