

Chapter 3/13 Book Exercises

	Per	Group
1) a) He	1	18
b) Cl	3	17
c) Ba	6	2
d) Fr	7	1

2) a) Periods are rows on the Periodic table and indicate the number of occupied electron principle energy levels. Groups are columns and indicate (for s and p blocks) the number of valence electrons.

b) 3rd period, 15th group
 $1s^2 2s^2 2p^6 3s^2 3p^3$

3) Atomic # 51 = Sb and has 5 valence e⁻.

4) Ge (C)

5) B graphite (has "delocalized" free flowing e⁻)

6) C atomic #

7) a) atomic radius = $\frac{1}{2}$ distance between neighboring nuclei. This is approximately the distance between the nucleus and outermost e⁻.

b) i) Noble gases do not have given atomic radii due to their resistance for bonding or coming in close contact w/ neighboring atoms

ii) Trend across period 3 atomic radii is that it gets smaller. This is due to increase of ENL where attraction of outer e⁻ with p⁺ increases pulling them closer to nucleus.

8) Si^{4+} is much smaller than Si^{4-} because it has lost a 3rd principle E level so is isoelectronic w/ Ne. Si^{4-} has gained 4e⁻ and is isoelectronic w/ Ar. It still has the 3rd E level and w/ additional 4e⁻, has more repulsion pushing e⁻ out farther.

9) A

10) B it takes energy to: add a second e⁻ to O⁻
remove e⁻ from Ca

11) B

12) D

13) a) K^+ loses the 4th E level and K still has the 4th so is larger.

b) from $\text{Si}^{4+} \rightarrow \text{P}^{3-}$, the loss of the 3rd E level for Si^{4+} makes it much smaller compared to P^{3-} which has added e⁻ causing e⁻ repulsion and a larger ion.

c) Na^+ lost an E level but is isoelectronic w/ F and Ne. So the difference in size is a result of e⁻ repulsion of other e⁻ and inner in F^-

14) S_8 vs P_4 (how they tend to exist)

S_8 will have more London disp. forces as it is a larger molecule, so will have a higher m.p.

15) D

16) C (# of p⁺)

17) $\text{Cl}^- > \text{Cl} > \text{Cl}^+$

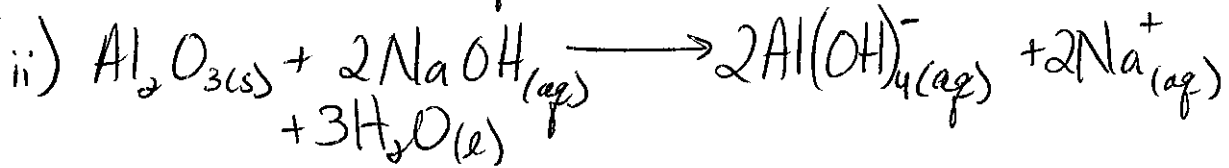
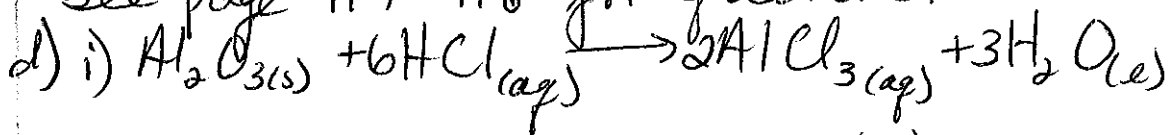
- 18) B U
- 19) C nuclear chg + electroneg.
- 20) D melting pt.
- 21) B $Cl^- > K^+ > Ca^{2+}$
- 22) heat is produced and can ignite the H_2 formed
the solution product is alkaline
- $$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$
- 23) D chemical reactivity
- 24) alkali metals increase in reactivity down the group.
halogens decrease in reactivity down the group.
- 25) C melting pt.
- 26) D $K + Cl_2$
- 27) D (pg. 109)
- 28) A nucleus has relative chg. of +117
- 29) A Mg
- 30) B N and P
- 31) D $SO_3(g)$

$$25^{\circ}\text{K} = 273 + 25 = 298\text{K}$$

32) a) MgO + SiO_2 solids, P_4O_{10} liquid, SO_2 is gas

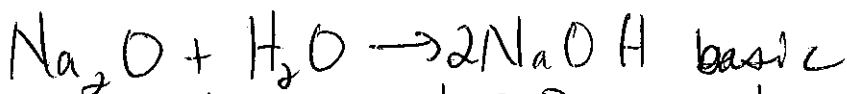
b) Ionic is strongest bonding here so MgO will have highest m.p. SiO_2 is a giant network covalent w/ a high # of bonds and will have a high m.p. (we will discuss more next chapter). P_4O_{10} has more London dispersion forces than SO_2 so P_4O_{10} is liquid and SO_2 is a gas

c) MgO = basic SiO_2 = acidic, P_4O_{10} and SO_2 = acids
see page 117-118 for equations.



33) Na and Mg oxides have basic character
Al has amphoteric character (acts as acid and as base)

Si, P, S, Cl ~~oxides~~ oxides have acidic character
Ar does not form oxides



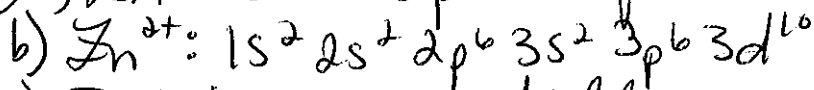
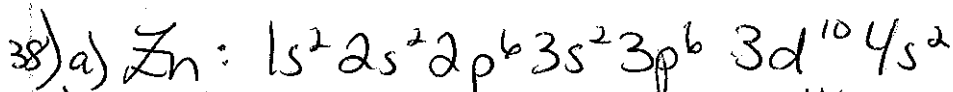
34)

	3d				4s
Sc ³⁺					
Ti ³⁺	1				
Ni ²⁺	1	1	1	1	1
Zn ²⁺	1	1	1	1	1

correct answer

← characteristic of metals, not just T.M.

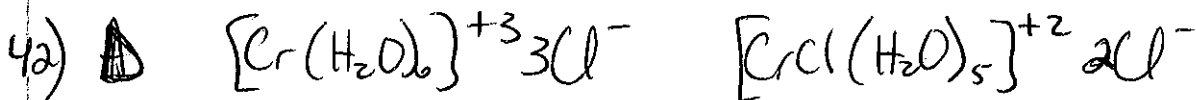
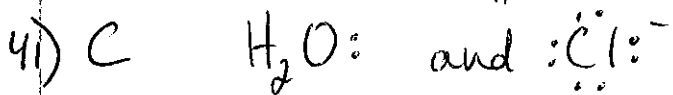
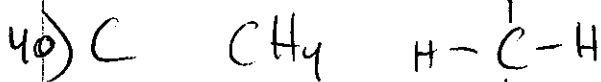
- 35) B and D but some exceptions such as Sc + Zn
36) B + Z
37) D (Vanadium)



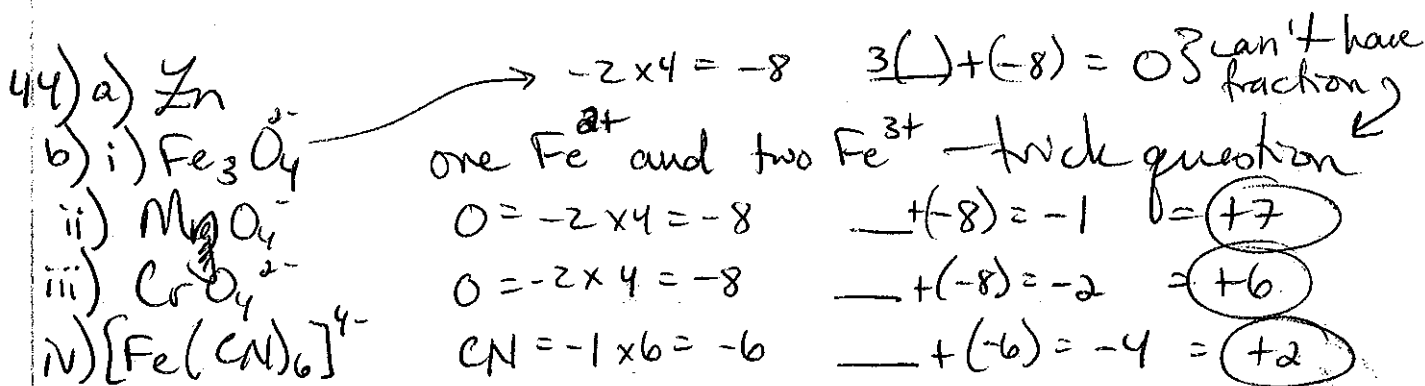
c) T.M. have a partially or incomplete d sub-shell or can give rise to cations w/ an incomplete d-sub shell.
Zn still has a full $3d^{10}$ even when as a cation.



Chromium has $2+$ oxidation state like calcium but still has a partially filled d sub-shell even when $4s^1$ and $1e^-$ from $3d$ is lost. Having the ability to lose d electrons enables Cr to have more oxidation states while Ca can only lose 2 before hitting a jump in ionization energy (see fig. 3.12).



43) C a pair of non-bonding e^-



45) a) d^2

b) square planar

c) homogeneous catalyst — same phase as reactants so will not get stuck in blood / blood vessels.

46) a) Ni

b) V_2O_5

c) Pd + Pt

47) a) heterogeneous catalysts are of a different state than the reactants. Homogeneous catalysts are in the same state as the reactants

b) heterogeneous T.M. catalysts provide a surface for reactants by weak bonding of the reactants w/ the 4s and 3d e⁻

c) heterogeneous catalysts are used in industry as they can easily be filtered out after the reaction occurs.

48) Mn D

49) D Cr

50) Zn is diamagnetic because it has no unpaired e^- to generate a magnetic field proportional to the one applied.

Cr is the most paramagnetic because it has a $4s^1 3d^5$ configuration so 6 e^- that are unpaired for maximum magnetism in this category.

51) $[Co(H_2O)_6]^{2+}$ and $[CoCl_4]^{2-}$

both have same oxidation state and type of metal

- # of ligands (coordination #)

- type of ligand and geometry of complex

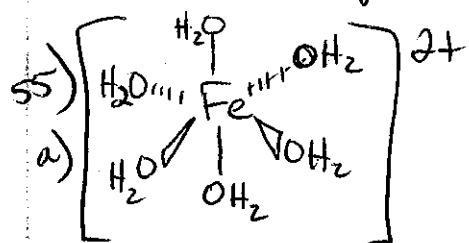
These variables alter the Δ of the complexes by changing the degree/distance of the ~~orbital~~ d orbitals splitting.

- 52) a) The nuclear charge of Fe is greater than Cr
b) The oxidation state of Fe^{3+} is higher than Fe^{2+} so will absorb ~~higher~~ a lower λ of E than Fe^{2+}
c) The NH_3 ligand is higher E on the spectrochemical series than H_2O causing a greater split of d orbitals

53) Fe^{2+} is colored because it has partially filled d sub-shell so e^- can be excited to a ~~higher~~ higher orbital $\underline{\quad} \underline{\quad} \underline{\quad} \underline{\quad} \underline{\quad} \underline{\quad}$ there are no open orbitals in Zn^{2+} so there cannot be colored solutions.

Fe^{2+} can reduce (lose e^- to another chemical species) other chemical species because it is able to lose more of the 3d electrons whereas Zn^{2+} is stable with $3d^{10} e^-$ and is ~~less~~ more stable so is not able to reduce other chemical species.

54) absorbance is $\sim 525 \text{ nm}$ which is green so the color of the complex is red.



b) splitting is greater in $[\text{Fe}(\text{CN})_6]^{4-}$ than $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ because CN^- produces a stronger field than H_2O

56) a) Fe^{3+} and Cr^{3+} have different charge densities so the interactions between the metal and the ligands are different $\text{Fe} >$ repulsion

b) oxidation state of Fe^{3+} and Fe^{2+} are different. Greater splitting occurs with lower oxidation state as fewer repulsions of d e^- occurs.