

Part I. Answer these questions by marking the best answer among the choices given: [10 points each]

1. Dialysate line bypass is activated in the condition when ...
 - a. Air was detected in blood
 - b. Air was detected in dialysate
 - c. High dialysate temperature was detected (*)
 - d. High blood pressure was detected

2. Two flowmeters are used in dialysate circuit to ...
 - a. Compute the pressure in the dialysate circuit
 - b. Measure ultrafiltration rate (*)
 - c. Detect loss of dialysate
 - d. Make the dialysis process more efficient

3. When there is a tear (and hence leak) in the membrane of the dialyzer, ... alarm is triggered.
 - a. Air bubble detection
 - b. Blood circuit pressure
 - c. High ultrafiltration
 - d. Blood leak (*)

4. The ultrafiltration rate is controlled by ...
 - a. Speed of dialysate pump placed after the dialyzer (*)
 - b. Speed of blood pump
 - c. Speed of proportioning pump
 - d. All of the above

5. To prevent bacterial buildup inside dialysate circuit, dialysis machines are disinfected with ...
 - a. Sodium hypochlorite (Bleach) (*)
 - b. Acetic acid (vinegar)
 - c. Cold water
 - d. Citric acid

6. If wrong concentrates are used for a hemodialysis machine, this is difficult to detect using ...
 - a. pH monitors
 - b. Proportioning pump speed monitors
 - c. Conductivity monitor
 - d. Any one of the above monitors alone (*)

7. The advantages of the peristaltic pump design of the blood pump do not include ...
 - a. Operation without direct contact with blood
 - b. Biocompatibility of its material (*)
 - c. Low hemolysis rate
 - d. Ability to operate manually in case of power failure

8. Almost all hemodialysis machines use ... technology to detect air foam in the blood.
 - a. Optical
 - b. Electromagnetic
 - c. Ultrasonic (*)
 - d. Bioimpedance

Part II. Mark the following statement as either True (T) or False (F): [5 points each]

9. If acid and bicarbonate inputs in hemodialysis are reversed, conductivity alarm will occur. (F)
10. New computerized hemodialysis monitoring systems can replace hemodialysis personnel. (F)
11. Cleaning and disinfection are not necessary for the blood circuit and dialyzer. (T)
12. Medical hemodialysis devices are designed for single fault tolerance. (T)
13. Water used to compose the dialysate solution is just a sterilized mineral water. (F)
14. Waste metabolites are removed from the patient's blood in hemodialysis using diffusion. (T)
15. Modern hemodialysis systems use fixed-volume proportioning. (F)
16. Integrity of dialysate circuit is monitored using dialysate pressure sensors. (F)

Part III. Answer the following question: [20 points]

It is desired to select a suitable flowmeter for use in ultrafiltration measurement in hemodialysis. If the desired nominal rates of dialysate flow and ultrafiltration are 100 L/hr and 2 L/hr respectively, what would be the minimum acceptable percentage accuracy of the flowmeter to satisfy the ultrafiltration accuracy requirements of the hemodialysis standard?

Standard error in ultrafiltration: 5%

Hence, acceptable error in ultrafiltration is $2 \times 5/100 = 0.1$ L/hr

This error comes from two flowmeters. Then, acceptable error in each flowmeter = $0.1/2 = 0.05$ L/hr

This amount to a percentage accuracy = $0.05 / 100 \times 100 \% = 0.05\%$