1. Refer to the handout on the Hodgkin-Huxley model. The Hodgkin-Huxley model is represented by a set of four nonlinear differential equations. The four “state variables” of this model are: (A) V, m, h, and n, (B) C, g_{Na}, g_{K}, and g_{L}, (C) α_{m}, α_{n}, β_{m}, and β_{n}, (D) E_{Na}, E_{K}, E_{L}, and I_{EXT}, (E) none of the above. (Hint: The state variables are a set of essential variables that completely define the states of a dynamic system.)

2. The double-sucrose-gap setting can be used to voltage-clamp an elongated piece of muscle. The purpose of the two sucrose gaps is: (A) to supply nutrition to the muscle tissue, (B) to activate the sodium and potassium channels, (C) to lubricate as the muscle contracts, (D) to separate the tissue into three electrically isolated compartments, (E) none of the above.

3. Which of the following statements is incorrect? (A) Type I error, the incorrect rejection of the null hypothesis, is false positive. (B) Type II error, the incorrect acceptance of the null hypothesis, is false negative. (C) The sensitivity is also the true positive rate. (D) The specificity is 1 minus the false negative rate, (E) none of the above.

4. The prostate-specific antigen (PSA) test has been used as a screening test for the prostate cancer. A PSA level higher than 4.0 ng/mL is considered a positive preliminary diagnosis of prostate cancer. We conduct a study on the diagnostic accuracy of the PSA test. The study group consists of 12,000 patients with biopsy done on the prostate, of which 4,000 patients have prostate cancer and 8,000 patients do not. The PSA results in 200 false negative cases and 800 false positive cases. The sensitivity and the specificity, respectively, of the PSA test are: (A) 0.975 and 0.80, (B) 0.95 and 0.90, (C) 0.80 and 0.975, (D) 0.90 and 0.95, (E) none of the above.

5. Refer to the paper entitled "Automated performance analysis of real-time QRS detection". What is the valid detection window in the error logger? (A) A time window around the R-wave reference within which a QRS detection is considered a true positive, (B) A window on the LCD display that shows the number of valid detections, (C) A probability window within which the true detection rate is considered acceptable, (D) A window of thresholds applied to the processed ECG signals for detecting the QRS complexes, (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 α? (A) 85, (B) 173, (C) 192, (D) 214, (E) none of the above.

7. For the above problem determine the damped frequency (ω_d), but express it in Hz. (A) 54 Hz, (B) 75 Hz, (C) 125 Hz, (D) 163 Hz, (E) none of the above.
8. ( ) 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 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.

9. ( ) The cardiac output was determined by use of the thermodilution method. A bolus of 50 cc saline at room temperature (20°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.

10. ( ) 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 O₂ 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.