1. Complete the schematic below for a microcontroller-based system that will allow 3 digital signals (named A, B, C) to share a single microcontroller input line (named IN1). Include 3 tri-state buffers assuming only one of their select (enable) inputs (named sA, sB, sC) can be active (high) at any given time. Include appropriate circuit elements to ensure IN1=0 when all 3 tri-state buffers are disabled. The functionality to be implemented is defined by the truth table below:

<table>
<thead>
<tr>
<th>sA</th>
<th>sB</th>
<th>sC</th>
<th>IN1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>A</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>C</td>
</tr>
</tbody>
</table>

2. Your boss has asked you to design a data acquisition system with an A/D converter to monitor an analog signal with information content between 100mHz and 30kHz.
   a) What is the minimum frequency at which you should sample the analog signal?
   b) Your boss tells you to include a filter to prevent aliasing from the sampling process. What type of filter (low pass, high pass, band pass) and what cutoff frequency should you choose?

3. Consider and A/D converter with a reference low at ground and a reference high of 3.3V.
   a) What is the resolution (in mV) if this is an 10-bit A/D?
   b) What is the resolution (in µV) if this is a 12-bit A/D?

4. Consider a 10-bit A/D with VRH = 2.1V and VRIL=0.4V. What analog value is represented by A/D digital output of $2B?  

5. What digital value (in hexadecimal) is read by a 16-bit A/D for a sensor input of 2.48V. Assume the A/D is referenced to 0.5V and 5.5V and truncates results so that any voltage between steps is assigned the value of the lower step.

6. In a serial communication system
   a) What is the function of a parity bit?
   b) What is the value of the parity bit for an EVEN parity check of data value $9E?

7. Sketch the data signal (TxD) as a function of time for a UART (SCI) sending a value of $A5. Assume there is no parity bit, but include start (0) and stop (1) bits.

8. List at least two similarities, using serial communication terms, between SPI and I²C.

9. For the following serial communication standards, list the typical signal names (using standard acronyms) found in the interface.
   a) SPI
   b) UART
   c) I²C

10. Your boss has asked you to connect six digital peripheral devices to a microcontroller. The peripheral devices have synchronous serial inputs and outputs, and each has a device enable/select pin. You have decided to complete this task using the SPI interface and a general purpose I/O port. List the signals, using standard SPI acronyms, in the bus between the microcontroller and the six peripheral devices. How many total signals are needed?