Open book/note. Each problem is worth 10 points.

1. (     )  Refer to the paper entitled "Microprocessor-based real-time QRS detection." What is the purpose of the sign consistency in the multiplication of backward differences (MOBD) algorithm? (A) to ensure that the QRS complex is not upside down, (B) to enhance large-magnitude signals, (C) to enhance high-frequency signals, (D) to ensure that the microprocessor can handle 2's-complement numbers, (E) none of the above.

2. (     ) After the execution of the C code on the right, what is the value of *temp*? (A) 142, (B) 158, (C) 190, (D) 255, (E) none of the above.

```
uns8 i;
uns16 temp;
... ... ...
temp = 0;
for (i=0; i<5; i++) {
    temp += 127;
    if (temp > 255) {
        temp = temp >> 1;
    }
}
```

3. (     )  An indirect blood-pressure measurement system uses a sphygmomanometer cuff to compress on the upper arm. A stethoscope is placed over a downstream artery.    The systolic arterial pressure is determined when (A) the first Korotkoff sound is detected, (B) the sound reaches its maximum level, (C) the sound changes from muffling to silence, (D) the sound reappears after the silencing, (E) none of the above.

4. For the above problem, the The diastolic arterial pressure is determined when (A) the first Korotkoff sound is detected, (B) the sound reaches its maximum level, (C) the sound changes from muffling to silence, (D) the sound reappears after the silencing, (E) none of the above.

5. (     )  In heart-failure patients the secretion of the atrial natriuretic peptide (ANP) by the cardiac muscles in the atria inhibits the renin-angiotensin regulation of the renal function. Which of the following circulatory parameters is mostly affected by the secretion of ANP?        (A) heart rate, (B) contractility, (C) preload, (D) afterload, (E) none of the above.

6. (     )   A "pop test" was conducted to evaluate the frequency response of a pressure catheter/transducer system.  The following waveform shows the step response of the system as the "pop" was introduced at time 0.  Assume that the system is a 2nd-order one.  What is the damping factor $\zeta$?        (A) 85, (B) 173, (C) 192, (D) 214, (E) none of the above.
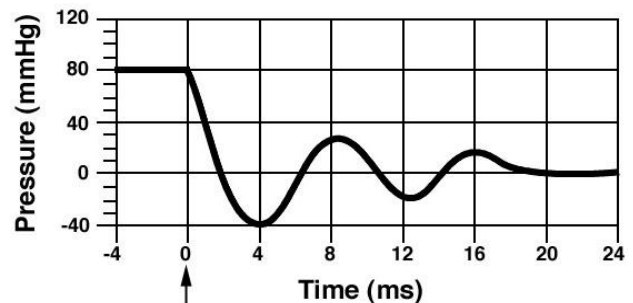
7. (     )    For the above problem determine the damped frequency ($\omega_d$), but express it in Hz. (A) 54 Hz, (B) 75 Hz, (C) 125 Hz, (D) 163 Hz, (E) none of the above.



8. (     ) The cardiac output was determined by use of the thermo-dilution method. A bolus of 50 cc saline at room temperature ($20^{\circ}$C) was rapidly injected into the right atrium.  The temperature was measured in the pulmonary artery as shown on the right. Assume a heat loss factor of 0.90. Determine the cardiac output in terms of liters per minute.        (A) 3 l/min, (B) 4 l/min, (C) 5 l/min, (D) 6 l/min, (E) none of the above.
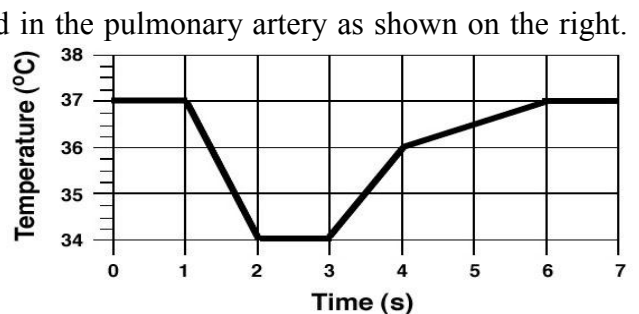


9. (     )  The Fick oxygen method was used to determine the cardiac output of a patient. The rate of oxygen consumption measured by the spirometer was 160 ml/min. The arterial and venous $O_2$ concentrations measured by the oximeter were 0.18 ml/ml and 0.14 ml/ml, respectively. Determine the cardiac output in terms of liter per minute.        (A) 3 l/min, (B) 4 l/min, (C) 5 l/min, (D) 6 l/min, (E) none of the above.

10. (      ) An implant artificial cardiac pacemaker has a catheter for sensing and stimulating the right atrium. When a spontaneous heartbeat is detected, the pacemaker inhibits the stimulation. What is the appropriate code for this pacemaker? (A) AOI, (B) AAI, (C) AOT, (D) DDD, (E) none of the above.