

Minerals - Rocks - Relative Age - Isostasy - Geotime -Tectonic Plate Movement

PART 1. MINERAL & ROCK RECOGNITION: *Multiple Choice* - Questions 1 through 59. **Answer on SCANTRON forms** Directions: *Identify the letter of choice that BEST completes the statement or answers the question.*
Note: For answers with two letters, bubble in two letters on a single line as an answer.

USE HAND LENS and HARDNESS TEST OFTEN!! Ask Instructor for an Acid Test result.

SAMPLE SET 1

1. Give cleavage direction(s) or pattern for sample "A".

- a. More than 3 directions b. 3 directions; @ 90°; c. 3 directions; NOT @ 90°; d. 2 directions; @ 90°;
- e. 2 directions; NOT @ 90°; a + b. 1 direction; b + c. None;

2. Give cleavage direction(s) or pattern for sample "B".

- a. More than 3 directions b. 3 directions; @ 90°; c. 3 directions; NOT @ 90°; d. 2 directions; @ 90°;
- e. 2 directions; NOT @ 90°; a + b. 1 direction; b + c. None

3. Name this pair of mineral samples (labeled "A" and "B"), in respective order.

- a. quartz & olivine; b. augite & hornblende; c. augite & tourmaline; d. plagioclase & K-spar;
- e. muscovite & biotite; a. + b. calcite & dolomite; b.+ c. tourmaline & garnet; c. + d. hornblende & tourmaline

4. This pair of minerals (labeled "A" and "B") are very abundant in which of the following rock pairs?

- a. sandstone & shale; b. limestone & marble; c. chert & quartzite; d. obsidian and pumice
- e. gabbro & basalt; a. + b. granodiorite & dacite; b. + c. granite & rhyolite; c. + d. None of these pairs

5. What feature(s) allows you to positively differentiate mineral "A" from mineral "B"?

- a. hardness; b. fizzes with acid c. luster; d. color e. cleavage; d + e. Both color and cleavage

SAMPLE SET 2

6. Give cleavage direction(s) or pattern for these two samples.

- a. None; b. 1 direction; c. 2 directions; NOT @ 90°; d. 2 directions; @ 90°;
- e. 3 directions; NOT @ 90°; a + b. 3 directions; @ 90°; c + d. More than 3 directions

7. Name this pair of mineral samples (labeled "A" and "B"), in respective order.

- a. quartz & olivine; b. augite & hornblende; c. augite & tourmaline; d. biotite & muscovite;
- e. plagioclase & K-spar; a. + b. calcite & dolomite; b.+ c. tourmaline & garnet; c. + d. hornblende & tourmaline

8. What feature allows the identification of this mineral pair from the other common mineral types?

- a. color; b. hardness; c. luster; d. acid test; e. exsolution lamellae;
- a. + b. striations; b. + c. one direction of perfect cleavage; c + d. taste

9. What feature allows you to differentiate mineral "A" from mineral "B"?

- a. taste; b. hardness; c. luster; d. color; e. one direction of perfect cleavage;
- a + b. exsolution lamellae; b + c. striations; c + d. fizzes with acid

10. Which rock would these minerals be in greater abundance: a foliated or non-foliated metamorphic rock?

- a. non-foliated; b. foliated; c. no difference d. not found in either of those rocks

SAMPLE SET 3

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

- a. gypsum, muscovite & biotite; b. tourmaline, quartz & K-spar; c. magnetite, augite & hornblende;
d. calcite, halite & gypsum; e. plag, K-spar & quartz; a + b. calcite, quartz & plagioclase;
b + c. tourmaline, quartz & garnet c + d. tourmaline, quartz & garnet d + e. gypsum, quartz & garnet

12. What one, single, physical property most distinctly sets two of these minerals apart from the third?

- a. luster; b. cleavage (or lack of); c. acid test d. magnetism e. color; a + b. hardness;

13. What is the general hardness of these minerals?

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

14. ALL THREE minerals (labeled "A", "B" and "C") are very abundant in which of the following rock pairs?

- a. gabbro & basalt; b. granite & rhyolite; c. siltstone & claystone; d. chert & quartzite;
e. limestone & marble; a + b. obsidian and peridotite b + c. None of these pairs

SAMPLE SET 4

15. Name this pair of mineral samples (labeled "A" and "B").

- a. muscovite & biotite; b. plagioclase & K-spar; c. augite & hornblende; d. gypsum and halite;
e. quartz & olivine; a + b. gypsum & calcite; b + c. muscovite and calcite c + d. K-spar & augite

16. Describe the cleavage pattern for sample "A".

- a. None; b. 1 direction; c. 2 directions; NOT @ 90°; d. 2 directions; @ 90°;
e. 3 directions; NOT @ 90°; a + b. 3 directions; @ 90°; c + d. More than 3 directions

17. Describe the cleavage pattern for sample "B".

- a. None; b. 1 direction; c. 2 directions; NOT @ 90°; d. 2 directions; @ 90°;
e. 3 directions; NOT @ 90°; a + b. 3 directions; @ 90°; c + d. More than 3 directions

18. What is the general hardness of these minerals?

- a. Both are soft; b. Both are hard; c. One is soft; the other hard d. No way to tell!

19. What property allows you a sure-fire positive means to differentiate mineral "A" from mineral "B"?

- a. luster; b. cleavage; c. acid test d. magnetism e. color; a + b. hardness

20. BOTH minerals (labeled "A" and "B") are exclusively associated with which of the three major rock type?

- a. igneous; b. metamorphic; c. sedimentary

SAMPLE SET 5

21. Name this pair of rock samples (labeled "A" and "B").

- a. sandstone and siltstone; b. granite and rhyolite; c. gabbro and granite; d. schist and gneiss;
e. limestone and chert; a + b. breccia and conglomerate; c + d. coquina and travertine

22. Select correct rock classification for these samples.

- a. Extrusive Igneous; b. Intrusive Igneous; c. Detrital sedimentary; d. Biochemical sedimentary;
e. Chemical sedimentary; a + b. Foliated metamorphic; b + c. Nonfoliated metamorphic

23. Which property(s) allows you to get a sure-fire positive means to differentiate sample "A" from sample "B"?
Note that it may be more than one property or test.

- a. color; b. texture; c. hardness; d. the acid test; e. Both color & texture; a. and b. Both, hardness & acid test

24. Which rock sample is softer?

- a. Sample "A"; b. Sample "B"; .

SAMPLE SET 6

25. Name this two pair of rock samples (labeled "A", "B", "C" and "D"), not necessarily in respective order.

- a. sandstone and siltstone; schist and gneiss; b. gabbro and granite; quartzite and marble
c. limestone and chert; diorite and andesite d. schist and gneiss; shale and sandstone
e. granite and rhyolite; basalt and gabbro a + b. sandstone and siltstone; breccia and conglomerate;
b + c. basalt and gabbro; schist and gneiss; c. + d. basalt and gabbro; shale and sandstone

26. Name of rock sample "A"?

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

27. Select correct rock classification for samples "A" and "C"

- a. Intrusive Igneous; b. Extrusive Igneous; c. Detrital sedimentary; d. Chemical sedimentary;
e. Biochemical sedimentary; a + b. Foliated metamorphic; c + d. Nonfoliated metamorphic

28. Select correct rock classification for samples "B" and "D"

- a. Intrusive Igneous; b. Extrusive Igneous; c. Detrital sedimentary; d. Chemical sedimentary;
e. Biochemical sedimentary; a + b. Foliated metamorphic; c + d. Nonfoliated metamorphic

29. Cooling history of the *magma* of Samples "A" and "C" is inferred to be relatively _____, whereas the cooling history of the *magma* of Samples "B" and "D" is inferred to be relatively _____.

- a. slow (1st blank); fast (2nd blank) b. fast (1st blank); slow (2nd blank) c. all four slow d. all four fast

SAMPLE SET 7

30. Name this pair of rock samples (labeled "A" and "B"), not necessarily in respective order.

- a. sandstone and siltstone; b. gabbro and granite; c. limestone and chert; d. schist and gneiss;
e. basalt and gneiss a + b. breccia and conglomerate; b + c. granite and rhyolite;

31. Rock Sample "A" has TWO distinctive textures. List TWO visible textures.

- a. aphanitic and glassy; b. porphyritic and pyroclastic; c. phaneritic and glassy;
d. pegmatitic and vesicular; e. aphanitic and pegmatitic;

32. Name of rock Sample "A"

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

33. Rock Sample "A" most likely formed at which one of the three major plate boundary settings?

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

34. Select correct rock classification for Sample "B".

- a. Extrusive Igneous; b. Intrusive Igneous; c. Silici-clastic sedimentary; d. Evaporate sedimentary;

e. Carbonate sedimentary; a + b. Foliated metamorphic; b + c. Nonfoliated

SAMPLE SET 8

35. Name this pair of rocks samples (labeled "A" and "B"), not necessarily in respective order.

- a. limestone and marble b. granite and rhyolite; c. shale and schist; d. gabbro and granite;
e. sandstone and quartzite; a + b. breccia and conglomerate; c + d. basalt and gabbro

36. Solid-state mineralization processes that change parent (protolith) rock into the daughter rock occurs under _____ conditions.

- a. igneous; b. sedimentary c. metamorphic;

37. Select correct rock classification for "Parent" (original protolith) rock sample.

- a. Extrusive Igneous; b. Intrusive Igneous; c. Detrital sedimentary; d. Chemical sedimentary;
e. Biochemical sedimentary; a + b. Foliated metamorphic; b + c. Nonfoliated metamorphic

38. Select correct rock classification for "Daughter" (modified protolith) rock sample.

- a. Extrusive Igneous; b. Intrusive Igneous; c. Detrital sedimentary; d. Chemical sedimentary;
e. Biochemical sedimentary; a + b. Foliated metamorphic; b + c. Nonfoliated metamorphic

39. Name of rock sample "A"?

- a. breccia; b. marble; c. rhyolite; d. sandstone e. gabbro; a + b. granite; b + c. gneiss;
c + d. limestone; d + e. quartzite

SAMPLE SET 9

40. Name this pair of rocks samples (labeled "A" and "B").

- a. limestone and marble b. granite and rhyolite; c. shale and schist; d. gabbro and granite;
e. siltstone and quartzite; a + b. breccia and conglomerate; b + c. basalt and gabbro

41. Select correct rock classification for "Parent" (original protolith) rock sample.

- a. Extrusive Igneous; b. Intrusive Igneous; c. Detrital sedimentary; d. Chemical sedimentary;
e. Biochemical sedimentary; a + b. Foliated metamorphic; b + c. Nonfoliated metamorphic

42. Select correct rock classification for "Daughter" (modified protolith) rock sample.

- a. Extrusive Igneous; b. Intrusive Igneous; c. Detrital sedimentary; d. Chemical sedimentary;
e. Biochemical sedimentary; a + b. Foliated metamorphic; b + c. Nonfoliated metamorphic

43. Name of rock sample "B"?

- a. breccia; b. marble; c. shale; d. schist; e. gabbro; a + b. granite; b + c. sandstone c + d. limestone;

SAMPLE SET 10

Matching. Choose from the following rock name choices to answer questions 44 to 46:

- a. chert; b.. limestone; c. sandstone; d. mudstone; e. breccia; a + b. conglomerate; b. + c. granite

44. Name of rock sample labeled "A"?

45. Name of rock sample labeled "B"?

46. Name of rock sample labeled "C"?

47. Which rock sample has a larger amount of clay?

- a. Sample "C"; b. Sample "B"; c. Sample "A"; d. All have same amount of clay; e. None has clay

48. Which rock sample most likely deposited closest to the site of the weathering source rock?

- a. Sample "C"; b. Sample "B"; c. Sample "A"; d. All about the same distance

49. Which rock sample most likely deposited furthest from the site of the weathering source rock?

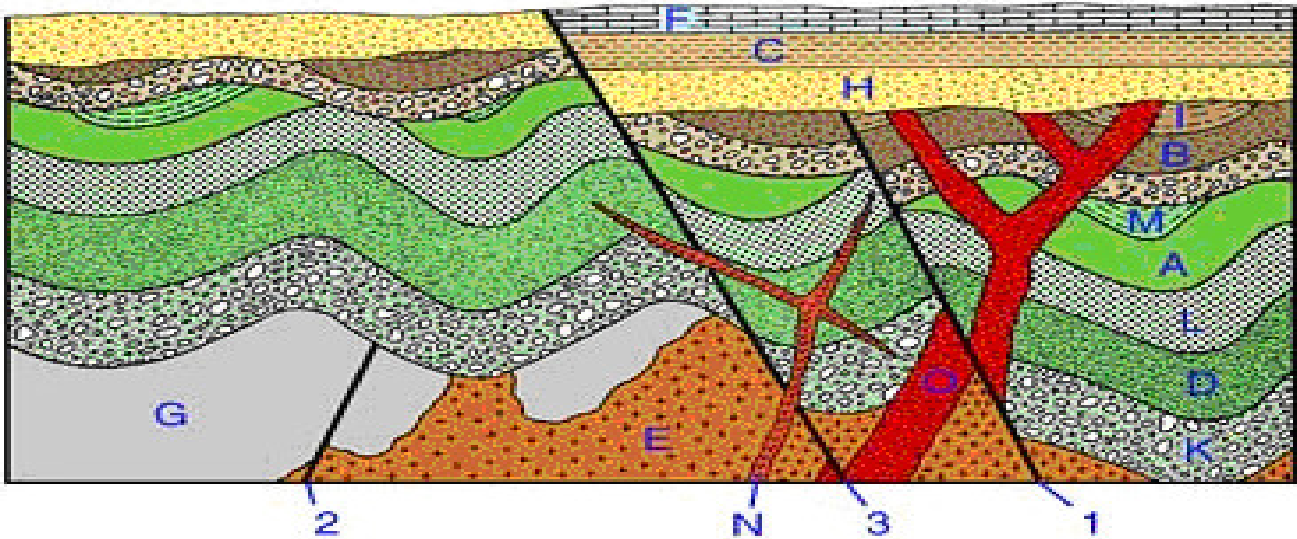
- a. Sample "C"; b. Sample "B"; c. Sample "A"; d. All about the same distance

50. Which rock sample most likely deposited in calm, quiet waters (very low-energy environment)?

- a. Sample "C"; b. Sample "B"; c. Sample "A"; d. All deposited in calm quiet waters e. None

PART 2. Relative Age - Geologic Block Diagram

Directions: Study the stratigraphic block diagram below. Use this diagram to answer questions 51 to 55.



51. The illustration above shows a geologic cross section. On a piece of paper, figure out the correct order, from oldest to youngest, in which the various rock units and faults were created. Choose the list from the selection below that has the correct temporal order of the seventeen lettered and numbered geologic features --- ordered from OLDEST (left end) to YOUNGEST (right end)

- a. E, G, 2, N, O, K, D, L, A, M, B, I, 1, H, C, F, 3
 b. E, G, K, 2, D, L, A, M, B, I, N, 1, O, 3, H, C, F
 c. F, C, H, O, 3, 1, N, B, I, M, A, L, D, 2, K, G, E
 d. G, E, 2, K, D, L, O, 1, H, C, A, M, B, I, F, 3, N
 e. G, E, 2, K, D, L, A, M, B, I, O, 1, H, C, F, 3, N
 a. + b. G, 2, E, K, D, L, 1, O, H, C, A, M, B, I, N, 3, F
 b. + c. B, I, O, 1, H, C, F, 3, N, G, E, 2, K, D, L, A, M
 c. + d. 2, G, D, K, O, N, A, L, E, 3, F, C, H, 1, I, B, M
 d. + e. 3, F, C, H, 1, I, B, M, A, L, D, K, O, N, 2, G, E

52. The key stratigraphic principle that you used to date geologic items K, D, L, A, M, B and I?

- a. Superposition
 b. Original horizontality
 c. Inclusion
 d. Cross-cutting

53. The key stratigraphic principle that you used to date geologic items 1, 2, 3, E, N, and Q?

- a. Original horizontality
- b. Superposition
- c. Cross-cutting Inclusion
- d. Inclusion

54. The type of unconformity lying directly beneath layer H, in the region to the left of fault 3?

- a. Angular unconformity
- b. Disconformity Angular unconformity
- c. Nonconformity
- d. Misconformity
- e. Angular incomformity

55. When did the folding event occur?

- a. After Formation H, but before Intrusion N
- b. After Fault 1, but before Intrusion O
- c. After Formation I, but before Formation H
- d. After Formation G, but before Formation I
- e. After Intrusion N, but before Fault 3

Part 3. ISOSTASY: *MODELING CRUSTAL BUOYANCY WITH THE MANTLE*

Multiple Choice: Questions 56 through 60. **Directions:** The following set of questions pertains to wood blocks floating in a water bath: Block "A" and Block "B". 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.*

56. Which of the following densities is closest to that of Block A?

- a. Between 0.4 and 0.2 g/cm³ Greater than 0.8 g/cm³
- b. Between 0.4 and 0.6 g/cm³
- c. Between 0.6 and 0.8 g/cm³
- d. Greater than 0.8 g/cm³
- e. Impossible to determine.

57. Which of the following densities is closest to that of Block B?

- a. Between 0.4 and 0.2 g/cm³ Greater than 0.8 g/cm³
- b. Between 0.4 and 0.6 g/cm³
- c. Between 0.6 and 0.8 g/cm³
- d. Greater than 0.8 g/cm³
- e. Impossible to determine.

58. If Block A was twice as thick as Block B, then Block A would _____.

- a. sit *lower* in the water than Block B
- b. sit *higher* in the water than Block B
- c. sit about the same in the water as Block B.
- d. There is no way to tell which block would sit higher or lower in the water.

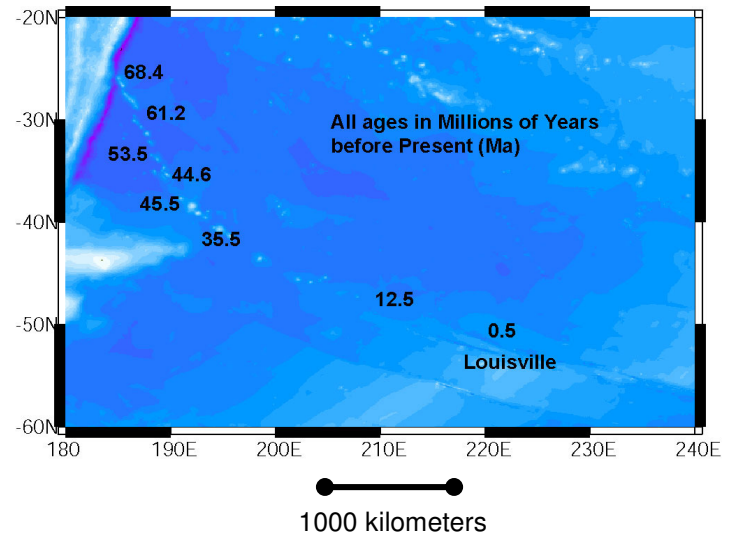
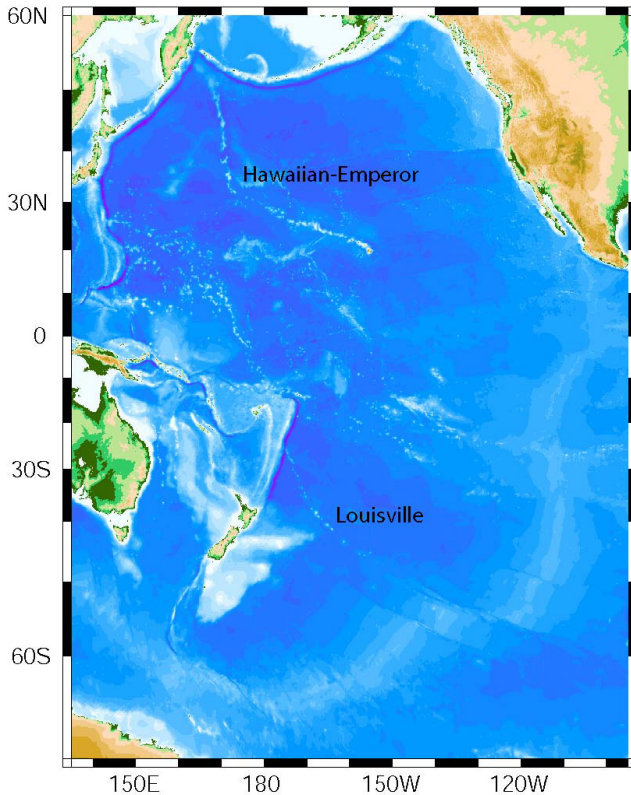
59. If the top 1/4 of Block A's thickness were removed, Block A would _____.

- a. sink lower into the water
- b. rise out of the water.
- c. just sit there - neither rise nor sink.
- d. start spinning like a top.

60. Which block best represents oceanic crust within this model: Block A or Block B?

- a. Block B
- b. Block A

Part 4. Plate Movement Analysis: Tectonic Plate Movement Over Fixed Hotspot - Louisville Seamount Chain – South Pacific Oceanic Hot Spot Track.



Multiple choices: Questions 61 through 63 **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 created 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 (1×10^5) cm

61. What is **average speed** for the Pacific plate associated with the Louisville Hotspot?
- Less than 1 cm/yr
 - Between 1 and 4 cm/yr
 - Between 4 and 7 cm/yr
 - Between 7 and 10 cm/yr
 - Greater than 10 cm/yr
62. What is the **average direction** of motion of the Louisville Seamount chain (Pacific plate) over the hot spot?
- a. South; b. Southwest; c.. West; d. Northwest e. North; a + b. Northeast; b + c. East; c + d. Southeast;
63. 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 _____.

- be moving on different tectonic plates
- be moving on the same tectonic plate.
- have formed from the same hot spot.
- None of the above.

Part 5: Geologic Timescale:

Multiple Choice: Questions 64 through 66

Directions: *Identify the letter of choice that BEST completes the statement or answers the question.*

64. Which of the following periods occurred during the Mesozoic?
- a. Cambrian
 - b. Triassic
 - c. Paleogene
 - d. Permian
 - e. Silurian
65. Which of the following epochs did NOT occur during the Tertiary period?
- a. Miocene
 - b. Eocene
 - c. Paleocene
 - d. Holocene
 - e. Oligocene
66. Which of the following ages is closest to the Mesozoic-Cenozoic boundary?
- a. 840 million years ago
 - b. 540 million years ago
 - c. 230 million years ago
 - d. 63 million years ago
 - e. 12 million years ago