

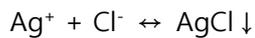
# BME Midterm exam. 2009-04-28 closed book

총 57점

1. - 총 19점

- (1) knowledge, service, integrity - 각 1점(총 3점)
- (2) cardio, retino, oculo, encephalo, musculo(or myo) - 각 1점(총 5점)
- (3) LVDT transducer(The linear variable differential transformer) - 2점

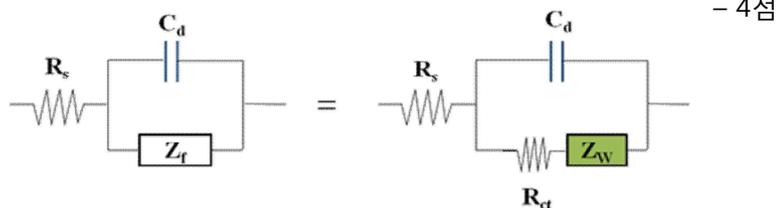
(4) a.  $\text{Ag} \leftrightarrow \text{Ag}^+ + \text{e}^-$



- b. Provide good electrical contact with the skin
- c. Reactions are reversible
- d. Maintains the potential of the reference electrode at a constant value regardless of the solution under test
- e. Non-polarized surface

- 3점

(5)



$R_s$  : solution resistance

$C_d$  : double layer capacitance

$Z_f$  : impedance of the Faradaic process

$R_{ct}$  : charge transfer resistance

$Z_w$  : impedance to Mass transfer of the electroactive species

2. - 총 16점

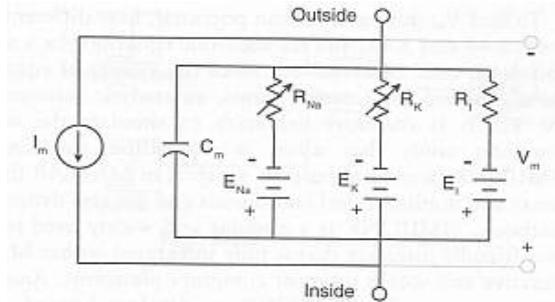
(1) Γ. Goldman equation. - 2점

$$V_m = \frac{RT}{F} \log_{10} \frac{P_K[K]_{in} + P_{Na}[Na]_{in} + P_{Cl}[Cl]_{out}}{P_K[K]_{out} + P_{Na}[Na]_{out} + P_{Cl}[Cl]_{in}} \cong -60mV \log_{10} \frac{P_K[K]_{in} + P_{Na}[Na]_{in} + P_{Cl}[Cl]_{out}}{P_K[K]_{out} + P_{Na}[Na]_{out} + P_{Cl}[Cl]_{in}}$$

Λ. Explain the change of membrane potential during active state. - 2점

Permeability란 단어를 사용하거나,  $P_{ion}$  등을 인용하여, 비교적 정확히 설명하였으면 2점 사용하지 않고, 설명을 적절히 하였으면, 1점.

(2) Drawing HH equivalent circuit- 4점 (정확하지 못한 경우 감점)



(3) 전압과 시간의 요소를 분리하여, 전압에 의한 영향을 제거하는 방법에 대한 설명 - 4점  
상수전압(Constant voltage)에 대한 언급을 통해 실험의 목적에 대한 설명이 있으면 2점.  
VI curve에 대한 그림 또는 언급을 통해 과정과 결과에 대한 설명이 있으면 2점  
(VI curve 결과에 대한 그림 및 결과 예상에 대한 언급이 없으면 1점)  
둘 다 포함하면 4점

(4) Describe equation of HH model- 4점

$$I_m = G_K(V_m - E_K) + G_{Na}(V_m - E_{Na}) + \frac{(V_m - E_L)}{B_L} + C_m \frac{dV_m}{dt}, G_K = \bar{G}_K n^4, G_{Na} = \bar{G}_{Na} m^3 b,$$

( $G_K$  and  $G_{Na}$ : the voltage-time-dependent conductance)

식을 모두 적고,  $G_K$  and  $G_{Na}$ 에 대한 설명까지 적으면 4점

식만 적었다면, 3점,

식을 적지 못하고, 설명만 하였다면 1점

3. - 총 10점

(1) 41, 50, 11 - 각 2점(총 6점)

(2) 0.5, 200(199.04)- 각 2점(총 4점)

- frequency가 원칙, frequency 값에 단위 안쓴 것은 만점, angular frequency에 단위를 쓰지 않거나, 잘못 쓰면(Hz) 감점

4. - 총 12점

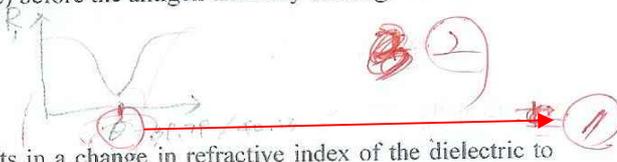
(1) - 4점

(2) - 4점

(3) - 4점

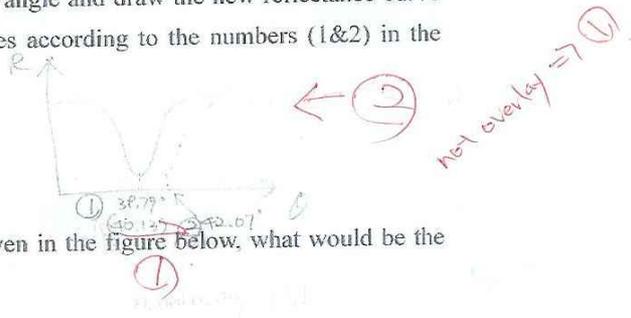
(1) Calculate the initial value of the resonance angle ( $\theta$ ). Draw the initial reflectance curve (x-axis: angle of incidence, y-axis: reflectance) before the antigen-antibody binding.

$\theta = 39.79^\circ / 40.13^\circ$  (1)  
 $39 \sim 41^\circ$



(2) The binding of antigen-antibody results in a change in refractive index of the dielectric to 1.44. Now calculate the final value of the resonance angle and draw the new reflectance curve overlaid with the previous drawing. Label the curves according to the numbers (1&2) in the figure (numbers you see in the Light Detector).

$\theta = 43.07^\circ / 42.07^\circ$  (1)  
 $42 \sim 43^\circ$



(3) When the binding occurs for the time course given in the figure below, what would be the time course change of the reflectance? Draw it.

(Appendix: Table of the arcsin x)

x	arcsin(x)
0.70	44.43
0.69	43.63
0.68	42.84
0.67	42.07
0.66	41.30
0.65	40.54
0.64	39.79
0.63	39.05
0.62	38.32
0.61	37.59

