Updated July 07/06 **CHAPTER 8 ANSWERS**

NUMERICAL ANSWERS TO ASSIGNED TUTORIAL PROBLEM SETS FOR CHEM205
FROM KOTZ & TREICHEL'S CHEMISTRY & CHEMICAL REACTIVITY, **6th Ed.**

NOTE: none of the answers from Ch.8 have been verified. Please report any errors.

Ch.	Q#	Comments
8	2	Mg: $1s^2 2s^2 2p^6 3s^2$ Mg in group 2A, has 2 e^-s in outer shell (2 valence e^-s) Ar: $1s^2 2s^2 2p^6 3s^2 3p^6$ Ar in group 8A, has 8 e^-s in outer shell (8 valence e^-s)
8	6a	Sr: $[Kr]5s^2$
	6b	Zr: $[Kr]4d^2 5s^2$
	6c	Rh: $[Kr]4d^7 5s^2$ ...but actually observed as $[Kr]4d^8 5s^1$
	6d	Sn: $[Kr]4d^{10} 5s^2 5p^2$
8	12a	draw orbital boxes for: Na^+: $1s^2 2s^2 2p^6$
	12b	draw orbital boxes for: Al^{3+}: $1s^2 2s^2 2p^6$
	12c	draw orbital boxes for: Ge^{2+}: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$
	12d	draw orbital boxes for: F^-: $1s^2 2s^2 2p^6$
8	16	draw orbital boxes for: Ni^{2+}: $[Ar]\ 3d^8 4s^0$ → paramagnetic
8	16	draw orbital boxes for: Ni^{3+}: $[Ar]\ 3d^7 4s^0$ → paramagnetic
8	20a	18 e^-
	20b	10 e^-
	20c	1 e^-
	20d	none; when $\ell = 0$, m_ℓ can only have value of 0
8	22	P: $[Ne]3s^2 3p^3$ with 1e^- in each of the p orbitals $n=3, \ell=0, m_\ell = 0, m_s = +\frac{1}{2}$ $n=3, \ell=0, m_\ell = 0, m_s = -\frac{1}{2}$ $n=3, \ell=1, m_\ell = -1, m_s = +\frac{1}{2}$ $n=3, \ell=1, m_\ell = 0, m_s = +\frac{1}{2}$ $n=3, \ell=1, m_\ell = +1, m_s = +\frac{1}{2}$
8	26	P < Ge < Ca < Sr < Rb
8	28a	Cs > Rb
	28b	$O^{2-} > O$
	28c	As > Br
8	32a	Al
	32b	Al
	32c	C (based on periodic trends); Si (according to experimental data)
	32d	Al < B < C
8	34a	F < O < S trend: increase across period, decrease down group
	34b	based on trends: predict highest I.E. for S. However, I.E. of O < N, and same thing observed for 3rd row --> real I.E. order = Si < Se < S < P

Ch.	Q#	Comments
8	34c	$F^- < O^{2-} < N^{3-}$ isoelectronic; size decreases as eff. nucl. charge increases
8	34d	Cs < Ba < Sr trend: increase to right, decrease down table
8	38a	draw orbital boxes for: Ce: [Xe] $4f^1$ $5d^1$ $6s^2$
8	38a	draw orbital boxes for: Ce^{3+}: [Xe] $4f^1$
8	38b	draw orbital boxes for: Ho: [Xe] $4f^{11}$ $5d^0$ $6s^2$
8	38b	draw orbital boxes for: Ho: [Xe] $4f^{11}$
8	42	$n = 4, \ell = 1, m_\ell = -1, m_s = +\frac{1}{2}$ $n = 4, \ell = 1, m_\ell = -1, m_s = -\frac{1}{2}$ $n = 4, \ell = 1, m_\ell = 0, m_s = +\frac{1}{2}$ $n = 4, \ell = 1, m_\ell = 0, m_s = -\frac{1}{2}$ $n = 4, \ell = 1, m_\ell = -1, m_s = +\frac{1}{2}$ $n = 4, \ell = 1, m_\ell = -1, m_s = -\frac{1}{2}$
8	44a	phosphorus
8	44b	beryllium
8	44c	nitrogen
8	44d	technetium
8	44e	chlorine
8	44f	zinc
8	48	a = alkaline earth metal; b = nonmetal (halogen); c = B; d = B.
8	52a	$Ca^{2+} < K^+ < Cl^-$
8	52b	$Cl^- < K^+ < Ca^{2+}$
8	52c	$Cl^- < K^+ < Ca^{2+}$
8	56a	V, vanadium
	56b	group 5B, period 4
	56c	transition element
	56d	paramagnetic, 3 unpaired e^-s
	56e	$n = 3, \ell = 2, m_\ell = -2, m_s = +\frac{1}{2}$ $n = 3, \ell = 2, m_\ell = -1, m_s = +\frac{1}{2}$ $n = 3, \ell = 2, m_\ell = 0, m_s = +\frac{1}{2}$ $n = 4, \ell = 0, m_\ell = 0, m_s = +\frac{1}{2}$ $n = 4, \ell = 0, m_\ell = 0, m_s = -\frac{1}{2}$
8	60	I.E. increases across P.T. and decreases down P.T. decrease occurs because e^- farther from nucleus, & electrostatic attractions between + nucleus and - electrons is distance dependent
8	64	Ca is smaller than K (Ca's valence e-s feel higher effective nuclear charge, Z*) ⇨ 1st IE Ca > 1st IE K. After 1st ionization: K^+ has noble gas configuration. K^+'s valence e^-s are in a lower energy shell (n=3 instead of n=4) so are closer to the nucleus, what we consider part of the potassium atom's electron core. Thus, removing the 2nd e^- requires much more E than removing the 1st e^-. Ca can lose a 2nd e^- more easily because this 2nd e^- comes from the same energy level (n=4 shell) as the 1st; the resulting Ca^{2+} has a noble gas configuration. Make sure you properly assign cause & effect: it's not that forming a noble gas configuration is particularly easy, it's that breaking a noble gas configuration (*e.g.,* $K^+ \rightarrow K^{2+} + e^-$) is so much more difficult because of the lower E of the e^- you are trying to remove and because of the increase in effective nuclear charge felt by this e^- (*e.g.,* K^{2+} has higher Z* than K^+).

Ch.	Q#	Comments
8	68	The 5th & 6th period transition metals have similar atomic radii. The 6th period transition metals have a higher mass per atom, which results in a higher density for the 6th row transition metals (assuming the atoms pack together in similar arrangements without any huge empty spaces…which they do…)
8	72a	reducing agent = Na. Sodium has low I.E., which plays a major role in making it good at reducing other substances.
8	72b	oxidizing agent = Cl_2. Chlorine has high E.A., which helps in this role….
8	72c	Na_2Cl would have a Cl^{2-} ion. Adding a 2nd e^- to Cl^- would involve putting an e^- into a higher energy level (higher n value electron shell), which is energetically unfavourable. Conversely, $NaCl_2$ would contain a Na^{2+} ion. This would require removing an e^- from Na's core, which is also energetically unfavourable (see #64).