

Review Packet #3 - Random Topics

Topic 3, 7

1) a)  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^3$

b) for the two electrons in the 4s: 4, 0, 0, +1/2 and 4, 0, 0, - 1/2

for the three electrons in the 4p: 4, 1, -1, +1/2; 4, 1, 0, +1/2 and 4, 1, +1, +1/2

c) Paramagnetic. It has three unpaired electrons.

d)  $Na_3As$  - each Na gives up one electron to the As, the As has a complete octet and the sodium atoms are ionically bonded to the arsenic

$AsCl_3$  - the three chlorines each have one half-filled orbital and the arsenic has three. So three covalent bonds are created and the As has one non-bonding pair to make a pyramidal structure.

$AsF_5$  - fluorine is so electronegative that it draws the two electrons of the non-bonding pair of  $AsCl_3$  into bonding. A 4d orbital is involved in the  $sp^3d$  hybridization, yielding a trigonal bipyramidal shape.

2)a) three points

Electron configuration of Na and Mg (1 pt)

Any one earns a point:

Octet / Noble gas stability comparison of Na and Mg

Energy difference explanation between Na and Mg

Size difference explanation between Na and Mg

Note: If only Na or Mg is used 1 point can be earned by showing the respective electron configuration and using one of the other explanations

Shielding/effective nuclear charge discussion earns the third point.

b) one point

Correct direction and explanation of any one of the following:

shielding differences

energy differences

# of proton/ # of electron differences

c) two points Any one set earns one point:

(i) Ni unpaired electrons. paramagnetic

(ii) Zn paired electrons/ diamagnetic

(iii) Ni unpaired electrons/ Zn paired electrons

(iiii) Ni paramagnetic/ Zn diamagnetic

Orbital discussion/ Hund's Rule/ Diagrams earns the second point.

d) two points

Expanded octet or  $sp^3d$  hybrid of phosphorous (1 pt)

Lack of d orbitals in nitrogen (1 pt) OR

nitrogen is too small to accommodate (or bond) 5 Fluorines or 5 bonding sites (2 pts)

3(a) Any of the following:

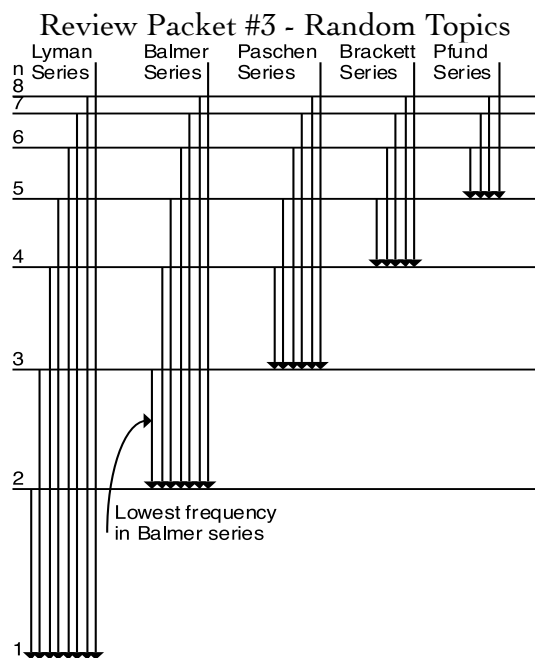
Quantized energy levels. Discrete energies.

Wave properties of electron result in discrete energy state.

(b) An electron in an excited-state atom can go to any of several lower energy states.

The lines in each series represents shifts from several higher energy states to a single lower energy state, identified by the same principal quantum number or energy.

(c)



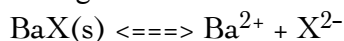
(d) Emission spectra obtained when electrons in excited atoms drop to lower energy levels.

Absorption spectra obtained when electrons in atoms in ground (or lower energy) state absorb electromagnetic radiation and move to higher energy states.

H atoms at  $25^\circ\text{C}$  are in lowest electronic energy state ( $n = 1$ ) and so the only absorptions will result from electrons moving from  $n = 1$  to higher levels.

1) a) 3 points

Recognition that dissolution is favored by shift to right of equilibrium,



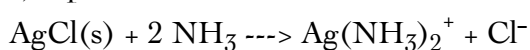
Recognition that conversions,  $\text{CO}_3^{2-} \rightarrow \text{HCO}_3^-$  and  $\text{SO}_3^{2-} \rightarrow \text{HSO}_3^-$  caused by  $\text{H}^+$ , result in greater solubility of the carbonate and sulfite

Recognition that  $\text{H}^+$  does not react appreciably with  $\text{SO}_4^{2-}$ , so as to increase the solubility of the sulfate, since  $\text{SO}_4^{2-}$  is a poor base (or equivalent)

b) 1 point

The sulfide ion is oxidized by warm nitric acid, shifting  $\text{CuS(s)} \rightleftharpoons \text{Cu}^{2+} + \text{S}^{2-}$  to the right.

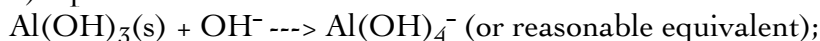
c) 2 points



Recognition that  $\text{NH}_3$  complexes Ag

Recognition of  $\text{Ag}(\text{NH}_3)_2^+$  complex and that  $\text{Hg}_2^{2+}$  and  $\text{Pb}^{2+}$  do not form soluble ammine complexes

d) 2 points



$\text{Fe}(\text{OH})_3$  does not react in this way.

Recognition of amphoterism of  $\text{Al}(\text{OH})_3$

2)a) 3 points

Add water to the mixture.

$\text{CaCO}_3$  does not dissolve in water whereas the  $\text{CaCl}_2$  does dissolve.

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Filter the solution. The aqueous  $\text{CaCl}_2$  solution passes through the filter paper and the  $\text{CaCO}_3$  is collected on the paper.

b) 3 points

Pipet an aliquot of known volume into a flask.

Add excess  $\text{AgNO}_3$  solution to precipitate  $\text{AgCl}$ .

Filter, dry, and then weigh the  $\text{AgCl}$ .

$\text{wt. AgCl} / \text{M.W. AgCl} = \# \text{ moles AgCl} = \# \text{ moles NaCl}$

$M = \text{moles AgCl (or NaCl)} / \text{Volume Aliquot in L}$

or

Take a known volume of solution. Evaporate solution to dryness and weigh the  $\text{NaCl}$  residue.

$\text{wt. NaCl} / \text{M.W. NaCl} = \# \text{ moles NaCl}$

$M = \# \text{ moles NaCl} / \text{vol. NaCl in L}$

Full credit for this problem could also be achieved by using a weight measurement of the solution (and obtaining the the weight of the solvent), evaporating the solvent, weighing the residue, and calculating the molality. Through the proper application of a colligative property, it was also possible to obtain full credit.

c) 2 points

Fractional distillation

(An ordinary distillation or separation received 1 point.)

3)a) three points

Precipitation of insoluble  $\text{BaSO}_4$  by adding a solution of a soluble sulfate, e.g.,  $\text{Na}_2\text{SO}_4$

Isolate  $\text{BaSO}_4$  by filtration

Purify  $\text{BaSO}_4$  by washing and drying it

b) three points

Dissolve copper(II) carbonate with nitric acid to form copper (II) nitrate solution

Isolate by avoiding the addition of excess acid

Purify by heating to drive off  $\text{CO}_2$

c) two points

Form  $\text{CaCl}_2$  solution by treating  $\text{CaBr}_2$  solution with  $\text{Cl}_2$ . Or add a soluble carbonate.

Separate the precipitated  $\text{CaCO}_3$ , wash, and dissolve it in  $\text{HCl}$ .

Purify  $\text{CaCl}_2$  solution by extracting the  $\text{Br}_2$  with  $\text{CH}_2\text{Cl}_2$  or equivalent. Or heat the solution.