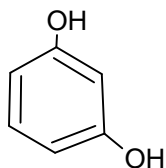


Chem 230, Fall, 2014
Homework Set # 1
Solutions to Short Answer Questions

1. Resorcinol (see below) has a hexane - water partition coefficient of 4.0. How could the organic phase be changed to give resorcinol a greater organic – water partition coefficient?



Switch to a more polar organic phase (e.g. toluene or ether).

2. It is desired to remove radioactive strontium (in the form Sr^{2+}) from a waste stream containing other metals. List two possible methods which could be used to transfer the radioactive strontium into an organic phase.

Use of a crown ether. Use of other organic ligands to produce a non-charged complex. Use of an anionic ion pair reagent.

3. Hydrogen peroxide is a highly water soluble gas that is an important oxidant in the atmosphere. Suggest a method to trap hydrogen peroxide in water.

Nebulizer. Bubbler. Denuder.

4. How can temperature play a role in trapping gases on solid or liquid supports?

Lowering the temperature will increase the efficiency of the solid or liquid support. Increasing the temperature can be used if it is desired to subsequently remove the gas from the support.

5. Explain why glycine ($\text{NH}_2\text{CH}_2\text{CO}_2\text{H}$) can not be partitioned at any pH into an organic phase without an ion-pairing reagent.

Glycine always exists in solution as ion (either +1 net charge, -1 net charge, or zwitter ion – compound with no net charge but with a + ion and a - ion). Ions generally are not soluble in organic solvents (or at least the less polar organic solvents used in liquid-liquid extraction).

6. List one factor that will determine whether a crown ether can effectively move cations from an aqueous phase to an organic phase.

Size of cation. Size of cavity. Solubility of crown ether in organic solvent.

7. Indicate three factors that can influence the partitioning of metals between the aqueous and organic phases using ligands that form metal-ligand complexes.

The net charge of the complex, the strength of the metal-ligand complex equilibrium constant, the fraction of the ligand that is in the correct species (e.g. anion form), the pH of the aqueous phase, the organic solvent used.

8. What is the difference between exhaustive extractions and non-exhaustive extractions?
In an exhaustive extraction, nearly all of the analyte (or compound of interest) is moved from a sample or raffinate phase to an extractant phase while in non-exhaustive, a considerable fraction is left in the sample phase. [Note: this has not yet been covered in class]

9. List two simple separation methods that are not based on partitioning?
Filtration, centrifugation, dialysis, selective membranes.

10. Why is it easier to trap non-polar compounds in an aqueous matrix than polar compounds (assuming both sets of compounds are uncharged) in an aqueous matrix using solid phase extraction?

Solid phase extraction will trap compounds best when the compounds to be trapped have a polarity similar to the solid phase materials and opposite to that of the solvent. Since water is the solvent above, it would make the most sense to use a reversed-phase solid phase extraction cartridge. This will retain non-polar compounds much better than polar compounds. It might be possible to use a normal-phase solid phase extraction cartridge, but most compounds do not stick to the column well in an aqueous environment.

11. Which type of solid phase extraction cartridge would make the most sense for retaining ethanol (a polar organic compound) in a gasoline (mostly non-polar alkyl and aromatic hydrocarbons) sample.

a) normal phase (or hydrophilic interaction)

b) reversed phase

c) cation-exchange

d) anion-exchange

a) normal phase (or hydrophilic interaction) – since analyte is polar in a non-polar environment