1. As shown on the right, six parameters of an ideal operational amplifier are listed. Circle the correct value for each parameter.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differential gain</td>
<td>$\infty$</td>
</tr>
<tr>
<td>Common mode gain</td>
<td>$\infty$</td>
</tr>
<tr>
<td>Common mode rejection ratio</td>
<td>$\infty$</td>
</tr>
<tr>
<td>Input impedance</td>
<td>$\infty$</td>
</tr>
<tr>
<td>Output impedance</td>
<td>$\infty$</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>$\infty$</td>
</tr>
</tbody>
</table>

2. Refer to the circuit on the right for questions 2 to 5. The stage-1 gain is defined by $(V_3 - V_4) / (V_1 - V_2)$. If we want to set the first-stage gain to 5.7, what value should be chosen for $R_1$?  
(A) 100 $\text{K}\Omega$,  
(B) 200 $\text{K}\Omega$,  
(C) 330 $\text{K}\Omega$,  
(D) 470 $\text{K}\Omega$,  
(E) none of the above.

3. The stage-2 gain is defined by $V_5 / (V_3 - V_4)$. What is the gain for stage 2?  
(A) –4.7,  
(B) –5.7,  
(C) –9.4,  
(D) –11.4,  
(E) none of the above.

4. Stage 3 is a bandpass filter with a passing band between 1 Hz and 30 Hz. If we choose $C_5 = 2 \mu\text{F}$, what value should $R_5$ be set at?  
(A) 24 K ,  
(B) 33 K ,  
(C) 56 K ,  
(D) 80 K ,  
(E) none of the above.

5. For stage 3, if choose $C_6 = 0.22 \mu\text{F}$, what value should $R_6$ be set at?  
(A) 24 K ,  
(B) 33 K ,  
(C) 56 K ,  
(D) 80 K ,  
(E) none of the above.

6. The C code on the right implements a digital filter. The input comes from ReadADC() subroutine, which acquires data from the on-chip A/D. The output is sent to port D, which is connected to an external D/A. What kind of filter is this?  
(A) FIR and causal ,  
(B) FIR and noncausal,  
(C) IIR and causal,  
(D) IIR and noncausal,  
(E) none of the above.

```c
uns8 input0, input1;
uns8 output0, output1;
uns16 temp;...

input1 = input0;
input0 = ReadADC();
temp = input0;
temp += input0;
temp += output1;
temp = temp >> 2;
PORTD = output0;
output1 = output0;
```

7. For the above problem, what is the filter equation?  
(A) $y[n] = (y[n-1] + x[n] + x[n-1]) / 2$ ,  
(B) $y[n] = (y[n-1] + 2 x[n] + x[n-1]) / 4$ ,  
(C) $y[n] = (y[n] + 2 x[n] + x[n-1]) / 2$ ,  
(D) $y[n] = (y[n] + x[n] + x[n-1]) / 4$ ,  
(E) none of the above.
8. We implement a digital filter according to: \( y[n] = x[n] - x[n-2] + \frac{y[n-2]}{4} \), where \( y[n] \) is the present output and \( x[n] \) the present input. Which of the following is the correct transfer function \( H(z) \) for this filter? (A) \( (z - 1)^2/(z - 1/4)^2 \), (B) \( (z^2 - 1)/(z^2 - 1/4) \), (C) \( (z + 1)^2/(z + 1/4)^2 \), (D) \( (z^2 + 1)/(z^2 + 1/4) \), (E) none of the above.

9. For the above problem, which of the following is the correct pole-zero plot for this filter?

10. For the above problem, we choose a sampling rate of 500 Hz. Which of the following is the correct frequency response, i.e. magnitude of \( H(e^{j2\pi f}) \), for this filter?

(E) none of the above.