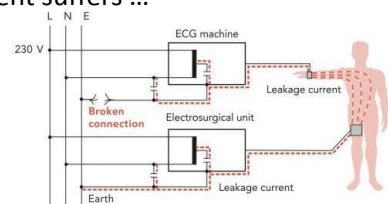


Part I. Answer these questions by marking the best answer among the choices given: [5 points each]

1. Conversion of a signal from continuous to discrete amplitude form is called ...
 - a. Sampling
 - b. Quantization (*)
 - c. Analog-to-digital conversion
 - d. Digital-to-analog conversion
2. Signal conditioning is an important step with bioelectric signals because they usually have ...
 - a. Low amplitude
 - b. High source impedance
 - c. Differential form
 - d. All of the above (*)
3. To select one bioelectric signal out of several input signals for processing, we can use ...
 - a. Analog multiplexer (*)
 - b. Analog demultiplexer
 - c. Digital multiplexer
 - d. Digital demultiplexer
4. To remove any interference from the 60 Hz AC mains without affecting other signal frequencies, we can use properly designed ...
 - a. Low-pass filter
 - b. High-pass filter
 - c. Band-pass filter
 - d. Band-reject filter (*)
5. The shown EEG signals are considered samples from ... signals.
 - a. Periodic
 - b. Not periodic (*)
 - c. Compact support
 - d. Random
6. For a 60 Hz current, voluntary control of muscles is maintained for currents less than ...
 - a. 1 mA
 - b. 5 mA (*)
 - c. 10 mA
 - d. 50 mA
7. The let-go current for a DC current is ... that of a 60 Hz current.
 - a. Higher than (*)
 - b. Lower than
 - c. Similar to
 - d. Nearly same as
8. In the shown image, when there is a broken earth connection, the patient suffers ...
 - a. Microshock
 - b. Macroshock (*)
 - c. Strong involuntary reaction
 - d. Loss of muscular control



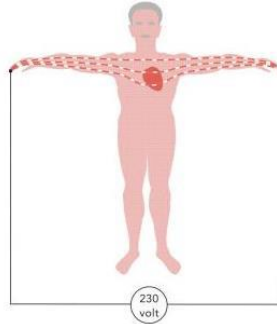
9. Mobile equipment should pass ...
 - a. Handle test
 - b. Drop test
 - c. Step test (*)
 - d. All of the above
10. The mechanical barriers that prevent microorganisms from penetrating into our bodies include ...
 - a. White blood cells
 - b. Stomach acid
 - c. Skin (*)
 - d. Hair
11. To ensure inactivation of viruses, it is sufficient to use ...
 - a. Chemical disinfection at temperature of at least 100°
 - b. Physical disinfection at temperature 75° for at least 15 min
 - c. Physical disinfection at temperature 105° for at least 1 min (*)
 - d. Physical disinfection at temperature 105° for at least 5 min
12. To ensure that all high-resistance bacterial spores are killed, we should use ...
 - a. Sterilization at temperature 121° for at least 15 minutes
 - b. Sterilization at temperature 134° for at least 6 hours (*)
 - c. Physical disinfection at temperature 105° for at least 15 min
 - d. Physical disinfection at temperature 105° for at least 6 hours
13. To reduce risk of exposure to contact transmission of disease, it is necessary to use ...
 - a. Isolation of patients
 - b. Gloves and gown
 - c. Chemical disinfection of hands
 - d. All of the above (*)

Part II. Mark the following statement as either True (T) or False (F): [2 points each]

14. 12-bit ADC has less quantization error than 8-bit ADC. (T)
15. Patient isolation works by ensuring ohmic continuity between patient and medical device. (F)
16. Blood sugar level signal is an example of a signal that repeats itself. (F)
17. Computer can only handle compact support signals. (T)
18. Signal isolation methods include optical and transformer based techniques. (T)
19. It is possible for a biomedical engineer to suffer a macroshock while repairing a medical device. (T)
20. When two medical devices are connected to a patient, it is safe to connect only one of them to earth. (F)
21. For a bone saw device, it should be ON only when the surgeon continuously presses a button. (T)
22. Disinfecting the skin eliminates both acquired and permanent bacterial colonization in the skin. (T)
23. To avoid airborne transmission of germs, a distance of 1 m to infectious patients should be kept. (F)
24. To lower costs of disinfection, chemical disinfection should be adopted by hospitals. (F)
25. Physical disinfection may have allergenic and toxic side effects. (F)

Part III. Answer the following questions: [10 points each situation]

26. Compute the maximum current that could flow through the subject in the situation below assuming a 60 Hz supply current that the skin of the subject is intact. Also, based on the value of the current, what would be the likely physiological effect of this current on the subject?



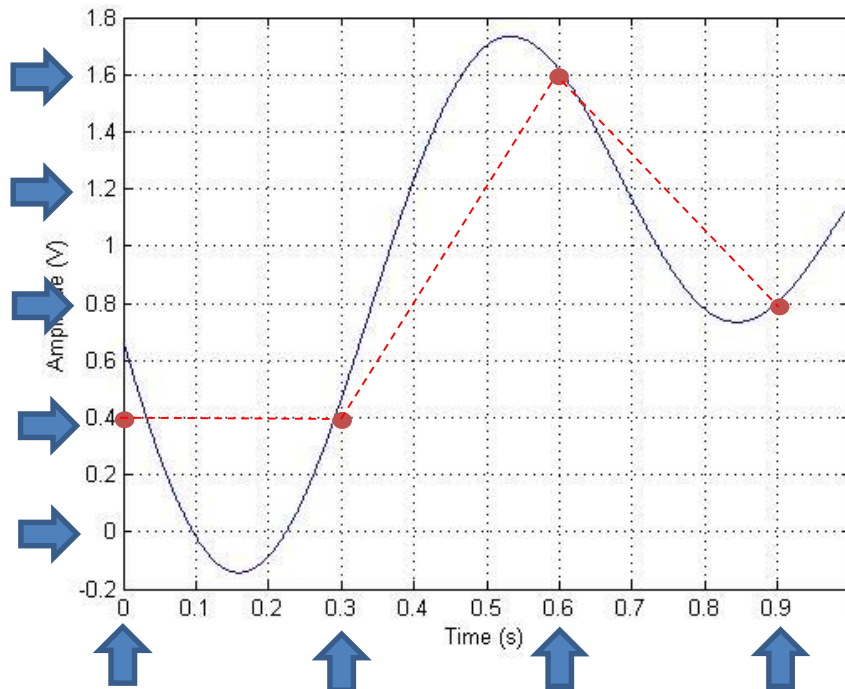
MAXIMUM current = 230 V / MINIMUM path resistance

MINIMUM Resistance = MINIMUM skin resistance x 2 + internal resistance between two limbs
 $= 15 \text{ K}\Omega \times 2 + 500\Omega = 30.5 \text{ K}\Omega$

Hence, MAXIMUM current = $230 / 30500 = 7.5 \text{ mA}$

Physiologic Effect (from lecture slide 4): **Painful shock and loss of muscular control**

27. For the signal shown below, if it is sampled with a sampling period of 0.3 s and quantized with a step of 0.4 V, draw the resultant digital signal. Comment on the similarity between the original analog and digital signals.



Comment: Digital signal does not represent original analog signal well. Reason: Insufficient sampling