Recitation Worksheet (Optional Extra Practice)

Name: key

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Textbook:

Chemistry & Chemical Reactivity

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Instructions:

- This recitation worksheet is optional extra practice for 17.3, 19.1
- You **do not** need to submit it to Gradescope.
- The answer key has been posted with this worksheet to eLC.
- A periodic table and formula sheet are attached to the end of this worksheet.

1. Calculate the molar solubility in mol/L of:

A. $Mg_3(AsO_4)_2$, $K_{sp} = 2.1 \times 10^{-20}$

$\boxed{4.5 \times 10^{-5}}$ M

① $Mg_3(AsO_4)_2(s) \rightleftharpoons 3Mg^{2+}(aq) + 2AsO_4^{3-}$

	$[Mg^{2+}]$	$[AsO_4^{3-}]$
Initial	0	0
Change	$+3s$	$+2s$
Equilibrium	$3s$	$2s$

② $K_{sp} = [Mg^{2+}]^3[AsO_4^{3-}]^2$

$= [3s]^3[2s]^2$

$= 108s^5$

$\therefore 2.1 \times 10^{-20} = 108s^5$

$\therefore s = \sqrt[5]{\frac{2.1 \times 10^{-20}}{108}}$

$= 4.547357596 \times 10^{-5}$ M

$\approx 4.5 \times 10^{-5}$

B. CeF_3, $K_{sp} = 8.0 \times 10^{-16}$

$\boxed{7.4 \times 10^{-5}}$ M

① $CeF_3(s) \rightleftharpoons Ce^{3+}(aq) + 3F^-(aq)$

	$[Ce^{3+}]$	$[F^-]$
Initial	0	0
Change	$+s$	$+3s$
Equilibrium	s	$3s$

② $K_{sp} = [Ce^{3+}][F^-]^3$

$8.0 \times 10^{-16} = [s][3s]^3$

$= 27s^4$

$\therefore s = \sqrt[4]{\frac{8.0 \times 10^{-16}}{27}}$

$= 7.377879463 \times 10^{-5}$ M

$\approx 7.4 \times 10^{-5}$ M

3. Which compound has the highest molar solubility?

$\boxed{E}$

A. AgCN, $K_{sp} = 5.97 \times 10^{-17}$
B. $PbSO_4$, $K_{sp} = 1.82 \times 10^{-8}$
C. PbS, $K_{sp} = 9.04 \times 10^{-29}$
D. NiS, $K_{sp} = 3.00 \times 10^{-20}$
E. $MgCO_3$, $K_{sp} = 6.82 \times 10^{-6}$

All ionic compounds have the same dissociation stoichiometry ∴ they can be ranked by solubility using Ksp

highest Ksp ∴ highest solubility

$PbS < NiS < AgCN < PbSO_4 < MgCO_3$

4. Calculate K_{sp} given the molar solubilities of the following compounds:

A. Barium phosphate, molar solubility 8.89×10^{-9} M

$\boxed{6.00 \times 10^{-39}}$

① $Ba_3(PO_4)_2(s) \rightleftharpoons 3Ba^{2+}(aq) + 2PO_4^{3-}(aq)$

	$[Ba^{2+}]$	$[PO_4^{3-}]$
Initial	0	0
Change	$+3S$	$+2S$
Equilibrium	$3S$	$2S$

② $K_{sp} = [Ba^{2+}]^3[PO_4^{3-}]^2$
$= [3S]^3[2S]^2$
$= 108S^5$
$= 108(8.89 \times 10^{-9})^5$
$= 5.99697945 \times 10^{-39}$
$\sim 6.00 \times 10^{-39}$

B. Ag_2S, molar solubility 1.26×10^{-16} M

$\boxed{8.00 \times 10^{-48}}$

① $Ag_2S(s) \rightleftharpoons 2Ag^+(aq) + S^{2-}(aq)$

	$[Ag^+]$	$[S^{2-}]$
Initial	0	0
Change	$+2S$	$+S$
Equilibrium	$2S$	S

② $K_{sp} = [Ag^+]^2[S^{2-}]$
$= [2S]^2[S]$
$= 4S^3$
$\therefore K_{sp} = 4(1.26 \times 10^{-16})^3$
$= 8.001504 \times 10^{-48}$
$\approx 8.00 \times 10^{-48}$

5. There are some data that suggest that zinc lozenges can significantly shorten the duration of a cold. If the solubility of zinc acetate, $Zn(CH_3COO)_2$, is 43.0 g/L, what is the solubility product, K_{sp} of this compound?

$\boxed{5.15 \times 10^{-2}}$ or 0.0515

① convert 43.0 g/L to mol/L

$$\frac{43.0\,g\ Zn(CH_3COO)_2}{1\,L} \times \frac{1\,mol\ Zn(CH_3COO)_2}{183.48\,g\ Zn(CH_3COO)_2} = 0.2343579682\ M$$

② $Zn(CH_3COO)_2(s) \rightleftharpoons Zn^{2+}(aq) + 2CH_3COO^-$

	$[Zn^{2+}]$	$[CH_3COO^-]$
Initial	0	0
Change	+s	+2s
Equilibrium	s	2s

③ $K_{sp} = [Zn^{2+}][CH_3COO^-]^2 = [s][2s]^2 = 4s^3 = 4(0.2343579682)^3 = 0.05148718689$
≈ 0.0515 or 5.15×10^{-2}

6. Which assignment of oxidation number is **INCORRECT** for the underlined element? Select all that apply. Insert letters without spaces in the answer box, example **ABCD.**

$\boxed{BE}$

~~A.~~ $K_2\underline{Cr}_2O_7$; +6
B. $\underline{N}H_3$; +3
~~C.~~ $H_2\underline{P}O_2^-$; +1
~~D.~~ $\underline{Se}O_3^{2-}$; +4
E. $Cu(\underline{N}O_3)_2$; +2

Ⓐ $K_2Cr_2O_7$ → 2−; K: 1+, Cr: ?
$(1 \times 2) + 2Cr + (7 \times (-2)) = 0$
$\therefore Cr = 6+$

Ⓑ NH_3 → 1+; N: ?
$\therefore (N) + (1 \times 1+) = 0$
$\therefore N = 3-$

Ⓒ $H_2PO_2^-$; O: 2−; H: 1+, P: ?
$(1+ \times 2) + P + (2 \times 2-) = 1-$
$\therefore P = 1+$

Ⓓ SeO_3^{2-}; O: 2−
$\therefore Se + (3 \times 2-) = 2-$
$\therefore Se = 4+$

Ⓔ $Cu(NO_3)_2$; O: 2−; Cu: 2+
$N + (3 \times -2) = 1-$
$\therefore N = 5+$

7. What is the coefficient of **Mn^{2+}** if the reaction below occurs in **acidic solution**?

C

$$S_2O_3^{2-} + MnO_4^- \longrightarrow SO_4^{2-} + Mn^{2+}$$

A. 5
B. 7
C. 8
D. 10
E. 14

① Oxidation: $S_2O_3^{2-}(aq) \rightarrow SO_4^{2-}(aq)$
Reduction: $MnO_4^-(aq) \rightarrow Mn^{2+}(aq)$

② Oxidation: $5H_2O + S_2O_3^{2-}(aq) \rightarrow 2SO_4^{2-}(aq) + 10H^+ + 8e^-$
Reduction: $5e^- + 8H^+ + MnO_4^-(aq) \rightarrow Mn^{2+}(aq) + 4H_2O$

③ Oxidation: $(5H_2O + S_2O_3^{2-}(aq) \rightarrow 2SO_4^{2-}(aq) + 10H^+ + 8e^-) \times 5$
Reduction: $(5e^- + 8H^+ + MnO_4^-(aq) \rightarrow Mn^{2+}(aq) + 4H_2O) \times 8$

③ Oxidation: $\cancel{25H_2O} + 5S_2O_3^{2-}(aq) \rightarrow 10SO_4^{2-}(aq) + \cancel{50H^+} + \cancel{40e^-}$
Reduction: $\cancel{40e^-} + \cancel{64H^+} + 8MnO_4^-(aq) \rightarrow 8Mn^{2+}(aq) + \cancel{32H_2O}$
$14H^+$ $\quad$ $7H_2O$

$14H^+(aq) + 5S_2O_3^{2-}(aq) + 8MnO_4^-(aq) \rightarrow 10SO_4^{2-}(aq) + 8Mn^{2+}(aq) + 7H_2O(l)$

check: 14H 8Mn 10S 47O $\quad$ 14H 8Mn 10S 47O

8. What is the oxidation half-reaction in the chemical reaction $Cr_2O_7^{2-}(aq) + Cl^-(aq) \longrightarrow Cr^{3+}(aq) + Cl_2(aq)$ balanced in acidic medium?

A

A. $2\ Cl^-(aq) \longrightarrow Cl_2(aq) + 2e^-$
B. $Cl_2(aq) + 2e^- \longrightarrow 2\ Cl^-(aq)$
C. $Cr_2O_7^{2-}(aq) + 14\ H^+(aq) + 6e^- \longrightarrow 2\ Cr^{3+}(aq) + 7\ H_2O(l)$
D. $Cr_2O_7^{2-}(aq) + 14\ H^+(aq) \longrightarrow 2\ Cr^{3+}(aq) + 7\ H_2O(l) + 6e^-$

Oxidation half-reaction:
$2Cl^-(aq) \rightarrow Cl_2(aq) + 2e^-$

Reduction half-reaction:
$6e^- + 14H^+(aq) + Cr_2O_7^{2-}(aq) \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$

9. What is the **reducing agent** in the following reaction between hexacyanoferrate (II) complex and hydrogen peroxide in acidic solution?

A

$$2\ [Fe(CN)_6]^{4-} + \overset{1+\ 1-}{H_2O_2} + 2\ \overset{1+}{H^+} \longrightarrow 2\ [Fe(CN)_6]^{3-} + 2\ \overset{1+\ 2-}{H_2O}$$

Reducing agent is oxidized (oxidation state of [Fe(CN)6] decreases

A. $[Fe(CN)_6]^{4-}$
B. H_2O_2
C. H^+
D. $[Fe(CN)_6]^{3-}$
E. H_2O

10. Which of the following equations are an oxidation-reduction reaction? Select all that apply. Insert letters without spaces in the answer box, example **ABCD.**

BCD

A. $H_2CO_3(aq) \longrightarrow H_2O(l) + CO_2(g)$
B. $2\ Li(s) + 2\ H_2O(l) \longrightarrow 2\ LiOH(aq) + H_2(g)$
C. $C_3H_8(g) + 5\ O_2(g) \longrightarrow 3\ CO_2(g) + 5\ H_2O(g)$
D. $4\ Ag(s) + PtCl_4(aq) \longrightarrow 4\ AgCl(s) + Pt(s)$
E. $2\ HClO_4(aq) + Ca(OH)_2(aq) \longrightarrow 2\ H_2O(l) + Ca(ClO_4)_2(aq)$
F. $3\ Cu(NO_3)_2(aq) + 2\ Na_3PO_4(aq) \longrightarrow 6\ NaNO_3 + Cu_3(PO_4)_2$

Redox reactions:

1) Single replacement (single displacement)
2) Combustion reaction

Reactions that are not redox:

1) Double replacement
2) Acid-base reactions
3) Decomposition reactions

11. Given the following laboratory observation, which of the following statements is **FALSE**?

C

1 $\overset{0}{Zn}(s) + \overset{2+}{Cu}\overset{1-}{Br_2}(aq) \longrightarrow \overset{0}{Cu}(s) + \overset{2+}{Zn}\overset{1-}{Br_2}(aq)$
2 $Cu\ (s) + ZnBr_2(aq) \longrightarrow$ No Reaction

~~A.~~ Zn is a stronger reducing agent than Cu. True
~~B.~~ Cu^{2+} is a stronger oxidizing agent than Zn^{2+}. True
C. Cu is a stronger reducing agent than Zn.
~~D.~~ The fact that Cu doesn't react with $ZnBr_2$ proves that copper attracts electrons more than does Zn.
~~E.~~ None of the above.

From reaction 1: In the single replacement reaction Zn replaces Cu^{2+} in $CuBr_2$ & gets oxidized ∴ Zn^{0} is a stronger reducing agent than Cu (also because reaction 2 does not occur)

12. The solubility of a salt MX_2 with a molar mass of 114 g/mol is 3.42 g/L. Calculate K_{sp}.

B

A. 2.70×10^{-5}
B. 1.08×10^{-4}
C. 9.00×10^{-4}
D. 2.25×10^{-4}
E. 6.75×10^{-8}

1 $MX_2(s) \rightleftharpoons M^{2+}(aq) + 2X^-(aq)$

	$[M^{2+}]$	$[X^-]$
Initial	0	0
Change	+S	+2S
Equilibrium	S	2S

2 convert $\dfrac{3.42\ g\ MX_2}{L} \times \dfrac{1\ mol\ MX_2}{114\ g\ MX_2} = \dfrac{0.030\ mol}{L} = S$

$K_{sp} = [M^{2+}][X^-]^2$

$\therefore K_{sp} = [S][2S]^2 = 4S^3$ → brackets indicate conc. in $\frac{mol}{L}$

$\therefore K_{sp} = 4(0.030)^3 = 1.08 \times 10^{-4}$

13. Select a statement that best describes the oxidation process.

D

some elements

A. In the oxidation process ~~all elements~~ change oxidation state. some elements
B. In the oxidation process ~~all elements~~ experience an increase in oxidation state.
C. In the oxidation process some elements change their oxidation state.
D. In the oxidation process some elements experience oxidation state increase.
E. In the oxidation process only oxygen increases its oxidation state.

Other element can also experience oxidation or an increase oxidation state

14. Trace amounts of oxygen gas can be "scrubbed" from gases using the following reaction:

A

$$4\ Cr^{2+}(aq) + \overset{0}{O_2}(g) + 4\ H^+(aq) \rightarrow 4\ Cr^{3+}(aq) + 2\ \overset{1+\ 2-}{H_2O}(l)$$

Which of the following statements is true regarding this reaction?
A. Oxygen gas is reduced to water.
B. Cr^{2+}(aq) is the ~~oxidizing agent~~. reducing agent because it gets oxidized to Cr^{3+}
C. O_2(g) is the re~~ducing agent~~. oxidizing agent because it gets reduced to O^{2-}
D. Electrons are transferred from O_2 to Cr^{2+}.

electrons are transferred from Cr^{2+} to O_2

15. Balance the following equation for an oxidation-reduction reaction occurring in an acidic solution:

D

$$IO_3^-(aq) + N_2H_4(aq) \rightarrow I^-(aq) + N_2(g) + H_2O(l)$$

The sum of the coefficients is
A. 8
B. 25
C. 18
D. 16
E. 32

Oxidation: $N_2H_4(aq) \longrightarrow N_2(g) + 4H^+(aq) + 4e^-$
Reduction: $6e^- + 6H^+(aq) + IO_3^-(aq) \longrightarrow I^-(aq) + 3H_2O(l)$

Oxidation: $(N_2H_4(aq) \longrightarrow N_2(g) + 4H^+(aq) + 4e^-)\times 6$
Reduction: $(6e^- + 6H^+(aq) + IO_3^-(aq) \longrightarrow I^-(aq) + 3H_2O(l))\times 4$

Oxidation: $6N_2H_4(aq) \longrightarrow 6N_2(g) + \cancel{24H^+}(aq)$
Reduction: $\cancel{24H^+(aq)} + 4IO_3^-(aq) \longrightarrow 4I^-(aq) + 12H_2O(l)$

$6N_2H_4(aq) + 4IO_3^-(aq) \longrightarrow 6N_2(g) + 4I^-(aq) + 12H_2O(l)$ ← divide by to simplify
$3N_2H_4(g) + 2IO_3^-(aq) \longrightarrow 3N_2(g) + 2I^-(aq) + 6H_2O(l)$

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
$h = 6.626 \times 10^{-34}$ $J{\cdot}sec^{-1}$
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
STP = 273.15 K and 1 atm
Avogadro's number: 6.022×10^{23}

Equations
d (density) = m/V
$P_1V_1=P_2V_2$
$V_1/T_1=V_2/T_2$
$P_1V_1/n_1T_1=P_2V_2/n_2T_2$
$PV=nRT$
$(P + a(n^2/V^2))\cdot(V - nb) = nRT$
molar mass (M) = mRT/PV
density (d) = MP/RT
$x_A = n_A/n_{tot} = P_A/P_{tot} = V_A/V_{tot}$
$P_{tot} = P_A + P_B + \ldots$
$n_{tot} = n_A + n_B + \ldots$

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

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

$Q = C \times \Delta T = c_{specific} \times m \times \Delta T$
$Q = n \times \Delta H$ (kJ/mol) $= m \times \Delta H$ (kJ/g)
$w = -P\Delta V$
$\Delta E = q + w$
$\Delta H° = \Sigma n\Delta Hf°(\text{products}) - \Sigma n\Delta Hf°(\text{reactants})$
$\Delta H° = \Sigma n\Delta H°(\text{bonds broken}) - \Sigma n\Delta H°(\text{bonds formed})$
$E=h\nu$
$c=\lambda\nu$
$\lambda = h/mv$

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

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

$C_g = kP_g$
$P_{solution}=P_{solvent}\ X_{solvent}$
$P_{solution}=\sum P_j=\sum P_jX_j$
$\Delta T_b = K_b m i$
$\Delta T_f = K_f m i$
$\pi = MRTi$

Thermodynamic and Electrochemistry

$S = k_b \times \ln(W)$
$k_b = 1.381 \times 10^{-23}$ J/K
$\Delta S = q_{rev}/T$
$\Delta S_{surr} = q_{surr}/T = -q_{rev}/T$
$\Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr}$
$\Delta S°_{rxn} = \Sigma v S°_{products} - \Sigma v S°_{reactants}$
$\Delta H°_{rxn} = \Sigma v H°_{products} - \Sigma v H°_{reactants}$
$\Delta G°_{rxn} = \Sigma v G°_{products} - \Sigma v G°_{reactants}$
$\Delta G = \Delta H - T\Delta S$
$\Delta G = \Delta G° + RT\cdot\ln Q$
$R=8.314$ J/mol.K
$\Delta G° = -RT\cdot\ln K$
$\Delta G= -nFE_{cell}$
$F = 96485$ J/(V·mol e^-)
$E°_{cell} = RT/nF \ln K$
$E°_{cell} = (0.0257/n) \ln K = (0.0592/n) \log K$
$E_{cell} = E°_{cell} - (RT/nF) \ln Q$
$E_{cell} = E°_{cell} - (0.0257/n) \ln Q$
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

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

pH = $-\log[H_3O^+]$

$K_w = 1.0 \times 10^{-14}$ at 25 °C

$K_w = [H_3O^+] \times [OH^-]$

$K_w = K_a \times K_b$

$pK_a = -\log[K_a]$

Buffer: pH = $pK_a + \log\frac{[A^-]}{[HA]}$

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

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]