# Medical Equipment I (Part 2) Term Exam – January 2014 (Model Answer)

## Solve as Much as You Can – Maximum Grade for Both Parts 1 and 2: 70 Points

## Part I. Complete the following sentences [1.5 points each]:

1. If we consider the ECG electrode as a biosensor, the primary measurement signal becomes the secondary measurement signal in the form of electrical voltage by …
    a. A special transducer
    b. The biosensor itself (*)
    c. The body
2. The ECG biosignal measurement does not encounter interference from …
    a. EMG signal
    b. Electrosurgical equipment
    c. Heart sounds (*)
3. If the R-R interval in ECG signal of a patient was measured to be 0.6 s, the estimated heart rate is …
    a. 100 beats/min (*)
    b. 75 beats/min
    c. 60 beats/min
4. When measuring blood pressure using auscultation method, the measurement cuff placed at the level of the leg of a standing patient gives … blood pressure measurement.
    a. Incorrectly high (*)
    b. Incorrectly low
    c. Correct
5. To measure the cardiac output noninvasively, … can be used to provide continuous measurement.
    a. PiCCO technology
    b. Right heart catheterization
    c. Impedance cardiography (*)
6. An example medical device that uses bio-optical signal is …
    a. Pulse oximeter (*)
    b. Thermography
    c. Blood pressure monitor
7. If the cardiac output of a patient is found to be 6L/min and the heart rate is 80 beats/min, then the stroke volume is estimated to be …
    a. 13.33 L
    b. 0.075 L (*)
    c. 0.48 L

8. CNAP uses pairs of sensor cuffs placed on adjacent fingers to …
    a. Get double measurements for higher accuracy
    b. Calibrate the measurements
    c. Decrease venous stasis in the measurement finger (*)
9. Balloon catheters are used to measure pressure in …
    a. Low pressure vascular system (*)
    b. High pressure vascular system
    c. Both low and high pressure vascular systems
10. In closed-loop medical devices, biosignal measurements are …
    a. Displayed to the physician
    b. Used to directly treat the patient based on their analysis (*)
    c. Stored and transmitted to a central monitoring location

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## Part II. Mark the following statements as True (T) or False (F) [1 point each]:

11. Measured value obtained by a measurement procedure is given as a numeric value. (F)
12. Capacitive force transducer measurements change linearly with applied force. (F)
13. Stronger bioelectric signals can be obtained using needle electrodes than surface electrodes. (T)
14. EOG signal is a major source of interference when measuring EEG signals. (T)
15. Systematic errors can be different for different methods of measurement. (T)
16. Pulmonary artery catheterization is widely considered as safe and efficient procedure. (F)
17. For septic shock patients, PiCCO technology can still be used effectively. (T)
18. It is sufficient to completely evaluate the heart function using only ECG measurements. (F)
19. Biosignal transducers can be used to correct for sensor nonlinearity in medical devices. (F)
20. In the oscillometric method, oscillations are largest at the mean arterial pressure. (T)

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## Part III. Answer the following problems:

21. [3 points] When measuring cardiac output using the indicator dilution method, the total amount of indicator injected was 2 grams and the integration of the indicator concentration curve with time in one cardiac cycle was 30 gram.second/Liter. Determine the measured cardiac output. (solution: 4 L/min)

22. [3 points] If the absorption coefficient of a blood sample at 650nm was found to be 800 and at 950nm was 250. Find the ratio of $HBO_2$ to HB in that sample. Assume the absorption of HB at these frequencies to be 2000 and 150 and those for $HBO_2$ to be 200 and 300 respectively. (solution: HBO2 0.5964 , HB 0.355, ratio: 1.68)

**Best of luck!**