**Name:** _____   **Grade:** _____

GEOL101 Laboratory - Preparatory Lab for Midterm Exam

Introduction & Purpose: In this lab you will review and improve upon the geologic concepts and skills covered in the first half of this geology laboratory course.   The purpose of this laboratory is to best prepare you for the laboratory midterm exam that you will be taking next week. This worksheet is designed to closely simulate the midterm exam material and format. Grade yourself when you are finished.

Part I – THE ROCK CYCLE
Directions: Pick the correct lettered word choice for each of the numbered blank boxes and ellipses in the incomplete rock cycle chart below. The boxes represent the three general rock types, whereas the ellipses represent rock-forming processes.   Your answers correspond to answer line numbers 1) through 8) on your Scantron card.

a.	Metamorphism	**e.**	Sedimentary Rock
b.	Weathering/transport/deposition	**a. + b.**	Cooling/crystallization
c.	Igneous Rock	**b. + c.**	Metamorphic Rock
d.	Lithification	**c. + d.**	Melting
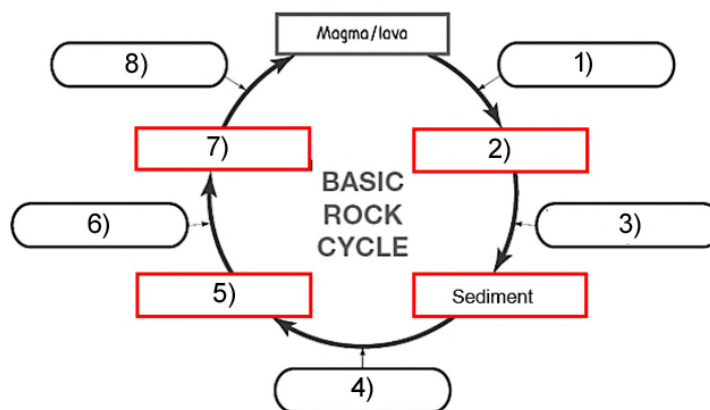
Part Ii. ISOSTASY: *MODELING CRUSTAL BUOYANCY WITH THE MANTLE*
Directions: The following set of questions pertains to a wood block floating in the water bath.   Use the principles of isostasy and the density of pure water to answer the questions below. *Identify the letter of choice that BEST completes the statement or answers the question.*

9. Which of the following densities is <u>closest</u> to that of the wood block? If density in between, choose higher
a.   0.8 g/cm^3 or greater
b.   Between 0.5 and 0.7 g/cm^3
c.   Between 0.3 and 0.5 g/cm^3
d.   Less than 0.3 g/cm^3

10. Imagine if the wood block was twice as <u>thick</u> as its present thickness. The thicker wood block would
_____, compared to thinner wood block.
a.   extend *higher* out of the water.
b.   extend *lower* into the water.
c.   still have the same percentages out and in the water as the thinner block.
d.   All of the above would be true.
e.   Both **b**. and **c**. are true

11. Imagine if the wood block was twice as <u>dense</u> as its present density. How would the denser wood block sit in the water, compared to less dense wood block?
a.   The denser wood block would sit higher out of the water.
b.   The denser wood block would sit *lower* into the water.
c.   The denser wood block would still have the same percentages out and in the water as the less dense block.
d.   Both **b**. and **c**. are true

12. **If the top 1/4 of the wood block thickness were removed, Block A would _____.**
   a. rise out of the water.
   b. sink lower into the water
   c. just sit there - neither rise nor sink.
   d. start spinning like a top.

13. **What happens when a continent undergoes a major ice cap-building glacial event?**
   a. The continent will rise up out of the mantle.
   b. The continent will sink lower into the mantle.
   c. The continent will just sit there - neither rise nor sink.
   d. The continent will begin to move away from the pole toward the equator

14. **What happens after a major continental mountain building event ends, but heavy erosion continues?**
   a. The continent will rise up out of the mantle.
   b. The continent will sink lower into the mantle.
   c. The continent will just sit there - neither rise nor sink.
   d. The continent will begin to move away from the pole toward the equator

15. ***Oceanic* crust is _____ and _____ than continental crust.**
   a. less mafic; thinner
   b. less mafic; thicker
   c. more mafic; thicker
   d. more mafic; thinner
   e. There is now way to tell for sure

Part III. Plate Tectonics Boundaries and Processes

Directions: *Match the geographic location (Capital Letter on located on map) with its associated tectonic feature or setting (small case letter(s)) in answer key).* Note: For answers with two letters, bubble in two letters as a single answer.

a. convergent plate boundary with *oceanic-oceanic* subduction
b. convergent plate boundary with *oceanic-continental* subduction
c. convergent plate boundary with *continent-continent* collision
d. divergent plate boundary with seafloor spreading

e. divergent plate boundary w/ continental rifting
a+b. transform plate boundary
b+c. hot spot volcanism
c+d. passive margin

____   **16.**   Locality A – **Mariana Islands and Trench**

____   **17.**   Locality B – **Mid-Atlantic Ocean underwater mountain belt**

____   **18.**   Locality C – **Chilean Trench and Andes Mountain range**

____   **19.**   Locality D – **Himalaya Mountains**

____   **20.**   Locality E – **Southern California**

____   **21.**   Locality F – **Northeast US seaboard**

____   **22.**   Locality G – **East Africa Rift Valley**

____   **23.**   Locality X – **Big Island, Hawaii**

Tectonic Plate Boundary Map
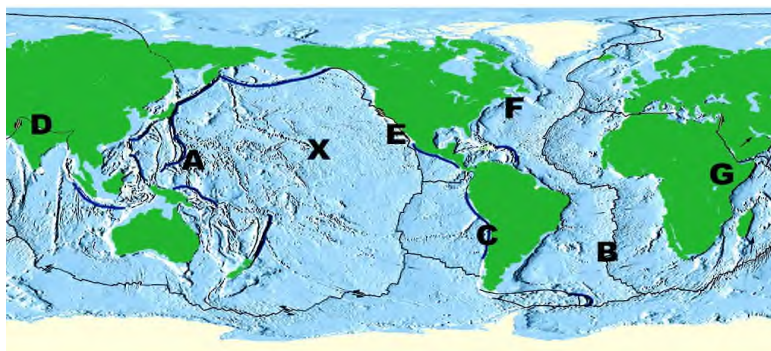
PART IV. Plate Movement Over a "Fixed" Hotspot - Louisville Seamount Chain Hot Spot Track

Directions: The Louisville Seamount **(LS)** chain is found in the South Pacific Ocean and is one of the longest seamount chains in the world, rivaling the Emperor Seamount - Hawaiian Island **(ES-HI)** chain in the North Pacific. Assume that the Louisville Seamount chain was generated by a stationary mantle hotspot – like the Hawaiian Island chain that you studied in lab. Below are several questions that address both of these oceanic volcanic chains, in terms of their inferred Pacific Plate movement, direction and speed. Use the Louisville Hot Spot Plate Motion Diagram to calculate the average plate speed and direction of the Pacific Plate.
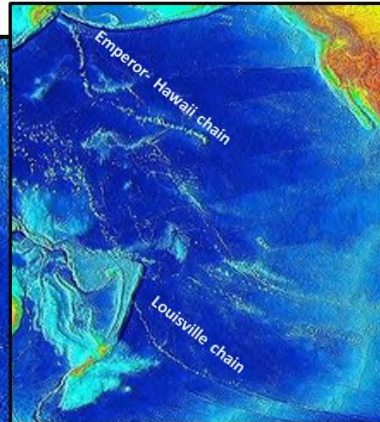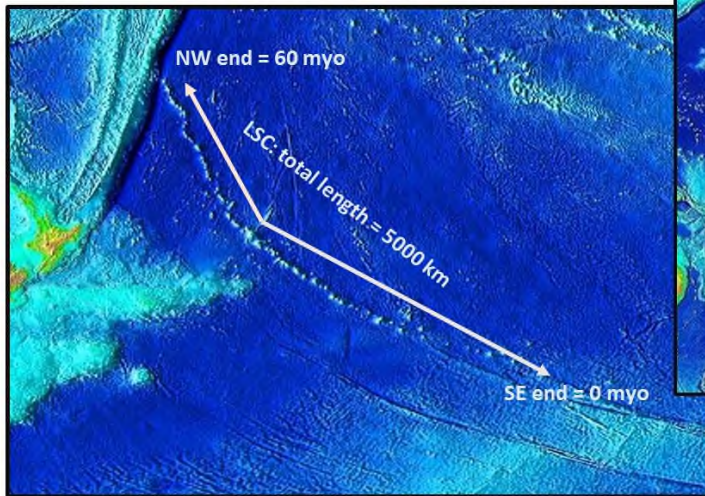

Speed Formula: Speed = distance/time (cm's/year) **Conversion Factor:** 1 km = 100,000 (1 x 10^5) cm

24. What is **average speed** for the Pacific plate associated with the Louisville Hotspot?
- **a.** 10 cm/yr or greater
- **b.** Between 6 and 9 cm/yr
- **c.** Between 3 and 6 cm/yr
- **d.** Between 1 and 3 cm/yr
- **e.** Less than 1 cm/yr

25. What's the **average direction** of motion of the Louisville Seamount chain (Pacific plate) over the hot spot?

a. North; **b.** Northeast; **c.** East; **d.** Southeast; **e**. South; **a. + b**. Northwest; **b. + c**. Southwest; **c. + d**. West;

26. How do the LS and ES-HI hot spot tracks compare, based *on* a comparison of hot spot **ages, directions and speeds,** in terms of whether they are on the same plate or on different plates?

The two hot spot traces appear to _____.

- **a.** be moving on different tectonic plates
- **b.** be moving on the same tectonic plate.

PART V. Plate Movement Analysis of *Mid-Ocean Ridge and Seafloor Spreading*

Directions: The South Atlantic Mid-Ocean Ridge (SAMOR) joins the South American and African and tectonic plates. Below are several questions that address the rate of seafloor spreading between the South American and African plates, Use the **South Atlantic Magnetic Anomaly Map** to calculate the average plate (seafloor spreading) **speed and direction** of each of the plates **over last 54 million years**. Use the diagram below to answer the questions.

27. What is the average direction of motion of the South American plate (west (left-side) of ridge) - in relation to the ridge axis - over the last 54 million years?
- **a.** North; **b.** East; **c.** South; **d.** West;
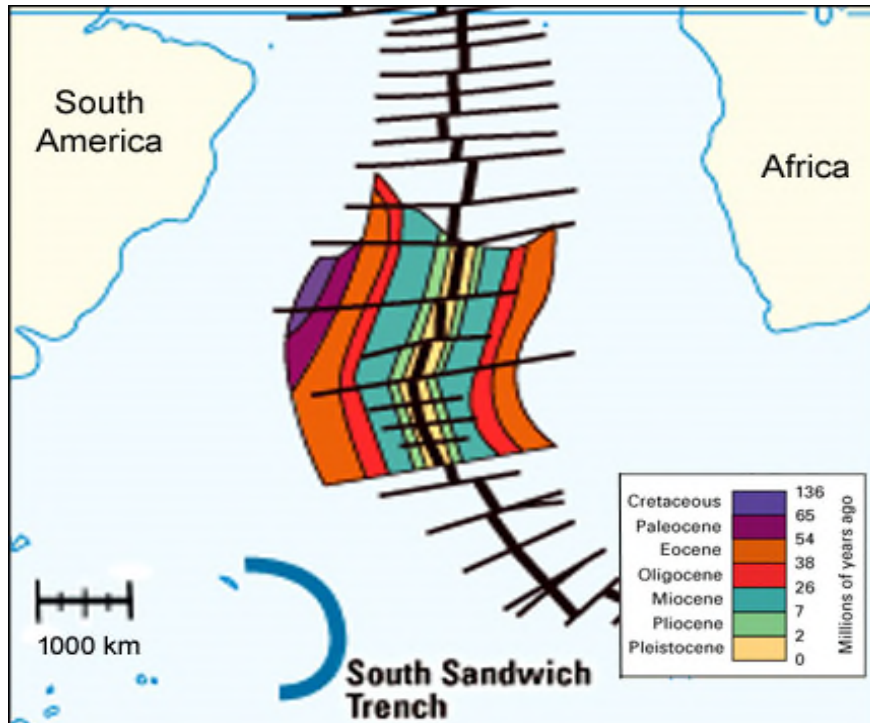
The South Atlantic Mid-Ocean Ridge (SAMOR) Map

28. What is the average speed for the South American plate over the last 38 million years as it moves away from the spreading ridge axis?
- **a.** 8 cm/yr or greater
- **b.** Between 8 and 6 cm/yr
- **c.** Between 6 and 4 cm/yr
- **d.** Between 2 and 4 cm/yr
- **e.** 2 cm/yr or less

29. How do the calculated spreading rates on opposite sides of the ridge axis compare to each other?
- **a.** They have roughly the same spreading rates.
- **b.** They have significantly different spreading rates.

30. The seafloor on opposite sides of the ridge axis appear to be _____
- **a.** all on the same tectonic plate.
- **b.** on different tectonic plates.
- **c.** No way to telling how many tectonic plate there are.

31. The dominant crustal stress along the South Atlantic Mid-Ocean Ridge to be is _____.
- **a.** compressional
- **b.** sheer
- **c.** tensional

32. The South American and African plates are joined by a _____ plate boundary.
- **a.** convergent
- **b.** divergent
- **c.** transform

33. The plate tectonic process occurring along the South Atlantic Mid-Ocean Ridge is called _____
- **a.** subduction
- **b.** seafloor collision
- **c.** seafloor spreading

PART VI. MINERAL IDENTIFICATION

Directions: *Identify the letter of choice that BEST completes the statement or answers the question.*
<u>Use hand lens,, Microscope and Hardness Test OFTEN</u>!!

SAMPLE SET 1 (Minerals)

34) What is the general hardness of these light-colored minerals?   Note: hardness of 5 and less is considered soft.

   a. all four are hard;   **b.** all four are soft;   **c.** one is hard; the other three soft   **d.** one is soft; the other three are hard

35) Which of these four minerals LACKS cleavage?

   a. Sample "1A";   **b.** Sample "1B"   **c.** Sample "1C"   **d.** Sample "1D"   **e.** All four samples lack cleavage

36) Name these four mineral samples (labeled "1A", "1B, "1C"and "1D"); not necessarily in respective order.

   a. calcite, quartz, potassium feldspar, and gypsum;
   b. gypsum, calcite, quartz, and halite;
   c. gypsum, plagioclase, halite, and muscovite;
   d. plagioclase, olivine, calcite and quartz;
   e. calcite, quartz, potassium feldspar, and gypsum;
   a + b. halite, gypsum, potassium feldspar & olivine;

SAMPLE SET 2 (Minerals)

37) Samples "2A", "2B, "2C" and "2D" are most abundant and/or common in which of the following rock pairs?

   a. gabbro & basalt;   **b.** granite & rhyolite;   **c.** siltstone & claystone;   **d.** chert & quartzite;

   e. limestone & marble;   **a + b.** schist and gneiss   **b + c.** pumice and obsidian

38) Which of these four minerals are *MAFIC* in composition?

   a. Only samples "2A"& "2B" are mafic;   **b.** Only samples "2B"& "2C" are mafic;   **c.** Only samples "2A"& "2C" are mafic;
      d. All four samples are mafic;   **e.** Only one sample is mafic;   **a + b.** None of the samples is mafic

39) Name these three mineral samples (labeled "2A", "2B, "2C" and "2D"); not necessarily in respective order.

   a. biotite, hornblende, magnetite and augite;
   b. augite, hematite, quartz, and olivine;
   c. plagioclase, olivine, quartz, and magnetite;
   d. hornblende, biotite, magnetite and plagioclase;
   e. augite, hornblende, olivine and magnetite;
   a + b. olivine, biotite, hematite and potassium feldspar

SAMPLE SET 3 (Minerals)

40) What is the general hardness of these four minerals?

               a. all four are hard;   **b.** all four are soft;   **c.** one is hard; the other three soft
         d. three are hard; the other one soft   **e.** two are hard; the other two are soft

41) All <u>four</u> of these minerals are very abundant/common in which one of the following rocks?

   a. gabbro   **b.** shale   **c.** granite;   **d.** quartzite;   **e.** limestone;   **a + b.** obsidian

42) Name these three mineral samples (labeled "3A", "3B, "3C", and "3D"); not necessarily in respective order.

   a. biotite, quartz, potassium feldspar, and plagioclase;
   b. potassium feldspar, gypsum, quartz and augite;
   c. plagioclase, olivine, hornblende, and quarts;
   d. calcite, olivine, quartz, and muscovite;
   e.   quartz, calcite, plagioclase, and biotite;
   a + b. calcite, muscovite, gypsum, and biotite;

PART VII. ROCK IDENTIFICATION
Directions: *Identify the letter of choice that BEST completes the statement or answers the question.*
<u>Use hand lens,, Microscope and Hardness Test OFTEN</u>!!

<u>SAMPLE SET 4</u> (Rocks)

43) Select the correct rock classification for sample "4A".
  a. Silici-Clastic Sedimentary;   **b.** Bio-Sedimentary;   **c.** Chemical Sedimentary   **d.** Intrusive Igneous;
      e. Extrusive Igneous;   **a + b.** Nonfoliated Metamorphic;   **b + c.** Foliated Metamorphic

44) Select the correct rock classification for samples "4B" and "4D".
  a. Silici-Clastic Sedimentary;   **b.** Bio-Sedimentary;   **c.** Chemical Sedimentary   **d.** Intrusive Igneous;
      e. Extrusive Igneous;   **a + b.** Nonfoliated Metamorphic;   **b + c.** Foliated Metamorphic

45) Name of rock sample "4C"?
  a. breccia;   **b.** marble;   **c.** granite;   **d.** gneiss;   **e.** limestone;   **a + b.** basalt;   **b + c.** sandstone;   **c + d.** schist

46) Name these four rock samples (labeled "4A", "4B", "4C" and "4D"); not necessarily in respective order.
  a. sandstone, marble, rhyolite and schist
  b. schist, gneiss, shale and sandstone
  c. basalt, obsidian, limestone and marble;
  d. basalt, siltstone, schist and pumice
  e. siltstone, basalt, quartzite and gneiss
  a + b. sandstone, quartzite, limestone and marble

<u>SAMPLE SET 5</u> (Rocks)

47) Select correct rock classification for samples "5A" and "5B"
  a. Silici-Clastic Sedimentary;   **b.** Bio-Sedimentary;   **c.** Chemical Sedimentary   **d.** Intrusive Igneous;
      e. Extrusive Igneous;   **a + b.** Nonfoliated Metamorphic;   **b + c.** Foliated Metamorphic

48) Cooling history of the *magma* of Samples "5A" and "5B" is inferred to be relatively_____, whereas the cooling history of the *magma* of Samples "5C" and "5D" is inferred to be relatively   _____.
  a. fast (1st blank); slow (2nd blank)   **b.** slow (1st blank); fast (2nd blank)   **c.** all four slow   **d.** all four fast

49) Rock sample "5A" <u>most likely</u> formed at which one of the three major plate boundary settings?
  a. Divergent;   **b.** Convergent;   **c.** Transform

50) Name these four rock samples (labeled "5A", "5B", "5C" and "5D"; not necessarily in respective order.
  a. schist, gneiss, shale and granite
  b. granite, gabbro, rhyolite, and basalt
  c. basalt, obsidian, pumice and limestone;
  d. obsidian, siltstone, schist and tuff;
  e. granite, shale, rhyolite and slate   ****
  a+b. limestone, obsidian, diorite and andesite

SAMPLE SET 6 (Rocks)

51) Select the correct rock classification name for <u>all three</u> of these rock samples.

    a. Silici-Clastic Sedimentary;   **b.** Bio-Sedimentary;   **c.** Chemical Sedimentary   **d.** Intrusive Igneous;

      e. Extrusive Igneous;   **a + b.** Nonfoliated Metamorphic;   **b + c.** Foliated Metamorphic

52) Select the most-likely "Parent" rock (original protolith) for all three rock samples "6A", "6B", and "6C".

    a. Basalt;   **b.** Limestone;   **c.** Granite;   **d.** Shale (mudstone);   **e.** Quartz sandstone

53) Which type of metamorphic foliation has distinctive light- and dark-colored layering or banding?

    a. Slaty;   **b.** Schistosic;   **c.** Gneissic   **d.** None do;   **e.** All three types have it.

54) Name these three rock samples (labeled "6A", "6B" and "6C"), not necessarily in respective order.

    a. slate, siltstone, and granite;   **e.** gneiss, rhyolite and siltstone

    b. gabbro, quartzite and slate   **a + b.** slate, obsidian, and limestone;

    c. limestone, slate and andesite   **b + c.** slate, schist and gneiss;

    d. schist, gneiss, and sandstone   **c + d.** gabbro; shale and sandstone

SAMPLE SET 7 (Rocks)

55) Select the correct rock classification name for <u>all four</u> of these rock samples.

    a. Silici-Clastic Sedimentary;   **b.** Bio-Sedimentary;   **c.** Chemical Sedimentary   **d.** Intrusive Igneous;

      e. Extrusive Igneous;   **a + b.** Nonfoliated Metamorphic;   **b + c.** Foliated Metamorphic

56) Which of these four rock samples has the highest percentage of clay minerals?

    a. Sample "7A"; **b.** Sample "7B"; **c.** Sample "7C"; **d.** Sample "7D"; **e.** None have clay

57) Which rock sample <u>most likely</u> deposited in <u>fastest-moving, turbulent waters</u> (highest-energy environment)?

    a. Sample "7A"; **b.** Sample "7B"; **c.** Sample "7C"; **d.** Sample "7D"; **e.** None most likely

58) Name these rock samples (labeled "7A", "7B", "7C" and "7D"); not necessarily in respective order.

    a. obsidian, siltstone, schist and pumice;
    b. gabbro, conglomerate, quartzite and diorite
    c. conglomerate, sandstone, granite, and slate
    d. schist, gneiss, shale and sandstone
    e. conglomerate, sandstone, siltstone, and shale
    a + b. basalt, obsidian, schist and limestone;

SAMPLE SET 8 (Rocks)

59. Name these four rock samples (labeled "8A", "8B", "8C" & "8D"), not necessarily in respective order.

    a. scoria, obsidian, shale and granite
    b. granite, shale, rhyolite and slate
    c. basalt, obsidian, pumice and limestone;
    d. obsidian, siltstone, schist and tuff;
    e. granite, gabbro, rhyolite, and basalt
    a+b. limestone, obsidian, diorite and andesite
    c+d. scoria, obsidian, tuff and pumice

60. Name of rock sample "8A"?

    a. breccia; **b.** marble; **c.** granite; **d.** gneiss; **e.** gabbro; **a + b.** rhyolite; **b + c.** scoria;

61. Select the correct rock classification for all four samples in Set 8

    a. Intrusive Igneous;   **b.** Extrusive Igneous;   **c.** Detrital sedimentary;   **d.** Chemical sedimentary;

        e. Bio-sedimentary;   **a + b.** Foliated metamorphic;   **c + d.** Nonfoliated metamorphic

62. Select the correct rock classification for samples "8C" and "8D"

    a. Intrusive Igneous;   **b.** Extrusive Igneous;   **c.** Detrital sedimentary;   **d.** Chemical sedimentary;

        e. Bio-sedimentary;   **a + b.** Foliated metamorphic;   **c + d.** Nonfoliated metamorphic

63. Cooling history of sample "8B" is inferred to be relatively _____

    a. slow   **b.** fast then slow   **c.** slow then fast   **d.** fast   **e.** very fast

64. Rock Sample "8A" <u>most likely</u> formed at which one of the three major plate boundary settings?

        a. Convergent;   **b.** Divergent;   **c.** Transform

<u>SAMPLE SET 9</u> (Rocks)

65. Name these four rock samples (labeled "9A", "9B", "9C" & "9D"), not necessarily in respective order.
    a. shale, obsidian, limestone and marble;
    b. granite, siltstone, schist and breccia
    c. siltstone, basalt, quartzite and gneiss
    d. sandstone, quartzite, limestone and marble
    e. granite, schist, limestone and conglomerate
    a+b. sandstone, marble, rhyolite and schist
    c+d. granite, limestone, diorite and slate

66. Name of rock sample "9A"?

    a. breccia; **b.** marble; **c.** granite; **d.** gneiss; **e.** gabbro; **a + b.** rhyolite; **b + c.** sandstone;

      c + d. basalt

67. Cooling history of sample "9A" is inferred to be relatively _____

    a. slow   **b.** fast then slow   **c.** slow then fast   **d.** fast   **e.** very fast

68. Select correct rock classification for samples "9B"

    a. Intrusive Igneous;   **b.** Extrusive Igneous;   **c.** Detrital sedimentary;   **d.** Chemical sedimentary;

        e. Bio-sedimentary;   **a + b.** Foliated metamorphic;   **c + d.** Nonfoliated metamorphic

69. Which type of metamorphism did sample "9B"most likely undergo?

    a. Contact metamorphism   **b.** Regional metamorphism   **c.** Sample "9B" is not metamorphic

70. Select correct rock classification for samples "9C"

    a. Intrusive Igneous;   **b.** Extrusive Igneous;   **c.** Detrital sedimentary;   **d.** Chemical sedimentary;

        e. Bio-sedimentary;   **a + b.** Foliated metamorphic;   **c + d.** Nonfoliated metamorphic

71. Select correct rock classification for samples "9D"

    a. Intrusive Igneous;   **b.** Extrusive Igneous;   **c.** Detrital sedimentary;   **d.** Chemical sedimentary;

        e. Bio-sedimentary;   **a + b.** Foliated metamorphic;   **c + d.** Non-foliated metamorphic

SAMPLE SET 10 (Rocks)

72. Name these four rock samples ("10A", "10B", "10C" & "10D"), not necessarily in respective order.

 a. schist, gneiss, shale and granite
 b. granite, shale, rhyolite and slate
 c. basalt, marble, granite and slate;
 d. obsidian, siltstone, schist and tuff;
 e. granite, gabbro, rhyolite, and basalt
 a+b. limestone, obsidian, diorite and andesite
 c+d. gneiss, conglomerate, diorite and siltstone

73. Name of rock sample "10A"?

    a. breccia;   **b.** marble;   **c.** granite;   **d.** gneiss;   **e.** gabbro;   **a + b.** rhyolite;   **b + c.** sandstone;

    c + d. basalt

74. Cooling history of sample "10A" is inferred to be relatively _____.

    a. slow   **b.** fast then slow   **c.** slow then fast   **d.** fast   **e.** very fast

75. Select correct rock classification for samples "10A" and "10C".

    a. Igneous;   **b.** Sedimentary;   **c.** Metamorphic;

76. Select correct rock classification for samples "10B"

    a. Intrusive Igneous;   **b.** Extrusive Igneous;   **c.** Detrital sedimentary;   **d.** Chemical sedimentary;

        e. Bio-sedimentary;   a + b. Foliated metamorphic;   c + d. Nonfoliated metamorphic

77. Select correct rock classification for samples "10D"

    a. Intrusive Igneous;   **b.** Extrusive Igneous;   **c.** Detrital sedimentary;   **d.** Chemical sedimentary;

        e. Bio-sedimentary;   a + b. Foliated metamorphic;   c + d. Nonfoliated metamorphic

Rock ID Extra Credit Section on Next Page

Rock ID Extra Credit Section – Worth up to 11 EC points (1/2 point per correct answer)

Directions: Go outside over to the Geology Rock Plaza (in central courtyard region of the science building) and name the various large rocks that are found in the courtyard. Note that each large rock there is labeled with a Letter. Go from rock to rock and attempt to identify each rock with its correct rock name, e.g. granite, sandstone, limestone, basalt, gneiss, etc. Below is a list of the letter ed rock boulders that you need to identify. Write the rock name down next to the rock letter.

Rock "A" = _____

Rock "B" = _____

Rock "C" = _____

Rock "D" = _____

Rock "E" = _____

Rock "F" = _____

Rock "G" = _____

Rock "H" = _____

Rock "I" = _____

Rock "J" = _____

Rock "K" = _____

Rock "L" = _____

Rock "M" = _____

Rock "N" = _____

Rock "O" = _____

Rock "P" = _____

Rock "Q" = _____

Rock "R" = _____

Rock "S" = _____

Rock "T" = _____

Rock "U" = _____

Rock "V" = _____