Multiple Choice Questions

**Colloids**

1. A soil colloid is a material that…

(a) is predominately primary minerals

(b) has a surface charge that is generally positive

(c) has a size of 1 μm or smaller

(d) often passes in near earth orbits

11. The building blocks of minerals are tetrahedral and octahedral crystalline

structures formed into sheets. They are made up primarily by:

1. Si and O in the tetrahedra and Al and O in the octahedra
2. Si and O in the octahedra and Al and O in the tetrahedra
3. Fe and O in the tetrahedra and Mg and O in the octahedra
4. Fe and O in the octahedra and Mg and O in the tetrahedral

1. The source of the pH dependent charge in soil colloids is associated with:

1. isomorphic substitution in the octahedral sheet
2. isomorphic substitution in the tetrahedral sheet
3. hydroxyl groups
4. all of the above

2. The pH dependent charge becomes increasingly positive (+) with:

1. increasing H+ concentration
2. decreasing H+ concentration
3. increasing Fe3+ concentration
4. decreasing Fe3+ concentration

2. The pH dependent charge becomes increasingly negative (-) with:

1. increasing H+ concentration
2. decreasing H+ concentration
3. increasing Fe3+ concentration
4. decreasing Fe3+ concentration

3. When referring to a 2:1:1 phylosilicate colloid, the numbers refer to:

1. 2 tetrahedral sheets to 1 octahedral sheet to 1 Mg hydroxide sheet
2. 2 octahedral sheets to 1 tetrahedral sheet to 1 Mg hydroxide sheet
3. 2 tetrahedral sheets to 1 octahedral sheet to 1 Ca hydroxide sheet
4. 2 octahedral sheets to 1 tetrahedral sheet to 1 Ca hydroxide sheet

3. When referring to a 2:1 phylosilicate colloid, the numbers refer to:

1. 2 tetrahedral sheets to 1 octahedral sheet to 1 Mg hydroxide sheet
2. 2 octahedral sheets to 1 tetrahedral sheet to 1 Mg hydroxide sheet
3. 2 tetrahedral sheets to 1 octahedral sheet
4. 2 octahedral sheets to 1 tetrahedral sheet

4. In soils, the pH dependent charge is largest with:

1. iron and aluminum oxides
2. 1:1 and 2:1 phylosilicate colloids
3. humus
4. amorphous colloids

10. In soils, the pH dependent charge is smallest with:

1. iron and aluminum oxides
2. 1:1 phylosilicate colloids
3. humus
4. 2:1 phylosilicate colloids

5. Anion Exchange Capacity (AEC) is a measure of a soils capacity to bind anions. This exchange is found predominately in.

(a) iron and aluminum oxides

1. 1:1 and 2:1 phylosilicate colloids
2. humus
3. amorphous colloids

6. Cation Exchange Capacity (CEC) is a measure of a soils capacity to bind cations, and is expressed as a total amount of:

1. charge that can be held by a given amount of soil
2. molecular weight that can be held by a given amount of soil
3. nutrient(s) that can be held by a given amount of soil
4. bases that can be held by a given amount of soil

7. The expansive nature (shrink-swell behavior) of 2:1 smectitic clay colloids is due to:

1. isomorphic substitution in the tetrahedral sheet
2. isomorphic substitution in the octahedral sheet
3. strong K bonds between phylosilicate layers
4. liberal upbringing

7. Isomorphic substitution from a 1o to a 2o mineral, results in a changed …

(a) CEC and pH,

(b) pH and shrink swell behavior,

(c) shrink swell behavior and (shape)

(d) mineral morphology (shape) and CEC

7. Isomorphic substitution is predominately …

1. in the tetrahedral sheet
2. in the octahedral sheet
3. dependent on size and charge of ions
4. due to a liberal upbringing

12. Isomorphic substitution accounts for the:

1. net neutral charge associated with phylosilicate colloids
2. predominantly negative charge associated with phylosilicate colloids
3. intermediate weathering associated with kaolinite
4. predominantly positive charge associated with phylosilicate colloids

**Ecology**

8. Organisms that derive energy from the consumption of organic matter are:

1. Chemo-autotrophs
2. Photo-autotrophs
3. heterotrophs
4. plants

31. Organisms that derive energy from the consumption of organic matter and use inorganic carbon are:

1. chemoautotrophs
2. photoautotrophs
3. chemoheterotrophs
4. photoheterotrophs

8. Organisms that derive energy from the consumption of inorganic electron donors are:

1. internet trolls
2. phototrophs
3. heterotrophs
4. lithotrophs

9. Some organisms, such as wood-rotting fungi and bacteria, specialize and use carbon sources that other organism cannot. They attack large pieces of wood by:

1. combustion
2. excreting enzymes
3. ingesting large particles
4. with a chainsaw

10. All organisms respire and, as an essential part of this process, electrons flow to an electron acceptor. The element acting as electron acceptor is reduced. For aerobic organisms, the reaction is:

1. O20 → 2O2-
2. Fe3+ → Fe2+
3. 2O2- → O20
4. SO42 → H2S

11. Survival and growth of microorganisms is dependent on:

1. temperature
2. moisture
3. availability of nutrients
4. all of the above

12. A single celled heterotrophic microorganism that preys on live bacteria is:

1. nematode
2. protozoa
3. fungi
4. algae

33. Soil macrofauna play an extremely important role in:

(a) potassium (K) nutrient cycling

(b) n-fixation

(c) C cycling

(d) Shakespeare’s sonnets

34. Microbial exponential growth is a response to

(a) symbiotic relationships

(b) inhibitor production

(c) opportunism

(d) specialization

23. Aerobic respiration in soil produces:

(a) lowered CO2 levels

(b) lowered soil pH

(c) bad breathe

(d) increased levels of soil organic matter

**pH, Buffering and CEC**

13. The pH of a solution containing a hydrogen ion concentration of 1 x 10-5 is:

1. 3 and its pOH is 6
2. 3 and its pOH is 7
3. 5 and its pOH is 8
4. 5 and its pOH is 9

12. The pH of a solution containing a hydrogen ion concentration of 1 x 10-11 is:

1. 11 and its pOH is 11
2. 11 and its pOH is 3
3. 3 and its pOH is 11
4. 3 and its pOH is 3

20. The pH of a solution containing a hydrogen ion concentration of 1 x 10-3 is:

1. 3 and its pOH is 9
2. 3 and its pOH is 11
3. 5 and its pOH is 7
4. 5 and its pOH is 9

20. The pH of a solution containing a hydrogen ion concentration of 1 x 10-6 is:

1. 5 and its pOH is 8
2. 5 and its pOH is 9
3. 6 and its pOH is 8
4. 6 and its pOH is 9

21. The naturally occurring acidic pH of rain water is due to which following chemical reaction:

1. NH4+ → H+ + NO3-
2. Ca(OH)2 + CO2 → CaCO3 + H2O
3. CO2 + H2O → H2CO3 ↔ H+ + HCO3-
4. FeS2 + H2O → H+ + SO42- +Fe

15. Protons chemically weather phylosilicate clays to solubilizing ions into the soil solution. In general these ions act as bases by increasing the pH of the soil solution. What ion at pH’s higher than 4.5 acts to hydrolyze water and lower the pH.

1. Ca2+
2. Al3+
3. H+
4. OH-

16. There are a number of natural acidification reactions (including some listed in question 14 above). All of these reactions are increased by:

* 1. vigorous leaching
  2. high biological activity
  3. presence of low base parent material
  4. all of the above

29. Soils tend to resist changes in pH. A soil with a higher absolute concentration of bases on its exchanges sites than another soil of similar nature is:

1. less resistant to pH change and has a lower buffering capacity
2. less resistant to pH change and has a higher buffering capacity
3. more resistant to pH change and has a lower buffering capacity
4. more resistant to pH change and has a higher buffering capacity

24. Soils tend to resist changes in pH. A soil with a lower absolute concentration of bases on its exchanges sites than another soil is:

1. less resistant to pH change and has a lower buffering capacity
2. less resistant to pH change and has a higher buffering capacity
3. more resistant to pH change and has a lower buffering capacity
4. more resistant to pH change and has a higher buffering capacity

18. Buffering at high pH’s (>7.5) is controlled primarily by the following chemical reaction:

(a) Al hydrolysis ~ e.g. Al(OH)2+ + H2O ↔ Al(OH)3 + H+

(b) carbonic acid formation ~ CO2 + H2O ↔ H+ + HCO3-

(c) carbonate formation ~ Ca2+ + 2(H+ + HCO3-) ↔ 2H+ + CaCO3 + H2O + CO2

(d) nitrification ~ NH4+ → H+ + NO3

19. Buffering at low pH’s (<4.5) is controlled primarily by the following chemical reaction:

(a) Al hydrolysis ~ e.g. Al(OH)2+ + H2O ↔ Al(OH)3 + H+

(b) carbonic acid formation ~ CO2 + H2O ↔ H+ + HCO3-

(c) carbonate formation ~ Ca2+ + 2(H+ + HCO3-) ↔ 2H+ + CaCO3 + H2O + CO2

(d) nitrification ~ NH4+ → H+ + NO3

14. Protons chemically weather phylosilicate clays to solubilizing ions into the soil solution. In general these ions act as bases by increasing the pH of the soil solution. Yet what ion at pH’s higher than 4.5 acts to hydrolyze water and lower the pH.

1. Ca2+
2. Al3+
3. H+
4. OH-

19. Plants have adapted to different pH ranges. Generally grassland plant species growing in drier environments (where pH’s are high):

1. are susceptible to Al toxicity and have high Fe nutrient requirements
2. have developed tolerances for Al and have high Fe nutrient requirements
3. are susceptible to Al toxicity and have high Ca nutrient requirements
4. have developed tolerances for Al and have high Ca nutrient requirements

32. Plants have adapted to different pH ranges. Generally forest plant species growing in humid environments (where pH’s are low):

1. are susceptible to Al toxicity and have high Fe nutrient requirements
2. have developed tolerances for Al and have high Fe nutrient requirements
3. are susceptible to Al toxicity and have high Ca nutrient requirements
4. have developed tolerances for Al and have high Ca nutrient requirements

12. Base saturation is a measure of a soil’s …

1. charge that is held by a given amount of soil
2. molecular weight that is held by a given amount of soil
3. ions that are held by a given amount of soil
4. bases that are held by a given amount of soil

22 As pH increases from 3.5 to 5.5, aluminum becomes \_\_\_\_\_\_\_ soluble. Additionally, this contributes to \_\_\_\_\_\_\_\_\_\_\_ in Al(OH)3 precipitation.

(a) more, increased

(b) less, increased

(c) more, decreased

(d) less, decreased

**Organic Matter, C and Nutrient Cycles**

22. The dry matter of organic matter is predominately:

1. polyphenols
2. cellulose
3. proteins
4. lignins

21. What percentage of organic matter is dry matter:

1. 10%
2. 15%
3. 25%
4. 50%

27. In the nitrogen cycle, the conversion of organic N to nitrate is:

1. nitrification
2. denitrification
3. immobilization
4. mineralization

27. In the nitrogen cycle, the conversion of organic N to ammonium is:

1. nitrification
2. denitrification
3. immobilization
4. mineralization

26. In the nitrogen cycle, the conversion of ammonium to organic N is:

1. nitrification
2. denitrification
3. immobilization
4. mineralization

28. Under reducing conditions, the conversion of NO3- to N2O and N2 is:

(a) nitrification

(b) denitrification

(c) immobilization

(d) mineralization

32. Nitrogen is fixed mostly by:

1. lightning
2. microorganisms
3. industrial N fixation – the petrochemical industry
4. fire

32. Phosphorus availability is predominately controlled by:

1. lightning
2. microorganisms
3. pH
4. fire

29. Loss of phosphorus from the P cycle occurs due to:

1. burning and erosion
2. denitrification and leaching
3. manure application
4. all of the above

29. Loss of nitrogen from the N cycle occurs due to:

1. burning and erosion
2. denitrification and leaching
3. harvesting
4. all of the above

29. Nitrogen is most susceptible to leaching when in the form of:

1. N2
2. NO3-
3. NH4+
4. all of the above

14. The primary product of decomposition is

1. biomass
2. organic acids
3. CO2
4. nutrients

27. The availability of nutrients is affected by many factors in the environment including pH. At \_\_\_\_\_\_ pH’s the availability of micronutrients is limited. Plants found in soil of these pH ranges, often have high \_\_\_\_\_\_ requirements.

(a) high, Ca

(b) high, Fe

(c) low, Ca

(d) low, Fe

28. Fertilization with NH4+ in anaerobic conditions tends to \_\_\_\_\_\_\_\_\_ the pH of the soil solution, while at the same time \_\_\_\_\_\_\_\_ NO3- leaching.

(a) increase, increasing

(b) increase, decreasing

(c) decrease, increasing

(d) decrease, decreasing

26. Low C:N (< 20:1) ratios will produce:

(a) net C mineralization and greatly diminished N availability to plants

(b) net C mineralization and greatly increased N availability to plants net

(c) net C immobilization and greatly increased N availability to plants

(d) net C immobilization and greatly diminished N availability to plants

29. Considering non-recalcitrant organic matter, a material with a low C:N ratio will decompose:

1. less rapidly than high C:N material
2. more rapidly than high C:N material
3. at the same rate as high C:N material
4. won’t decompose

28. High C:N (>20:1) ratios will produce:

(a) net C mineralization and greatly diminished N availability to plants

(b) net C mineralization and greatly increased N availability to plants net

(c) net C immobilization and greatly increased N availability to plants

(d) net C immobilization and greatly diminished N availability to plants

27. Considering non-recalcitrant organic matter, a material with a high C:N ratio will decompose:

1. less rapidly than low C:N material
2. more rapidly than low C:N material
3. at the same rate as low C:N material
4. won’t decompose

28. Generally, when soil is removed from cultivation:

1. the C and N contents increases in the soil
2. the C content increase and the N content decreases in the soil
3. the C content decreases and the N content increases in the soil
4. the C and N contents decreases in the soil

30. When soil is under intensive cultivation:

1. the C and N contents increases
2. the C content increase and the N content decreases
3. the C content decreases and the N content increases
4. the C and N contents decreases

30. C loss from soil can be limited by

(a) reducing fertilization

(b) reducing erosion

(c) increasing drainage

(d) increasing harvest

27. Factors controlling organic matter decay are:

(a) Placement

1. Size and Surface Area
2. C:N Ratio
3. All of the above

24. Which is the most important factor controlling organic matter decay:

(a) Placement

1. Size
2. C:N Ratio
3. Surface Area

31. Organic matter decomposition involves respiration with the following components – C6H12O6, 6O2, 6CO2 and 6H2O. In aerobic respiration this process:

1. consume O2 and consume CO2
2. consume O2 and produce CO2
3. produce O2 and consume CO2

(d) produce O2 and produce CO2

26. The decomposition of organic matter produces colloidal humic materials that are resistant to decomposition. This resistance is due to;

(a) the content of carboxyl groups

(b) the development of low C:N ratios

(c) the content of polyphenolic compounds

(d) chelation of metals

27. The soil Order with the highest proportion of organic matter is:

(a) Andisol

(b) Vertisol

(c) Histosol

(d) Ultisol

**Temperature, Moisture and Energy**

11. Global warming associated with clouds is due to:

1. long wave radiation adsorption
2. short wave radiation adsorption
3. long and short wave radiation adsorption
4. heat

20. The greenhouse effect associated with clouds is due to:

1. long wave radiation adsorption from the earth
2. short wave radiation adsorption from the earth
3. long wave radiation adsorption from the sun
4. short wave radiation adsorption from the sun

2. Solar energy is delivered to the soil via short wave radiation, which then heats up the soil. This heat is dissipated through

(a) evaporation

(b) conductance to the air

(c) reradiation as long wave radiation

(d) all of the above

32. Moisture is the most important factor for two of the Soil Orders. These are:

1. Andisols and Vertisols
2. Alfisol and Ultisols
3. Histosols and Aridisols
4. Gellisols and Mollisols

16. Water moves in soils:

1. from areas of low water potential to areas of high water potential
2. from areas of high water potential to areas of low water potential
3. from areas of more negative water potential to less negative water potential
4. always in a downward direction

1. As soil systems become increasingly anaerobic …

(a) redox potentials decrease

(b) O2 concentrations increase

(c) C sources become more abundant

(d) respiration produces more energy

17. The amount of heat transferred (heat conductivity) will be greatest in a:

1. dry clay soil
2. dry sand soil
3. wet clay soil
4. wet sand soil

18. The heat capacity is a measure of the energy required to heat up a material. It is greatest in:

1. the air
2. water
3. a dry soil
4. a wet soil

19. Soils will warm up quicker in the spring with:

1. a surface mulch on a hot sunny day
2. no surface mulch on a hot sunny day
3. a surface mulch on a hot rainy day
4. no surface mulch on a hot rainy day

4. A soil heats up based on its heat capacity. This capacity

(a) increases with decreasing bulk density

(b) increases with increasing water content

(c) decreases heat stress on plants

(d) decreases with increasing particular density

5. When all temperatures are relatively equal, a warm soil cools quicker in the fall when

(a) the soil is wet and then a cool, dry weather front moves through

(b) the soil is dry and then a cool, dry weather front moves through

(c) the soil is wet and then a cool, wet weather front moves through

(d) the soil is dry and then a cool, wet weather front moves through

10. The direction of water movement in soils is determined by:

1. gravimetric potential
2. matrix potential
3. solute potential
4. total potential

11. Prolonged **unsaturated** subsurface water flow is most pronounced in

(a) coarse textures because matrix potential is strong

(b) fine textures because matrix potential is strong

(c) coarse textures because matrix potential is weak

(d) fine textures because matrix potential is weak

12. Which of the following are most important to **saturated** water flow and gas exchange?

1. micropores and macropores
2. interaggregate pores (between peds)
3. intraaggregate pores (within peds)
4. a really good attitude

13. Volumetric water content (θ) is:

1. volume of water / volume of pores
2. volume of water / volume of soil
3. volume of water / mass of soil
4. volume of water / volume of soil solids

14. As the surface area of a soil volume increases, the matrix potential of a soil:

1. decreases
2. stays the same
3. increases
4. varies

15. The characteristic of water that is partly responsible for capillary rise is:

1. matrix potential
2. adhesion
3. soil texture
4. solute potential

13. All organisms respire and, as an essential part of this process, electrons flow to an electron acceptor. The element acting as electron acceptor is reduced. For anaerobic organisms, the reaction is **not**:

1. O20 → 2O2-
2. Fe3+ → Fe2+
3. 2O2- → O20
4. SO42 → H2S

Circle the Correct Term, Fill in the Blanks or Short Paragraph

**pH drives much of the ion dynamics in the soil solution**

1. As pH increases from 3.5 to 5.5, aluminum becomes [***more / less***] soluble.
2. As pH decreases from 5.5 to 3.5, aluminum becomes [***more / less***] soluble.
3. Under alkaline conditions [***calcium / hydrogen***] is more dominant on the exchange complexes.
4. When Ca(OH)2 is added to an acidic soil soluble…

[***Al precipitates as Al(OH)3 / Al becomes more soluble***].

**The availability of nutrients in the soil solution is affected by pH.**

1. Micronutrients more available at [**high / low**] pH’s. An example of such a nutrient would be [***Ca / Fe***].
2. While at the same pH the availability of most macronutrients [***increases / decreases***].
3. Macronutrients more available at [**high / low**] pH’s. An example of such a nutrient would be [***Ca / Fe***].
4. While at the same pH the availability of most macronutrients [***increases / decreases***].
5. What pH is optimum for macro and micro nutrient availability? \_\_\_\_\_\_\_\_\_\_\_\_

**Colloids play an incredibly important role in soil chemistry**

1. Non-crystalline silicate colloids are produced primarily by chemical weathering of [***igneous / metamorphic***] parent materials.
2. While sesquioxides are [***primary / secondary***] minerals found in large concentration in spodosols and [***alfisols / Oxisols***].
3. Organic colloids consist of [***long / short***] C chain molecules that are neither mineral nor crystalline.
4. Cation Exchange Capacity (CEC) is a measure of a soils capacity to bind cations. The substitution of cations on the exchange sites is governed by four characteristics of ion(s) or “rules”. List **two** of the four.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. There are three pools of acidity. The first **active acidity** is associated with the proton concentration in the soil solution. The second is associated with the acid cations on the cation exchange sites, while the third is acid cations within the phylosilicate and/or organic structure. Name the second and third acidity pools.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. List four factors controlling the rate of organic matter decay.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. List three effects of aerobic respiration in the soil.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

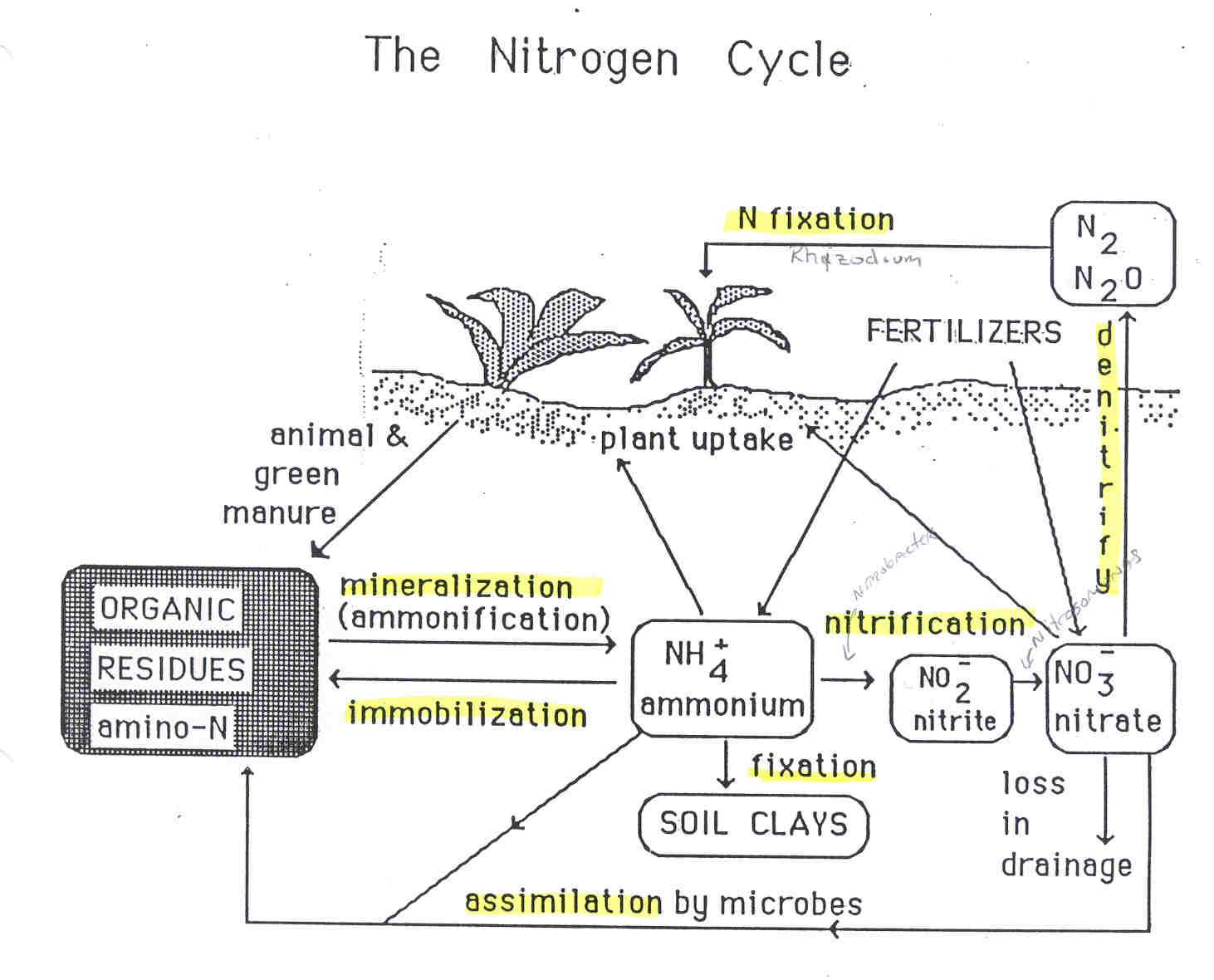
1. Fluxes in nutrient cycles are generally controlled by three things other than the nutrient in question (i.e. N, P, K or S). Besides oxygen content what other environmental conditions control nutrient cycling?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_

. For each of the numbered flux conversions shown on the following diagram …

* 1. **name the process** **AND**
  2. indicate whether the conversion product can be lost by **leaching or volatilization** **AND**

3) indicate whether the flux process is **mediated by microorganisms (Y or N)**



**1**

**2**

**3**

**5**

**4**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Process | Loss potential | Mediated (yes / no) |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |

33. There are three pools of acidity. The first, **active acidity** is associated with the proton concentration in the soil solution. The second is associated with the acid cations on the cation exchange sites, while the third is acid cations within the phylosilicate and/or organic structure. Name the second and third acidity pools.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

34. There are five specific factors controlling the loss of nutrients from (NPK, etc.) from the soil. While climate (temperature and moisture) plays a role in these losses, the factors are more related to management specific practices. Name three of these five factors.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

35. Base saturation is a measure of …

36) We discussed four ecological classification systems. Pick one (a), explain what it is (b) and why do we use it (c).

a) Classification based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) what is it…

c) why do we use it…

1) Colloids play an incredibly important role in soil chemistry. **Non-crystalline** silicate colloids are produced primarily by chemical weathering of [***igneous / metamorphic***] parent materials. While **sesquioxides** are [***primary / secondary***] minerals found in large concentration in spodosols and [***alfisols / Oxisols***]. Finally **organic colloids** consist of [***long / short***] C chain molecules that are neither mineral nor crystalline.

2) The availability of nutrients is affected by many factors in the environment including pH. At [***high / low***] pH’s the availability of macronutrients is limited. An example of such a nutrient would be [***Ca / Fe***]. While at the same pH the availability of most micronutrients [***increases / decreases***]. An example of such a micronutrient would be [***Mg / Mn***].

3) As pH decreases from 5.5 to 3.5, aluminum becomes [***more / less***] soluble. Under acidic conditions [***aluminum / hydrogen***] is more dominant on the exchange complexes. When Ca(OH)2 is added to the acidic soil [***Al precipitates as Al(OH)3 / Al becomes more soluble***].

pH controls the solubility (and thus availability) of nutrients in the soil solution. In general macro and micro nutrients are available at different pH’s. At what pH’s (**high or low**) are macronutrients more available and what pH is optimum for macro and micro nutrient availability?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

31) As pH decreases from 5.5 to 3.5, aluminum becomes [***more / less***] soluble. Under acidic conditions [***aluminum / hydrogen***] is more dominant on the exchange complexes. When Ca(OH)2 is added to an acidic soil soluble

[***Al precipitates as Al(OH)3 / Al becomes more soluble***].

32) pH is a measure of **[*H+ / OH*-]** concentration in the soil solution. As the concentration of this ion increases the pH of the soil solution **[*increases / decreases*].**

33) Colloids play an incredibly important role in soil chemistry. Non-crystalline silicate colloids are produced primarily by chemical weathering of [***igneous / metamorphic***] parent materials.

While sesquioxides are [***primary / secondary***] minerals found in large concentration in spodosols and [***alfisols / Oxisols***].

Finally organic colloids consist of [***long / short***] C chain molecules that are neither mineral nor crystalline.

34) Saturated flow is more rapid in coarse textured soils because matrix potential is **[*greater / lesser*]** than in fine textured soils. Unsaturated flow is through ***[matrix / gravitational]*** flow in soils.

Therefore, fine texture soils act as a barrier to downward flow in ***[saturated / unsaturated]*** soils and course texture soils are a barrier to upward flow in ***[saturated / unsaturated]*** soils.

35) Capillary rise is the product of two forces acting on water. These forces are

\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_

36) Cation Exchange Capacity (CEC) is a measure of a soils capacity to bind cations. The substitution of cations on the exchange sites is governed by four characteristics of ion(s) or “rules”. List **two** of the four.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_

38. List four factors controlling the rate of organic matter decay.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

39. List three effects of aerobic respiration in the soil.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

40. Fluxes in nutrient cycles are generally controlled by three things other than the nutrient in question (ie N, S, P or K). Besides oxygen content what other environmental conditions control nutrient cycling?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Connections Games or Short Essay

Explain (or describe) the relationship between

We encourage you to use graphics and words to illustrate you argument. Limit your answer to the expanse of this page and make sure that your writing is legible.

* + 1. **Colloids, Base Saturation and Buffering**
    2. **Colloids, CEC and buffering**
    3. **Nutrients, pH and colloids**

37) Explain (or describe) the relationship between. (100 words maximum)

**pH** , **Base Saturation** and **Nutrient Availability**

Mulch plays an important role in temperature regulation of soils. Explain the following mulching schedule for a horticultural operation in the Northeast.

Winter Mulch – Spring removal – Summer mulch – Fall removal