Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	MEDICAL INSTRUMENTATION
COURSE CODE	:	BWC 41003
PROGRAMME	:	BWC
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) **Figure Q1(a)** shows the electrode-electrolyte interface where the electrode consists of metallic atoms, C and the electrolyte is an aqueous solution containing cations of the electrode metal C^+ and anions A^-. Differentiate the oxidation and reduction processes that potentially occured at the electrode-electrolyte interface.

(5 marks)

(b) A test electrode is placed in a physiological saline bath in the laboratory, along with an Ag/AgCl electrode having half-cell potential of +0.223 V. The DC voltage between the two electrodes is measured with a very-high impedance voltmeter and found to be +0.572 V with the negative test electrode. The magnitude of the impedance between the two electrodes is measured as a function of frequency at very low current as shown in **Figure Q1(b)**. Based on this information,

(i) write the oxidation equation in the Ag/AgCl electrode,

(2 marks)

(ii) determine the half-cell potential of the test electrode,

(3 marks)

(iii) sketch and clearly label the equivalent circuit for the biopotential electrodes,

(5 marks)

(iv) determine the resistance of electrode lead wire, R_s,

(1 marks)

(v) calculate the resistance of electrode-electrolyte interface, R_d, and

(2 marks)

(vi) calculate the capacitance across the double layers of charge at electrode-electrolyte interface when frequency equal to 100 Hz.

(2 marks)

Q2 (a) List the **FIVE (5)** electrodes that are used to make 12-lead ECG recordings which are connected to patient during cardio measurement.

(5 marks)

(b) Sketch a typical lead II electrocardiogram and label the P wave, QRS wave and T wave.

(8 marks)

(c) **Figure Q2(c)** shows seven brain diagnostic equipment (i.e., the SPECT, PET, fMRI, MRS, EEG, IEEG and MEG) that are available in major medical centres. Explain why the MEG is better than the others.

(7 marks)

Q3 (a) **Table Q3(a)** shows two alternative methods in blood pressure measurement in order to overcome the problems frequently faced by the conventional sphygmomanometer blood pressure measurement.

Table Q3(a)

Oscillometric blood pressure measurement	Ultrasonic blood pressure measurement

(i) Explain the auscultatory method performed by medical staff in determining blood pressure.

(4 marks)

(ii) State **TWO (2)** problems in the conventional sphygmomanometer blood pressure measurement.

(4 marks)

(iii) Differentiate the oscillometric blood pressure and the ultrasonic blood pressure measurement.

(4 marks)

(b) The photoplethysmograph (PPG) circuit is normally consist of two components, a photocell and a light source. Sketch and label the circuit diagram in an appropriate order.

(8 marks)

Q4 (a) Atmospheric pressure at sea level is 760 mmHg. Calculate the partial pressure of oxygen (O_2), nitrogen (N_2) and carbon dioxide (CO_2). (Given that the composition percentages for O_2, N_2 and CO_2 are 20.96%, 79% and 0.04%, respectively)

(6 marks)

(b) **Figure Q4(b)** shows the lung volumes and capacities for a standard 70 kg male breathing at rest by using a spirometer. From the graph, identify the inspiratory reserve volume (IRV) and tidal volume (TV) and their approximate quantity (in litres, *l*).

(4 marks)

(c) Two respiratory diseases such as hypoxia and hypercapnia require artificial repiratory ventilation.

(i) Classify **TWO (2)** types of artificial respiratory ventilation.

(3 marks)

(ii) State the difference between hypoxia and hypercapnia.

(3 marks)

(d) Conclude the radiofrequency catheter ablation procedure and its corresponding diseases that it can be applied to.

(4 marks)

Q5 (a) Defibrillators are devices that deliver electrical shocks to the heart in order to convert rapid irregular rhythms of the upper and lower heart chambers to normal rhythm. To deliver electrical shocks rapidly to the heart, a defibrillator charges a capacitor by applying a voltage across it, and then the capacitor discharges through the electrodes attached to the chest of the patient undergoing ventricular fibrillation. In a defibrillator design, a 64μF capacitor is charged by bringing the potential difference across the terminals of the capacitor to 2500 V.

(i) Calculate energy that stored in the capacitor.

(3 marks)

(ii) Calculate the charge that is stored on the capacitor?

(3 marks)

(iii) Calculate the average electrical current (in amperes) that flows through the patient's body if the entire stored charge is discharged in 10 ms.

(4 marks)

(b) (i) Explain the human's physiological responses towards diathermy.

(4 marks)

(ii) Classify the classes of laser safety and their corresponding hazards.

(4 marks)

(iii) Describe the purpose of endoscope.

(2 marks)

- END OF QUESTIONS -

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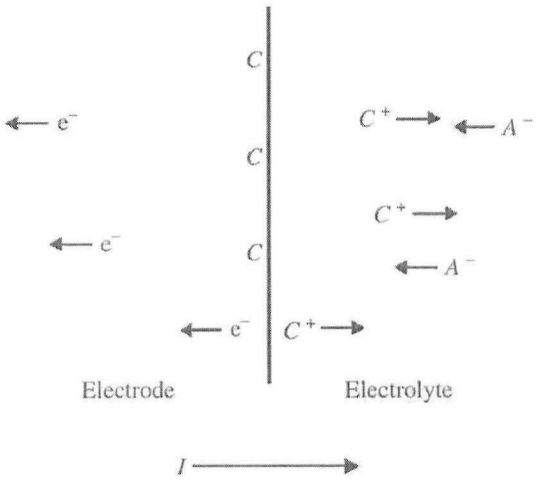

Figure Q1(a)

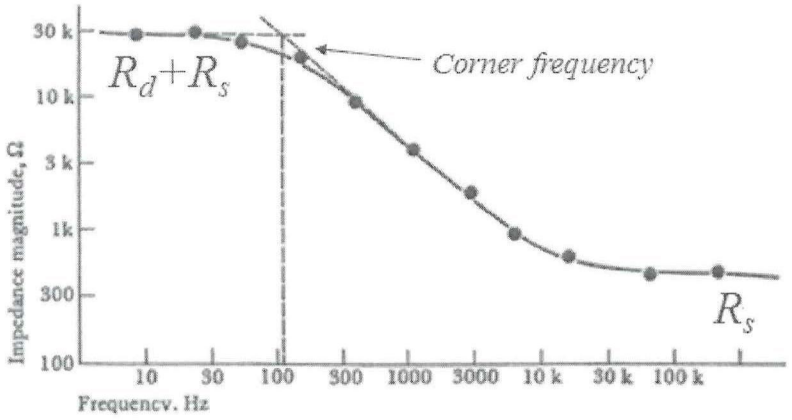

Figure Q1(b)

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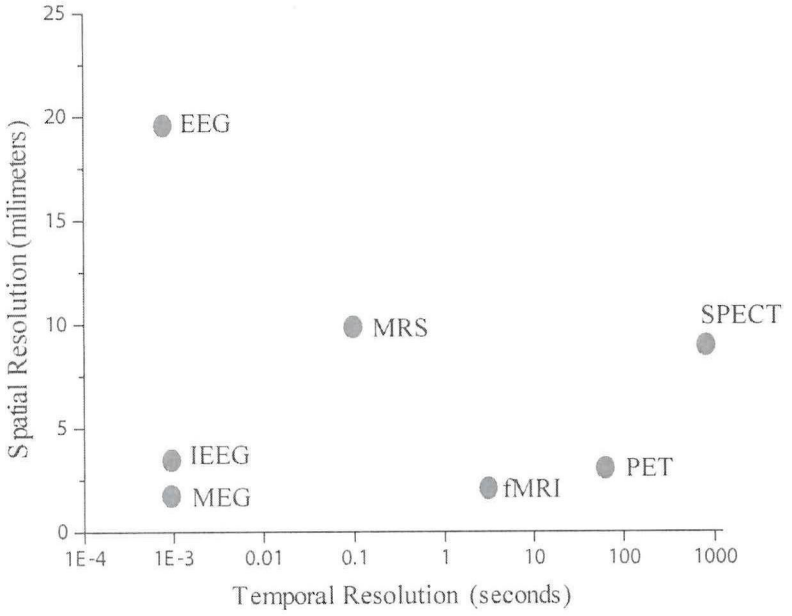

Figure Q2(c)

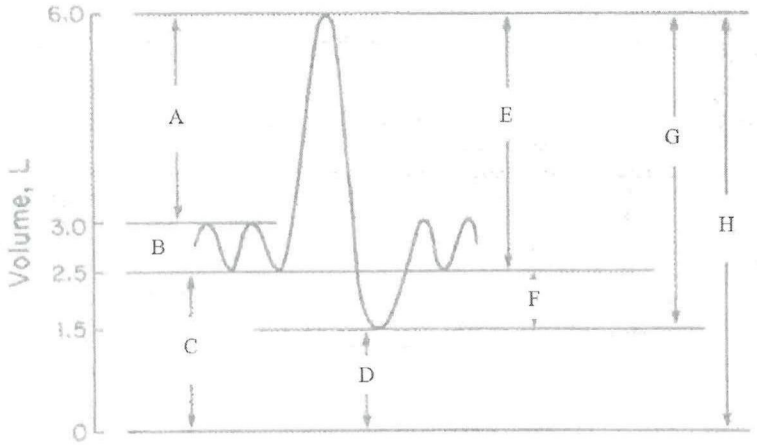

Figure Q4(b)