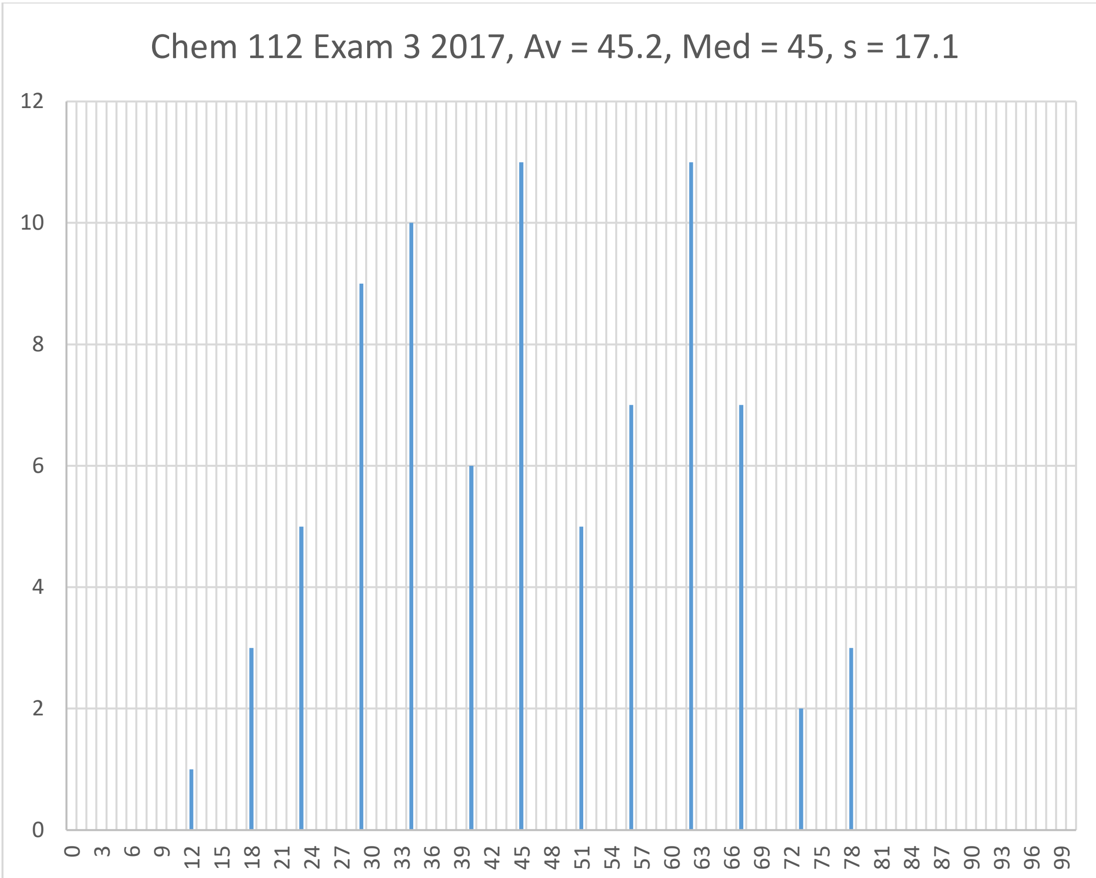

CLASS______________ TEST______________ DATE______________

SCANTRON **ITEM ANALYSIS-** **QUESTIONS 1-25** Number of wrong responses FORM NO. 9702 **REORDER O** **www.ScantronS**

FORMS SCORED	CLASS AVERAGE	ITEM 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
83	80	69	27	52	32	65	22	51	44	75	64	27	50	29	38	49	43	49	43						

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EW-9702-2 17

DO NOT OPEN THIS EXAM UNTIL YOU ARE INSTRUCTED TO DO SO

- Please print your name on the scantron
  - Last Name, First Name
  - That's all that's needed

- Sit in odd numbered seats.

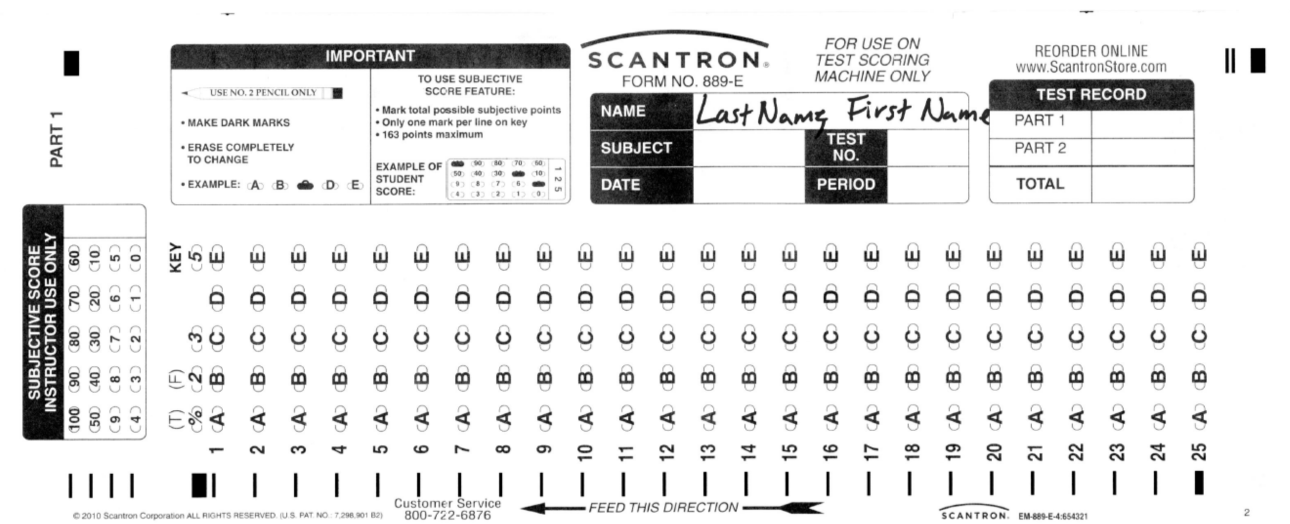
- Books & Bags in the front of the room.

- No text entry calculators.

- Use the exams as scratch paper.

- Keep the exams when you are done.

- Turn in the scantrons.



100 total points. Questions 1-18 worth 5.5 points each. Question 19 worth 1 point.

Constants	R = 8.314 J/K-mol R = 0.0821 l-atm/K-mol	1 mole = 6.022 x 10^{23}	Faraday = 96,500 coulombs
Chem 111 Equations q = m Cs (ΔT)	**Gas Equations** $u = \sqrt{\frac{3RT}{M}}$	$(P+(n^2a/V^2))(V-nb)=nRT$	PV = nRT
Pythagorean Theorem:	$a^2 + b^2 = c^2$	**Volume of a cube:**	$V = l^3$
Henry's Law	$S = k_HP$		
Clausius-Clapeyron Equation	$\ln P = \frac{-\Delta H_{vap}}{RT} + b$	$\ln \frac{P_2}{P_1} = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$	
Colligative Properties	$\pi = MRT$	$P_A = P_A^0X_A$ $\Delta P = P_A^0X_B$	
	$\Delta T_b = K_bc_m$	$\Delta T_f = K_fc_m$	
Chemical Kinetics $\ln[A]_t = -kt + \ln[A]_0$	$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$	**Arrhenius Equation** $k = A\left(e^{-\frac{Ea}{RT}}\right)$	$\ln \frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$
Chemical Equilibrium	aA + bB = cC + dD	$K_C = \frac{[C]^c[D]^d}{[A]^a[B]^b}$	$K_p = K_c(RT)^{\Delta n}$
pH pH = - log [H^+]	antilog(x) = 10^x pX = - log X	$K_aK_b = K_w$	Henderson-Hasselbach Eqn $pH = pK_a + \log\frac{[base]}{[acid]}$
Quadratic formula	$ax^2 + bx + c = 0$	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	
Chemical Thermodynamics	$\Delta U = q + w$	$w = -P\Delta V$	$\Delta G = \Delta H - T\Delta S$
$ln\left(\frac{K_2}{K_1}\right) = \frac{-\Delta H^0_{rxn}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$	$\Delta G = \Delta G^0 + RT\ln Q$	$\Delta G^0 = -RT\ln K$	$\Delta G^0 = -nFE_{cell}$
Electrochemistry	$E^0_{cell} = E^0_{cathode} - E^0_{anode}$	Nersnt Equation $E_{cell} = E^0_{cell} - \frac{RT}{nF}\ln Q$	At 298K $E_{cell} = E^0_{cell} - \frac{0.0592}{n}\log Q$

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 **H** 1.008																	2 **He** 4.0026
3 **Li** 6.94	4 **Be** 9.0122											5 **B** 10.81	6 **C** 12.011	7 **N** 14.007	8 **O** 15.999	9 **F** 18.998	10 **Ne** 20.180
11 **Na** 22.990	12 **Mg** 24.305											13 **Al** 26.982	14 **Si** 28.085	15 **P** 30.974	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.948
19 **K** 39.098	20 **Ca** 40.078	21 **Sc** 44.956	22 **Ti** 47.867	23 **V** 50.942	24 **Cr** 51.996	25 **Mn** 54.938	26 **Fe** 55.845	27 **Co** 58.933	28 **Ni** 58.693	29 **Cu** 63.546	30 **Zn** 65.38	31 **Ga** 69.723	32 **Ge** 72.630	33 **As** 74.922	34 **Se** 78.97	35 **Br** 79.904	36 **Kr** 83.798
37 **Rb** 85.468	38 **Sr** 87.62	39 **Y** 88.906	40 **Zr** 91.224	41 **Nb** 92.906	42 **Mo** 95.95	43 **Tc** (98)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57-71 *	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89-103 #	104 **Rf** (265)	105 **Db** (268)	106 **Sg** (271)	107 **Bh** (270)	108 **Hs** (277)	109 **Mt** (276)	110 **Ds** (281)	111 **Rg** (280)	112 **Cn** (285)	113 **Nh** (286)	114 **Fl** (289)	115 **Mc** (289)	116 **Lv** (293)	117 **Ts** (294)	118 **Og** (294)

* Lanthanide series	57 **La** 138.91	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.36	63 **Eu** 151.96	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.05	71 **Lu** 174.97
# Actinide series	89 **Ac** (227)	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

1] The equilibrium constant is given for two of the reactions below. Determine the value of the missing equilibrium constant. [1]

$2A(g) + B(g) \rightleftharpoons A_2B(g)$ $K_c = ?$

$A_2B(g) + B(g) \rightleftharpoons A_2B_2(g)$ $K_c = 16.4$

$2A(g) + 2B(g) \rightleftharpoons A_2B_2(g)$ $K_c = 28.2$

A) 11.8
B) 0.00216
C) 0.582
D) 462
E) 1.72

2] What is Δn for the following equation in relating K_c to K_p? [2]

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

A) 3
B) -1
C) -2
D) 2
E) 1

3] Consider the following reaction:

$CH_4(g) + 2\ H_2S(g) \rightleftharpoons CS_2(g) + 4\ H_2(g)$

A reaction mixture initially contains 0.50 M CH_4 and 0.75 M H_2S. If the equilibrium concentration of H_2 is 0.44 M, which of the following will allow you to find the equilibrium constant (K_c) for the reaction. [3]

a] $K_c = \frac{x(4x)^4}{(0.50-x)(0.75-2x)^2}$ where x = 0.44

b] $K_c = \frac{x(4x)^4}{(0.50-x)(0.75-2x)^2}$ where x = 0.11

c] $K_c = \frac{x(4x)}{(0.50-x)(0.75-2x)}$ where x = 0.11

d] $K_c = \frac{x(x)^4}{(0.50-x)(0.75-x)^2}$ where x = 0.44

e] $K_c = \frac{x(x)^4}{(0.50-x)(0.75-x)^2}$ where x = 0.11

4] Consider the following reaction at equilibrium. What effect will increasing the temperature have on the system? [4]

$C_3H_8(g) + 5\ O_2(g) \rightleftharpoons 3\ CO_2(g) + 4\ H_2O(l)$ $\Delta H° = -2220$ kJ

A) The reaction will shift to the left in the direction of reactants.
B) The reaction will shift to the right in the direction of products.
C) The equilibrium constant will increase.
D) The equilibrium constant will decrease.
E) No effect will be observed.

5] Which of the following species is amphoteric? [5]

A) CO_3^{2-}
B) HF
C) NH_4^+
D) HPO_4^{2-}
E) None of the above are amphoteric.

6] Calculate the pH of a solution that contains 7.8×10^{-6} M OH^- at 25°C. [6]

A) 1.28
B) 5.11
C) 12.72
D) 8.89
E) 9.64

7] Which of the following is a **weak** base? [7]

A) $NH(CH_3)_2$
B) N_2
C) NaOH
D) CH_2CH_2
E) None of the above are weak bases.

8] Calculate the pH of a buffer that is 0.225 M $HC_2H_3O_2$ and 0.162 M $KC_2H_3O_2$. The K_a for $HC_2H_3O_2$ is 1.8×10^{-5}. [8]

A) 4.89
B) 9.11
C) 4.60
D) 9.26
E) 4.74

9] Which of the following will allow the calculation the pH when 25.0 mL of 0.100 M acetic acid (HA) is mixed with 25.0 mL of 0.100 M NaOH. Ka = 1.8×10^{-5} 9

a] (mol OH^- added) = (mol acid) therefore pH = 7.00

b] (mol OH^- added) = (mol acid) therefore use $pH = pK_a + \log \frac{[base]}{[acid]}$

c] (mol OH^- added) = (mol acid) therefore use $A^- + H_2O \rightleftarrows HA + OH^-$

d] (mol OH^- added) > (mol acid) the pH is pK_a

e] (mol OH^- added) < (mol acid) the pH is ½ pK_a.

10] If the solubility of Ag_2CrO_4 in water is 6.3×10^{-5} M the Ksp for this compound is, 10

A) 1.0×10^{-12}

B) 5.0×10^{-2}

C) 3.0×10^{-3}

D) 2.6×10^{-13}

E) 9.1×10^{-7}

11] If the pKa of $HCHO_2$ is 3.74 and the pH of an $HCHO_2/NaCHO_2$ solution is 3.11, which of the following is **true**? 11

A) [$HCHO_2$] < [$NaCHO_2$]
B) [$HCHO_2$] = [$NaCHO_2$]
C) [$HCHO_2$] << [$NaCHO_2$]
D) [$HCHO_2$] > [$NaCHO_2$]
E) [$HCHO_2$] = ½ [$NaCHO_2$]

12] Which of the following is true for a spontaneous process? 12

A) $\Delta H_{sys} > 0$ & $\Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr} = 0$

B) $\Delta E_{univ} = \Delta E_{sys} + \Delta E_{surr} = 0$ & $\Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr} > 0$

C) $\Delta E_{univ} = \Delta E_{sys} + \Delta E_{surr} > 0$ & $\Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr} > 0$

D) $\Delta E_{univ} = \Delta E_{sys} + \Delta E_{surr} > 0$ & $\Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr} = 0$

E) $\Delta E_{univ} = \Delta E_{sys} + \Delta E_{surr} = 0$ & $\Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr} < 0$

13] ________ is a thermodynamic function that increases with the number of energetically equivalent ways to arrange components of a system to achieve a particular state.[13]

A) Heat of reaction
B) Free energy
C) Entropy
D) Enthalpy
E) Molar equivalence

14] Place the following in order of increasing entropy at 298 K. [14]

$C_2H_6(g)$, Pb(*s*), Mg(*s*), $CH_4(g)$

A) Mg, Pb, C_2H_6, CH_4
B) C_2H_6, CH_4, Pb, Mg
C) Pb, Mg, CH_4, C_2H_6
D) Mg, Pb, CH_4, C_2H_6
E) Pb, Mg, C_2H_6, CH_4

15] For the following example, identify the following. [15]

$H_2O(l) \rightarrow H_2O(g)$

A) a negative ΔH and a negative ΔS
B) a positive ΔH and a negative ΔS
C) a negative ΔH and a positive ΔS
D) It is not possible to determine without more information.
E) a positive ΔH and a positive ΔS

16] Determine the equilibrium constant for the following reaction at 298 K. [16]

$Cl(g) + O_3(g) \rightarrow ClO(g) + O_2(g)$ $\quad \Delta G° = -34.5$ kJ

A) 1.12×10^6
B) 0.986
C) 8.96×10^{-7}
D) 4.98×10^{-4}
E) 5.66×10^5

17] Consider the following reaction at constant P. Use the information here to determine the value of ΔS_{surr} at 298 K. Predict whether or not this reaction will be spontaneous at this temperature. [17]

$N_2(g) + 2\ O_2(g) \rightarrow 2\ NO_2(g)$ $\Delta H = +66.4$ kJ

A) ΔS_{surr} = +223 J/K, reaction is not spontaneous

B) ΔS_{surr} = -2656 J/K, reaction is spontaneous

C) ΔS_{surr} = -223 J/K, reaction is not spontaneous

D) ΔS_{surr} = +66.4 kJ/K, reaction is not spontaneous

E) ΔS_{surr} = -66.4 J/K, it is not possible to predict the spontaneity of this reaction without more information.

18] Which BrØnsted-Lowry acid is **not** considered to be a strong acid in water? [18]

A) HI

B) HBr

C) H_2SO_3

D) H NO_3

E) HCl

19] My recitation meets at

a) 12:30 pm on Thursdays
b) blank
c) blank
d) 2:30 pm on Thursdays

Answers

[1] E
[2] E
[3] B Kc = 0.038
[4] A
[5] D
[6] D
[7] A
[8] C
[9] C
[10] A x = 6.3e-5; (2x)2x = Ksp = 1.0e-12
[11] D
[12] B
[13] C
[14] D
[15] E
[16] A
[17] C
[18] C