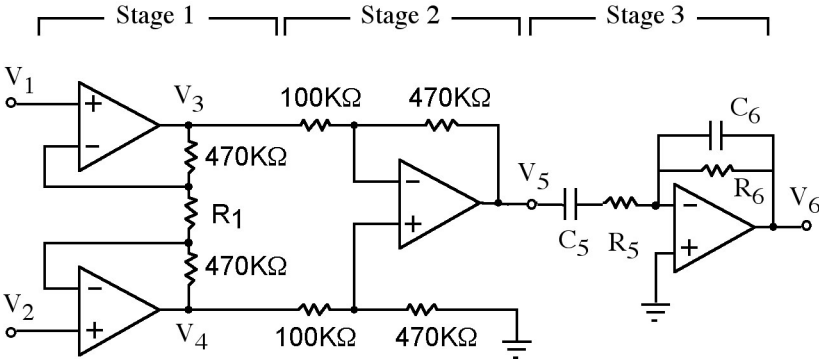
BME 360 Biomeasurment Sample Exam #2 Spring 2011 Name:

Open book/note. 10 points for each question (10 x 10 = 100 points).

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

Differential gain	0	∞
Common mode gain	0	∞
Common mode rejection ratio	0	∞
Input impedance	0	∞
Output impedance	0	∞
Bandwidth	0	∞

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 KΩ, (B) 200 KΩ, (C) 330 KΩ, (D) 470 KΩ, (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 μF, 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 μF, 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.

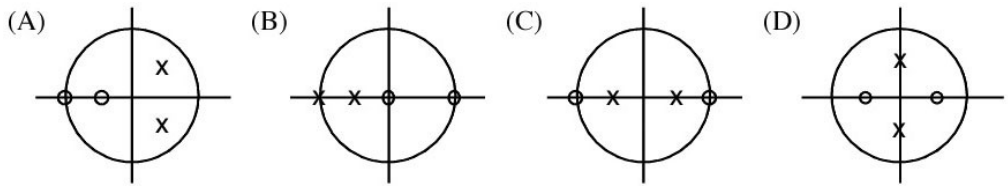
```
uns8 input0, input1;
uns8 output0, output1;
uns16 temp;
……
input1 = input0;
input0 = ReadADC();
temp = input0;
temp += input0:
temp += input1;
temp += output1;
temp = temp >>2;
output0 = temp;
PORTD = ouput0:
output1 = output0;
```

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.

3 MORE QUESTIONS ON THE BACK

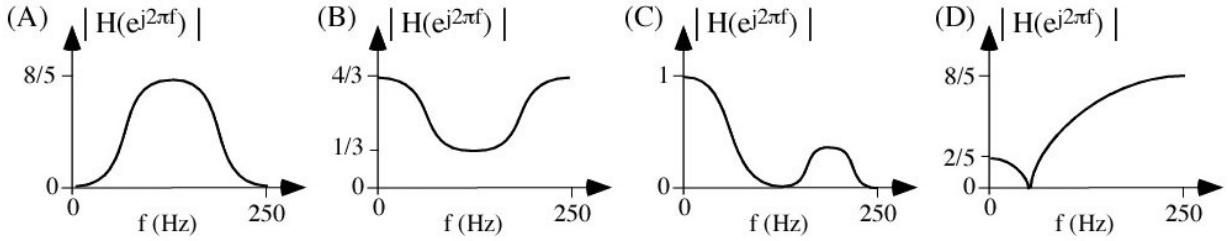
8. ( ) We implement a digital filter according to: $y[n] = x[n] - x[n-2] + y[n-2]/4$, where $y[n]$ is the present output and $x[n]$ the present input. Which of the following is the correct transfer function H(z) for this filter? (A) $(z-1)^2/(z-1/4)^2$, (B) $(z^2-1)/(z^2-1/4)$, (C) $(z+1)^2/(z+1/4)^2$, (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?



(E) none of the above. (The big cycle is the unit circle on the z-plane. A zero is shown by o and a pole by x.)

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.