Recitation Worksheet Two

Name: Key

UGA ID:

Textbook:
Chemistry & Chemical Reactivity
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Instructions:

- This recitation worksheet covers Ch. 1.7, 1R.
- Please enter your first and last name as it appears on the eLC roster (do not use a nickname that is not reflected in eLC).
- Your UGA myID is a combination of letters and numbers (example: Dr. Seivert's MyID is mds73312). **Do not use your 81x number**.
- Your completed worksheet has to be submitted to **Gradescope**. You have multiple options for submission:
  - You may use an app to annotate the worksheet by placing your answers in the answer boxes and showing your work when appropriate. Afterward, submit the worksheet to Gradescope. You will not need to upload anything to eLC.
  - You may print out the worksheet, write your answers in the answer boxes, and show your work on it when appropriate. Afterward, convert the worksheet to a PDF and submit to Gradescope. You will not need to upload anything to eLC.
  - If you do not have access to a printer, you may type your answers directly into the worksheet PDF and then submit it to Gradescope. Write your work on separate sheets of paper, convert them to a PDF, and upload to the appropriate dropbox on eLC.
  - There is a Gradescope app available for both iOS and Android devices that allows you to scan and submit your printed work, or you can submit your fillable PDF directly.
- The following criteria **must** be met to be eligible for full credit:
  - You must make sure the pages are in the correct order and have the same layout as the original worksheet when submitting to Gradescope regardless of your submission type.
  - Answers must be written in the corresponding answer boxes.
  - You must show your work when appropriate.
- This worksheet is due no later than **9:00 AM on the Saturday of the recitation week.**
- A periodic table and formula sheet are attached to the end of this worksheet. Please keep these attached to your worksheet in the correct order when submitting to Gradescope.

1. Which of the following statements are **true**?

D

A. A child sitting stationary on a swing has potential energy
B. The same child moving back and forth on the swing from the previous option has kinetic energy
C. Energy cannot be created or destroyed, and the total energy of the universe is constant
D. All of the above are true
E. None of the above are true

2. Express 784,000,000 in proper, exponential (scientific) notation.

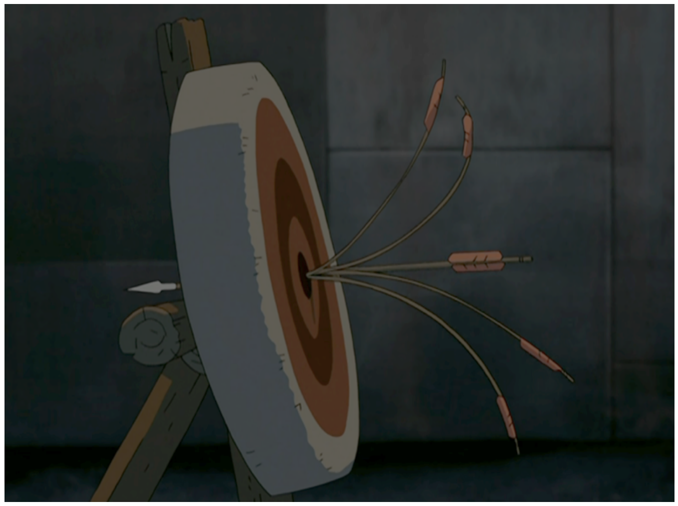
7.84×10^{8}

3. A student goes to the lab and is tasked with measuring the mass of a block of nickel metal that has a known mass of 16.00 grams. The student takes three different measurements in which they collect the following masses: 15.99 grams, 14.78 grams, and 15.29 grams. What statement best describes their results?

D

A. Their measurements are both precise and accurate
B. Their measurements are precise, but not accurate
C. Their measurements are accurate, but not precise
D. Their measurements are neither precise or accurate

4. In Season 1, Episode 13 of *Avatar: The Last Airbender*, the Yu Yan Archers are introduced, a group of skilled individuals important to the episode's plot. Commander Zhao, one of the characters in the show says, "their *precision* is legendary". An image from the episode below showcases their skills, in which one of the archers shoots three arrows separately wherein each subsequent arrow is shown piercing through the other, with all three ultimately going through the bullseye.



(a) Based on the image above, what would be a better representation of Commander Zhao's statement?

C

A. "their accuracy, but not precision, is legendary"
B. "their precision, but not accuracy, is legendary"
C. "their precision and accuracy is legendary"
D. None of the above, the Commander's original statement should be kept as is

(b) Near the end of the episode, Admiral Zhao (at this point he has received a promotion to Admiral) needs the Yu Yan Archers to shoot a single arrow at their opponent from a far distance using the element of surprise. It is assumed that they only have one attempt to make this work, in which the Admiral says "a situation like this requires...*precision*" alluding to his statement made earlier in the episode.

Was Admiral Zhao correct in saying precision (alone) was necessary?

B

A. Yes, precision alone was needed
B. No, only accuracy was needed
C. No, both accuracy and precision was needed
D. No, neither accuracy or precision was needed

5. Which of the following statements include exact values? Select any that apply and answer with capital letters and no spaces (e.g. ABCDE).

AC

A. There are 3 cars in the parking lot
B. A box weighs 45 grams
C. There are 100000 cm in 1 km
D. A certain metal has a density of 9.64 g/cm^3
E. The trip is 127.1 miles

6. Record the number of significant figures for each of the following values below. In each box, you only need to record the integer (e.g. for one sig fig, record "1"). If there is an infinite number of significant figures, write "INF".

(a) 4700 — 2

(b) 4700 grams — 2

(c) 4700 pencils — INF

(d) 4700. — 4

(e) 470.0 — 4

(f) 0.4700 — 4

(g) 00.4700 — 4

(h) 4700.0100 — 8

(i) 4.7000000×10^{32} — 8

(j) 0.000470000 — 6

7. If the melting point of indium is 156.2 °C, what will be the physical state of indium at 323 °F?

$\boxed{B}$ exceeds melting point

$156.2\,°C = \left(\frac{5}{9}\right)(°F - 32)$

$312.2\,°F$

A. Indium would be gaseous at 323 °F
B. Indium would be liquid at 323 °F
C. Indium would be solid at 323 °F

8. Liquid nitrogen is used to freeze biological samples quickly, as nitrogen is a liquid at 77 K. What is this temperature in degrees Fahrenheit? Report your answer in **standard notation**.

$\boxed{-321}$ °F

be careful - three sig figs

$77\,K = °C + 273.15$

$°C = -196.15\,°C$

$-196.15\,°C = \frac{5}{9}\,°F - 17.77778$ (inf) (inf)

$-178.37222 = \frac{5}{9}\,°F$

$°F = -321.07\,°F$

9. What are the correct abbreviations for the following units of measurement: microliter, picogram, and nanometer?

$\boxed{D}$

A. microliter: mL, picogram: pG, nanometer: Nm

B. microliter: mL, picogram: Pg, nanometer: nM

C. microliter: μL, picogram: Pg, nanometer: NM

D. microliter: μL, picogram: pg, nanometer: nm

E. microliter: ML, picogram: pg, nanometer: Nm

F. microliter: μL, picogram: Pg, nanometer: nM

10. Perform the following conversions below and report your answers in **scientific notation**.

(a) Convert 145.21 kg to mg:

$\boxed{1.4521} \times 10^{\boxed{8}}$ mg

$$\frac{145.21\ kg \mid 10^{3-(-3)}\ mg}{\mid 1\ kg}$$

(b) Convert 12.21 pm to Mm:

$\boxed{1.221} \times 10^{\boxed{-17}}$ Mm

$$\frac{12.21\ pm \mid 10^{-12-(6)}\ Mm}{\mid 1\ pm} = 12.21 \times 10^{-18}\ Mm$$

$$\downarrow$$

proper scientific notation $\hookrightarrow 1.221 \times 10^{-17}$ Mm

(c) Convert 1.73×10^5 m^3 to cm^3:

$\boxed{1.73} \times 10^{\boxed{11}}$ cm^3

$$1.73 \times 10^5\ m^3 \times \left(\frac{10^{0-(-2)}\ cm}{1\ m}\right)^3 = 1.73 \times 10^{11}\ cm^3$$

(d) Convert 42.1 cm^3 to nL:

$\boxed{4.21} \times 10^{\boxed{7}}$ nL

$$42.1\ cm^3 \times \left(\frac{1\ mL}{1\ cm^3}\right)\left(\frac{10^{-3-(-9)}\ nL}{1\ mL}\right) = 42.1 \times 10^6\ nL$$

$$= 4.21 \times 10^7\ nL$$

proper scientific notation

11. Complete the mathematical operations below and record your answers in the appropriate number of significant figures to receive full credit. Report your answers in **standard notation**.

(a) $0.05000 \times 21.000000 =$ $\boxed{1.050}$

4 sf 8 sf

(4 sf)

(b) $0.459 + 12.33 - 0.00100 =$ $\boxed{12.79}$

(two decimals)

(c) $141.010 - 13.99 + 1.0 =$ $\boxed{128.0}$

(one decimal)

(d) $(433.621 - 333.9) \times 11.900 =$ $\boxed{1190}$

$99.721 \times 11.900 = 1186.6799$

(one decimal) $= 1190$

(e) $\dfrac{(249.362 + 42)}{63.498} =$ $\boxed{4.59}$

$\dfrac{291.362}{63.498} = 4.5885$

12. Assuming 100 is an exact number in this mathematical expression, what is the answer to the percent calculation expressed to the correct number of significant figures? Report your answer in **standard notation**.

$$\frac{8.9250 - 8.905}{8.9250} \times 100 =$$

$\boxed{0.22}$ %

$\dfrac{0.020}{8.9250} \times 100 = 0.22409\ \%$

13. A student goes to their car and checks their tire pressure. They find the tire pressure is 33 psi (i.e. pound per square inch, or lb/in^2). Convert the pressure 33 lb/in^2 to mg/dm^2 (1 in = 2.54 cm; 1 kg = 2.205 lb). Report your answer in **scientific notation**.

$\boxed{2.3} \times 10^{\boxed{8}}$ mg/dm^2

$$\frac{33\ \text{lb}}{\text{in}^2}\left|\frac{1\ \text{kg}}{2.205\ \text{lb}}\right|\frac{10^{3-(-3)}\ \text{mg}}{1\ \text{kg}}\left|\left(\frac{1\ \text{in}}{2.54\ \text{cm}}\right)^2\right|\left(\frac{1\ \text{cm}}{10^{-2-(-1)}\ \text{dm}}\right)^2$$

14. An iodine atom has a diameter of 2.66×10^{-10} m. If iodine atoms are lined up so that they are just touching, how many of them would it take to have a line 1.00 feet long? Report your answer in **scientific notation**.

$\boxed{1.15} \times 10^{\boxed{9}}$ atoms

$$1.00\ \text{feet} \times \left(\frac{1\ \text{m}}{3.28\ \text{feet}}\right) \times \left(\frac{1\ \text{iodine atom}}{2.66 \times 10^{-10}\ \text{m}}\right)$$

15. In ancient times, volume was measured by the omer and weight by the shekel. Given the conversions below, calculate the density of gasoline (0.680 g/mL) in shekels/omer.

1.0 shekel = 14.1 g
1.00 omer = 3.964 L

$\boxed{D}$

A. 12.2 shekels/omer
B. 82.2 shekels/omer
C. 38.0 shekels/omer
D. 191 shekels/omer
E. 0.242 shekels/omer

$$\frac{0.680\ \text{g}}{\text{mL}}\left|\frac{1.0\ \text{shekel}}{14.1\ \text{g}}\right|\frac{1\ \text{mL}}{10^{-3-0}\ \text{L}}\left|\frac{3.964\ \text{L}}{1.00\ \text{omer}}\right.$$

volume displacement

16. A student fills a graduated cylinder with deionized water up to the 35.50 mL line. They then carefully place a copper rod into the cylinder and note that the new volume reading is 36.51 mL. If the density of copper is 8.96 g/cm^3, what was the mass of the copper rod (in grams)? Report your answer in **standard notation**.

9.05	g

$V = 36.51\ mL - 35.50\ mL = 1.01\ mL = 1.01\ cm^3$

$d = \frac{m}{V}$

$8.96\ g/cm^3 = \frac{m}{1.01\ cm^3} \rightarrow m = 9.05\ g$

volume displacement

17. Another student performing a similar experiment obtains a silver rod that has a mass of 23.99 grams and carefully places it in a graduated cylinder filled with deionized water. They note the new volume reading in the graduated cylinder is 110.25 mL. Unfortunately, the student forgot to take an initial reading of the volume in the cylinder prior to adding the silver rod. If the density of silver is 10.49 g/cm^3, what was the initial volume in the cylinder? Report your answer in **standard notation** and **five significant figures**.

107.96	mL

$d = m/V$

$10.49\ g/cm^3 = \frac{23.99\ g}{V} \rightarrow V = 2.2869399\ cm^3$ (or mL)

$110.25\ mL - 2.2869399\ mL = 107.9631\ mL$

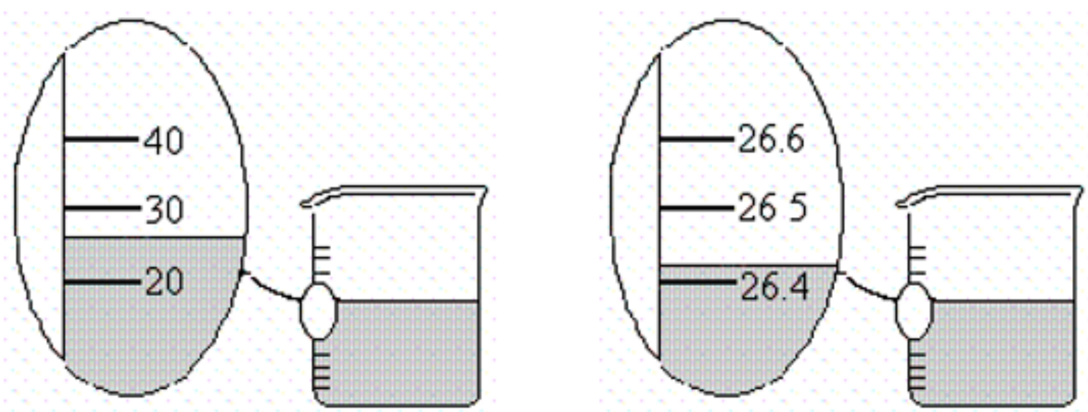
18. What is the length of the line with correct significant figures according to the ruler?

$\boxed{D}$

22.? m
↳ uncertin digit

A. 22 cm
B. 22.20 cm
C. 20 cm
D. 22.2 cm
E. The correct significant figures cannot be determined

19. Consider two different beakers filled with an unknown solvent below. Both beakers below have different levels of precision. If both beakers are poured into one container, what would be the volume to the correct number of significant figures?



$\boxed{A}$

26 mL
↳ uncertin digit

26.42 mL
↳ uncertin digit

A. 52 mL
B. 52.4 mL
C. 52.42 mL
D. 52.420 mL
E. All of the above are correct

Sum = 26 mL + 26.42 mL

= 52.42 mL

Extra Practice Questions: these questions will not be graded.

1. The degree of agreement among several measurements of the same quantity is called _______ and it reflects the reproducibility of a given type of measurement. The agreement of a particular value with the true value is called ________.

A

A. Precision, accuracy
B. Accuracy, precision
C. Exactness, precision
D. Exactness, correctness
E. Accuracy, correctness

2. Which of the following are exact numbers? Select any that apply and answer using capital letters with no spaces (e.g. ABCDE).

BC

A. A 1.00 lb block of cheese
B. 24 crayons in a box
C. 2.54 cm equal 1 inch
D. A 10.5 m tree
E. 4 cups of flour in a cake

3. Round 2.3459994 to five significant figures. Keep your answer in **standard notation**.

2.3460

4. In which item below is the result expressed **incorrectly** in terms of number of significant figures?

$\boxed{C}$

A. 3.14 x 2.584 = 8.11

B. 0.003/0.0015 = 2

C. 1.314 + 189.71 = ~~191.0~~ 191.02

D. 96.4 × 10^3 = 96,400

E. all results are expressed to the appropriate number of significant figures

5. Complete the mathematical operations below and record your answers in the appropriate number of significant figures. Report your answers in either scientific or standard notation.

(a) $29.1 \times (8.31 \times 10^4) \times 120 =$ $\boxed{2.9 \times 10^8}$

3 SF × 3 SF × 2 SF

(2 SF)

(b) $$\frac{(2.83000 \times 10^3) \times (1.2100 + 99.9)}{20.55} = \boxed{1.392 \times 10^4}$$

$$\frac{(2.83000 \times 10^3) \times (101.11)}{20.55} \rightarrow \frac{2.861413 \times 10^5}{20.55} = 1.39242 \times 10^4$$

(c) $(41.540 \times 2.71500) - 4.513 =$ $\boxed{108.27}$

112.7811 − 4.513 = 108.2681

(d) $$\frac{(2.36 \times 10^3) \times (2.360 \times 10^2)}{(2.3600 \times 10^1)} = \boxed{2.36 \times 10^4}$$

(3 SF)

volume displacement

6. A piece of indium with a mass of 16.6 g is submerged in a graduated cylinder containing 46.3 mL of water. After addition of this metal sample, the water level increases to 48.6 mL. What is the density (g/mL) of indium from these data? Report your answer in **standard notation**.

7.2

g/mL

48.6 - 46.3 mL = 2.3 mL

$$d = \frac{16.6\ g}{2.3\ mL}$$

7. Zirconium metal has a density of 6.49 g/cm^3. How many liters of zirconium are present in 5.41 pounds of this metal? Report your answer in **standard notation**. (1 pound = 453.59 grams)

0.378

L

$$5.41\ \text{pounds} \times \left(\frac{453.59\ g}{1\ \text{pound}}\right) \times \left(\frac{cm^3}{6.49\ g}\right) \times \left(\frac{1\ mL}{1\ cm^3}\right) \times \left(\frac{1\ L}{1000\ mL}\right)$$

8. Which of the following is an **incorrect** statement regarding unit systems?

B

A. There are more centimeters in a foot than there are inches in a foot.
B. There are 1×10^3 L in 1 mL.
C. A nanometer is larger than a picometer.
D. Kilograms are the base unit of mass in the SI system.

9. Which of the following options is at the highest temperature?

B

A. 71.4 °F
B. 22.1 °C
C. 294.65 K

10. A car uses oil at a rate of 1.5 quarts per 4250 miles. What is the rate of oil usage in milliliters/kilometer?

1 liter = 1.06 quarts
1 kilometer = 0.62137 miles

B

$$\frac{1.5 \text{ quarts}}{4250 \text{ miles}} \left| \frac{1 \text{ L}}{1.06 \text{ quarts}} \right| \frac{10^{0-(-3)} \text{ mL}}{1 \text{ L}} \left| \frac{0.62137 \text{ miles}}{1 \text{ km}} \right.$$

A. 1.4 mL/km
B. 0.21 mL/km
C. 890 mL/km
D. 0.14 mL/km

11. If one 5.0 ounce can of ginger ale contains 15 grams of sugar, and 1.0 grams of sugar contains four calories, how many calories are in a 12.0 ounce bottle of this same brand of ginger-ale? Report your answer in **standard notation**.

140 calories

$$12.0 \text{ ounces} \times \left(\frac{15 \text{ g sugar}}{5.0 \text{ ounces}}\right) \times \left(\frac{4.0 \text{ calories}}{1.0 \text{ g sugar}}\right)$$

12. A drug has a recommended dose of 4.00 mg/kg of body mass. If a person's body mass is 215 pounds, what dose in milligrams will this individual need? Report your answer in **standard notation**.
(1 pound = 453.59 g)

$\boxed{390.}$ mg

$$215 \text{ pounds} \times \left(\frac{453.59 \text{ g}}{1 \text{ pound}} \right) \times \left(\frac{10^{0-(-3)} \text{ kg}}{1 \text{ g}} \right) \times \left(\frac{4.00 \text{ mg}}{1 \text{ kg}} \right)$$

$$= 390. \text{ mg}$$

Periodic Table of the Elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.01																	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.63	33 As 74.92	34 Se 78.97	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc [97]	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
37 Cs 132.91	56 Ba 137.33		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]		104 Rf [267]	105 Db [268]	106 Sg [269]	107 Bh [270]	108 Hs [269]	109 Mt [277]	110 Ds [281]	111 Rg [282]	112 Cn [285]	113 Nh [286]	114 Fl [290]	115 Mc [290]	116 Lv [293]	117 Ts [294]	118 Og [294]

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
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]

Formula Sheet

Length
1 kilometer = 0.62137 mile
1 inch = 2.54 centimeters (exactly)
1 Ångstrom = 1×10^{-10} meter

Energy
1 joule = 1 $kg \cdot m^2/s^2$
1 calorie = 4.184 joules
1 Calorie = 1 kilocalorie = 1000 calories
1 L·atm = 101.325 joules

Pressure
1 pascal = 1 N/m^3 = 1 $kg/m \cdot s^2$
1 atmosphere = 101.325 kilopascals = 760 mm Hg = 760 torr = 14.70 lb/in^2
1 bar = 1×10^5 Pa (exactly)

Temperature
0 K = −273.15°C
K = °C + 273.15
°C = (5/9)(°F − 32)

Mass
1 kg = 2.205 lbs

Volume
1 mL = 1 cm^3 = 1 cc

Constants
$c = 2.998 \times 10^8$ m/sec
$h = 6.626 \times 10^{-34}$ J·sec
R = 0.08206 L·atm/mol·K = 8.314 J/mol·K
Specific heat of water = 4.184 J/g·K
Mass of an electron: 9.109×10^{-31} kg
Mass of a proton: 1.673×10^{-27} kg
RH = 2.18×10^{-18} J
Specific heat of water = 4.184 J/g·K
Avogadro's number: 6.022×10^{23}
F = 96485 J/(V·mol e^-)
$K_w = 1.0 \times 10^{-14}$ at 25 °C
$k_b = 1.381 \times 10^{-23}$ J/K

Equations
$(P + a(n^2/V^2)) \cdot (V - nb) = nRT$
molar mass (M) = mRT/PV
density (d) = MP/RT

$$KE = \frac{3}{2}RT$$

$$\mu_{rms} = \sqrt{\frac{3RT}{M}}$$

$$\frac{Rate\ of\ effusion\ A}{Rate\ of\ effusion\ B} = \sqrt{\frac{MW_B}{MW_A}}$$

$$\Delta E = -2.18 \times 10^{-18} J\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

$$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$C_g = kP_g$
$P_{solution} = P_{solvent}\, X_{solvent}$
$P_{solution} = \sum P_j = \sum P_j X_j$
$\pi = MRTi$

Thermodynamic and Electrochemistry

$S = k_b \times \ln(W)$
$\Delta S = q_{rev}/T$
$\Delta G = \Delta G° + RT \cdot \ln Q$
R=8.314 J/mol.K
$\Delta G° = -RT \cdot \ln K$
$\Delta G = -nFE_{cell}$
$E°_{cell} = RT/nF \ln K$
$E°_{cell} = (0.0257/n) \ln K = (0.0592/n) \log K$
$E_{cell} = E°_{cell} - (RT/nF) \ln Q$
$E_{cell} = E°_{cell} - (0.0257/n) \ln Q$
Electrolysis: Q (total charge) = I × t = n × F

Integrated Rate Laws & half-life

$$\ln\frac{[A]}{[A]_0} = -kt$$

$$\frac{1}{[A]} = kt + \frac{1}{[A]_0}$$

$$[A] = -kt + [A]_0$$

$$t_{1/2} = \frac{[A]_0}{2k}$$

$$t_{1/2} = \frac{\ln 2}{k} = \frac{0.693}{k}$$

$$t_{1/2} = \frac{1}{k[A]_0}$$

$$ln\frac{k_2}{k_1} = -\frac{\mathrm{E_a}}{\mathrm{R}}\left(\frac{1}{\mathrm{T_2}} - \frac{1}{\mathrm{T_1}}\right)$$

Equilibrium and Acid / Base

$K_P = K_c \times (RT)^{\Delta n}$

$$ln\frac{K_2}{K_1} = \frac{\Delta H°_{rxn}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$