High 100
Median 92

Chemistry – 4311
November 21, 2014

Exam #3 **Name** Key

(20) 1. Matching (use a letter only once)

ΔG^o for an electrochemical cell is m.

The emf E of an electrochemical cell is j.

The equilibrium constant varies versus temperature according to h.

For the biochemist standard state, pH is g.

ΔG_r for a chemical reaction is l.

The metabolic pathway from glucose to pyruvate, is called o.

The action potential is the sudden spike in the k potential.

For the reaction $O_2(g) + 4H^+ + 4e^- \rightarrow 2H_2O$, increasing H^+ will n E.

At equilibrium and constant T & P, ΔG_r equals f.

The membrane potential for K^+ ions is i.

a. $-RT\ E^o$

b. $E^o - 0.0257V\ \ln[K^+]$

c. the citric cycle

d. fourteen

e. $K_2/K_1 = R\ln(T_2/T_1)$

f. zero

g. decrease

h. $\ln(K_2/K_1) = (-\Delta H_r^o/R)[T_2^{-1} - T_1^{-1}]$

i. $0.0257V\ \ln\{[K^+]_{ex}/[K^+]_{in}\}$

j. $E^o - (RT/\nu F)\ln Q$

k. membrane

l. $\Delta G_r^o + RT\ln Q$

m. $-\nu F E^o$

n. increase

o. anaerobic glycolysis

p. unity

q. seven

r. $-\nu F \ln K$

s. carbohydrate

t. $RT\ln Q$

$c = 3.00 \times 10^8$ m/s $F = 96{,}500$ C/mole

$h = 6.626 \times 10^{-34}$ J s R 298 K/F = 0.0257 V

R= 8.314 J/mol-K

R= 1.987 cal/mol-K

R= 0.08206 L-atm/mol-K

$N_A = 6.02 \times 10^{23}$

1 atm = 101.325 kPa = 760 torr

$k_B = 1.381 \times 10^{-23}$ J/K

(20) 2. Consider the equilibrium constant between β-sheet and α-helix conformations of a peptide; i.e. β-sheet ↔ α-helix.

a. If the equilibrium constant is 1,000 at 25 °C, what is ΔG_r° in kJ?

$$\Delta G_r^\circ = -RT\ln K = -8.314 \times 298 \times \ln(1000)$$
$$= -17{,}114\ J = -17.1\ kJ$$

b. If K = 10 at 100 °C, what is ΔH_r° in kJ?

$$\ln \frac{K_2}{K_1} = -\frac{\Delta H_r^\circ}{R}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]$$

$$\ln \frac{10}{1000} = \frac{-\Delta H_r^\circ}{8.314}\left[\frac{1}{373} - \frac{1}{298}\right]$$

$$\Delta H_r^\circ = -56{,}744\ J = -56.7\ kJ$$

(25) 3. Consider the galvanic cell Cd(s) | Cd^{2+} | | Cu2+ | Cu(s) with the reduction potentials

$$Cd^{2+} + 2e^- \rightarrow Cd(s) \quad E^\circ = -0.403\ V$$
$$Cu^{2+} + 2e^- \rightarrow Cu(s) \quad E^\circ = 0.337\ V$$

a. What is the chemical reaction for the cell?

9 $Cu^{2+} + Cd(s) \longrightarrow Cu(s) + Cd^{2+}$

b. What is E° for the cell?

6 0.740 V

c. Calculate ΔG_r° for the cell reaction?

6 $\Delta G_r^\circ = -\nu F E^\circ = -2 \times 96{,}500 \times 0.740 = -142{,}820\ J$
$= -142.8\ kJ$

d. Show how to calculate the equilibrium constant K for the cell reaction.

6 $\Delta G_r^\circ = -\nu F E^\circ = -RT\ln K$

$$\ln K = \frac{\nu F E^\circ}{RT}, \quad K = e^{\nu F E^\circ / RT}$$