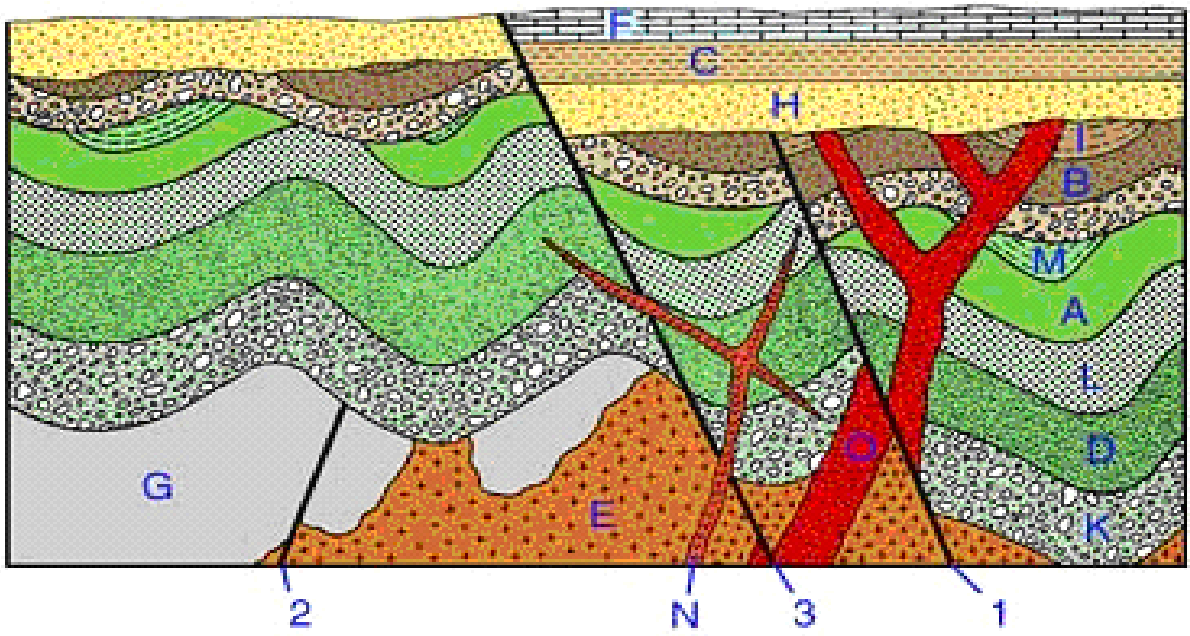
Name: _____ **Grade:** _____

GEOL101 Laboratory - Preparatory Lab for Final Exam

Introduction & Purpose: In this lab you will review and improve upon the geologic concepts and skills covered in the second final exam that you will be taking next week. This worksheet is designed to simulate the final exam material and format.

Part I. Relative Age - Geologic Block Diagram

Directions: Use the stratigraphic block diagram below to answer questions 1 through 5.



1.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 <u>OLDEST (left end) to YOUNGEST (right end)</u>

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

2. 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

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

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

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

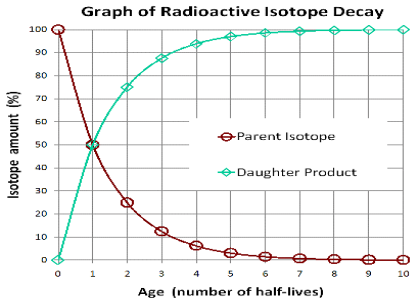
a.	Angular unconformity
b.	Disconformity
c.	Nonconformity
d.	Misconformity
e.	Geometric inconsistency

5.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 II. Stratigraphic Block Diagram Absolute Dating Determination

Directions: Calculate the correct absolute dates for the igneous rock units using the appropriate isotopic analyses and the radiometric dating method.



Isotopic Age Dating

Dating Method	Parent/Daughter Isotopes	Half Lives	Materials Dated	Age Date Range
Carbon (C)/Nitrogen (N)	C-14/N-14	5,730 years	Shells, limestone, organic materials	100-50,000 years
Potassium (K)/Argon (Ar)	K-40/Ar-40	1.3 billion years	Biotite, whole volcanic rock	100,000-4.5 billion years
Rubidium (Rb)/Strontium (Sr)	Rb-87/Sr-87	47 billion years	Micas	10 million-4.5 billion + years
Uranium (U)/Lead (Pb)	U-238/Pb-206	4.5 billion years	Zircon	10 million-4.5 billion + years
Uranium (U)/Lead (Pb)	U-235/Pb-207	710 million years	Zircon	10 million-4.5 billion + years

A. <u>Isotopic Analyses of Granite Pluton Unit "E"</u>: The granite intrusion "E" in the geologic block diagram contains pristine zircon crystals that were processed and analyzed for **Uranium-235 and Lead-207 content**. Laboratory analyses of the samples yielded the following U-235 / Pb-207 ratio:

Parent U-235 = 50% Daughter Pb-207 = 50%

6. Number of half lives elapsed: _____

a.	0.25
b.	0.5
c.	0.75
d.	1.0
e.	1.25

7. Calculated age of Granite Intrusion "E" = _____ million years old

a.	178
b.	355
c.	533
d.	710
e.	888

B. <u>Isotopic Analyses of Andesite Dike Unit "O"</u>: The andesite lava flow "O" in the geologic block diagram also contains zircon crystals that were processed and analyzed for **Uranium-235 and Lead-207 content**. The laboratory analyses of the samples yielded the following U-235 / Pb-207 ratio:

Parent U-235 = 70.7% Daughter Pb-207 = 29.3%

8. Number of half lives elapsed: _____

a.	0.25
b.	0.5
c.	0.75
d.	1.0
e	1.25

9. Calculated age of Andesite Dike Unit "O": = _____ million years old

a.	178
b.	355
c.	533
d.	710
e.	888

C. <u>Fossil Analyses of</u> Neuropteris. Directions: Fern leave fossil imprints of ***Neuropteris*** were found in **Rock Unit "H".** Using your lab manual, determine the age range of this fossil.

10. The age range of Neuropteris is _____ **million years old**

a.	60 to 80
b.	150 to 170
c.	280 to 300
d.	430 to 450
e.	470 to 490

Absolute Age of granite = _____ m.y.o

Absolute Age of dike = _____ m.y.o

Age range of fern fossil = _____ to _____ m.y.o

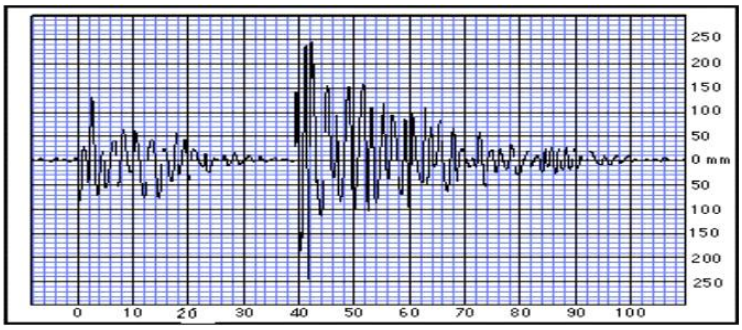
11. Based on above age data, the <u>*Best Constrained Age Range*</u> of the Unconformity that lies directly beneath layer "H" and above dike "O", is _____ to _____ millions of years

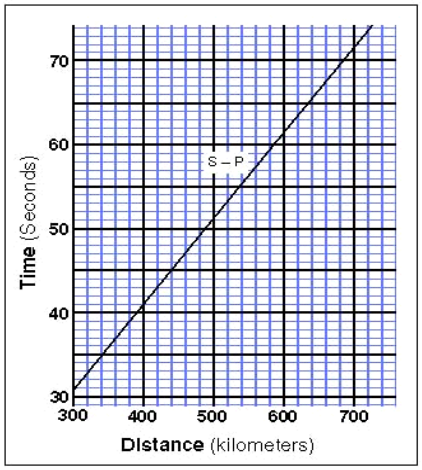
a.	150 to 170

b.	170 to 355
c.	280 to 355
d.	300 to 710
e.	355 to 710

Part III. Analysis of a Seismogram

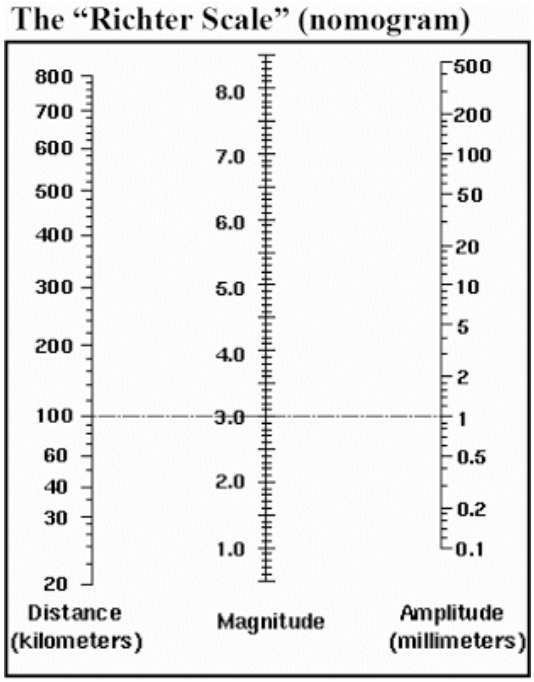
Directions: Study the seismogram from Phoenix, AZ, shown below. Use the S-P Interval chart to determine how far away Phoenix is to the earthquake epicenter. Then use Richter magnitude chart to determine the magnitude of the earthquake. **Note:** Ignore the seismogram above the Richter scale chart. Answer questions 12 through 15 for the seismogram diagrams.





12. **How far away is Phoenix, Arizona from the earthquake epicenter?**

a.	Roughly 800 kilometers
b.	Roughly 600 kilometers
c.	Roughly 400 kilometers
d.	Roughly 200 kilometers



13. **What was the magnitude of the earthquake?**

a.	Greater than 6
b.	Between 5 and 6
c.	Between 4 and 5
d.	Between 3 and 4
e.	Less than 3

14. **Which of the following substrates poses the greatest seismic hazard for building a home on?**

a.	Granite
b.	Poorly-cemented sandstone
c.	Dry, compacted mix of sand and clay.
d.	Water-saturated, poorly compacted silt and sand

15. **Which of the following substrates poses the least seismic hazard for building a home atop?**

a.	Granite
b.	Poorly-cemented sandstone
c.	Dry, compacted mix of sand and clay.
d.	Water-saturated, poorly compacted silt and sand

PART IV - Ennis Quadrangle Topographic Map

Directions: Study the Ennis, Montana Quad topo map provided to you by your instructor. Answer the following Ennis topo map questions 16 through 28.

16. What is the verbal map scale of the Ennis Quad topo map?

1 inch of map distance equals _____ mile(s) of real ground distance.

a. 50
b. 10
c. 5
d. 1
e. 0.5

17. What is the topo maps' contour interval? (in feet)

a. 80
b. 60
c. 40
d. 20
e. 10

18. What is the magnetic declination for the Ennis, Montana region?

a. 13 E
b. 13 1/2 W
c. 18 1/2 E
d. 18 ½ W

19. Which direction does the Madison River flow?

a. Northward
b. Southward
c. Impossible to tell.
d. Either northward or southward - depends on the time of year.

20. Which direction does the Cherry Creek flow?

a. West
b. East
c. Impossible to tell.
d. Either west or east - depends on the time of year.

21. What are the directions of latitude and longitude on this map?

a. North Latitude; South Longitude
b. West Latitude; East Longitude
c. North Latitude; West Longitude
d. South Latitude; East Longitude

22. What is the geographic location name listed on the map with the following Lat/Long coordinates? Hint: It's a ranch. **NOTE:** This is location "A" for later questions 24, 25, and 26.

Latitude: **45° 18' 3" north** Longitude: **111° 36' 27"** west

a. Dutton Ranch
b. Fan Mountain Ranch
c. Jumping Horse Stock Ranch
d. Lake Ennis Ranch
e. Lawton Ranch

23. What are the latitude-longitude coordinates for Southeastern shoreline of Lake Ennis (location is marked with a "+"? Note: This is **Location** "**B**" for later questions.

a. Latitude = 111˚ 47' 45"N Longitude = 45˚ 20' 00"W
b. Latitude = 111˚ 37' 45"N Longitude = 45˚ 00' 00"W
c. Latitude = 45˚ 25' 30"N Longitude = 111˚ 40' 00"W
d. Latitude = 45˚ 48' 40"N Longitude = 111˚ 28' 10"W
e. Latitude = 45˚ 56' 45"N Longitude = 111˚ 10' 00"W

24. What is the distance from Location A (Question 22) **to Location B** (Question 23)**?**

a. 17 miles
b. 13 miles
c. 8 miles
d. 5 miles
e. 2 miles

25. What is the AZIMUTH bearing from Location A (Question 22) **to Location B** (Question 23)**?**

a. 340
b. 240
c. 190
d. 60
e. 10

26. Which of the following *quadrant* compass bearings is the most accurate for the direction starting from Location A (Question 22) **and heading to Location B** (Question 23)**?**

a. Bearing = S20W
b. Bearing = S60E
c. Bearing = N20W
d. Bearing = N60E

27. What is the slope gradient of the Cedar Creek Fan (mountain front to Bear Creek? (ft/mi)

a. 1000 feet/mile
b. 500 feet/mile
c. 250 feet/mile
d. 100 feet/mile

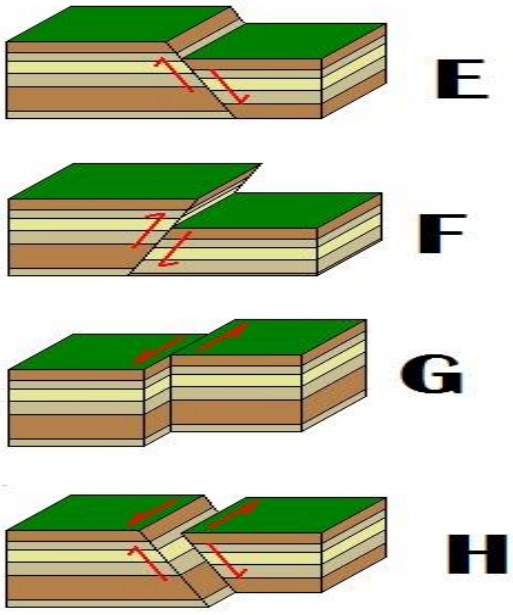
28. What type of vegetation covers the mountains west of Ennis?

a. No vegetation
b. Scrub
c. Wooded
d. Orchard
e. Vineyard

Part V. Fault Identification

Directions: *Match the geologic feature (Capital Letter) with its associated geologic term (small-case letter(s)) (Questions 29 through 32).*

a. Right-lateral strike-slip fault
b. Left-lateral strike-slip fault
c. Reverse fault
d. Normal fault
e. **e.** Oblique fault (combo dip-/strike-slip)



_____ **29. Feature E**
____ **30. Feature F**
____ **31. Feature G**
____ **32. Feature H**

33. Which side of Fault "E" is the hanging wall?

a. Right side block
b. Left side block
c. Neither side is a hanging wall

34. Which type of directed crustal stress created Fault "E"?

- **a.** Tensional stress
- **b.** Compressional stress
- **c.** Lateral shear stress

35. Fault "F" was most likely created at which type of plate boundary?

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

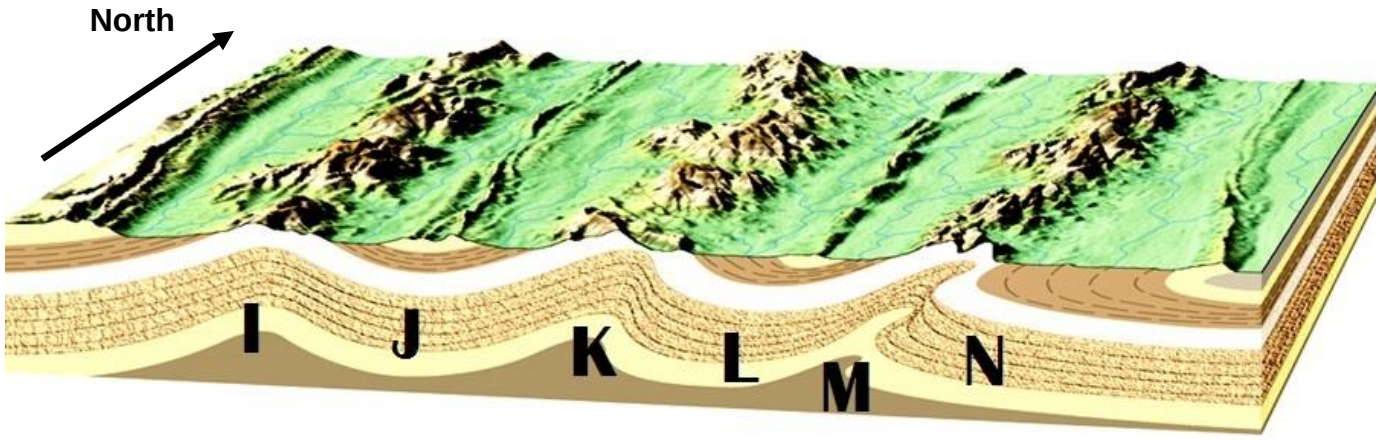
36. Fault "G" was most likely created at which type of plate boundary?

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

Part VI. Fold Identification

Directions: *Match the geologic feature (Capital Letter) with its associated geologic term (small-case letter(s)) for questions 37 through 42 below.*

- **a.** Asymmetrical anticline
- **b.** Asymmetrical syncline
- **c.** Overturned anticline
- **d.** Overturned syncline
- **e.** Symmetrical anticline
- **a. + b.** Symmetrical syncline



____ 37. Feature I
____ 38. Feature J
____ 39. Feature K
____ 40. Feature L
____ 41. Feature M
____ 42. Feature N

43. The set of folds shown above are plunging folds. True or false?

- **a.** True
- **b.** False

44. The fold axes for the above folds have a north-south strike. True or false?

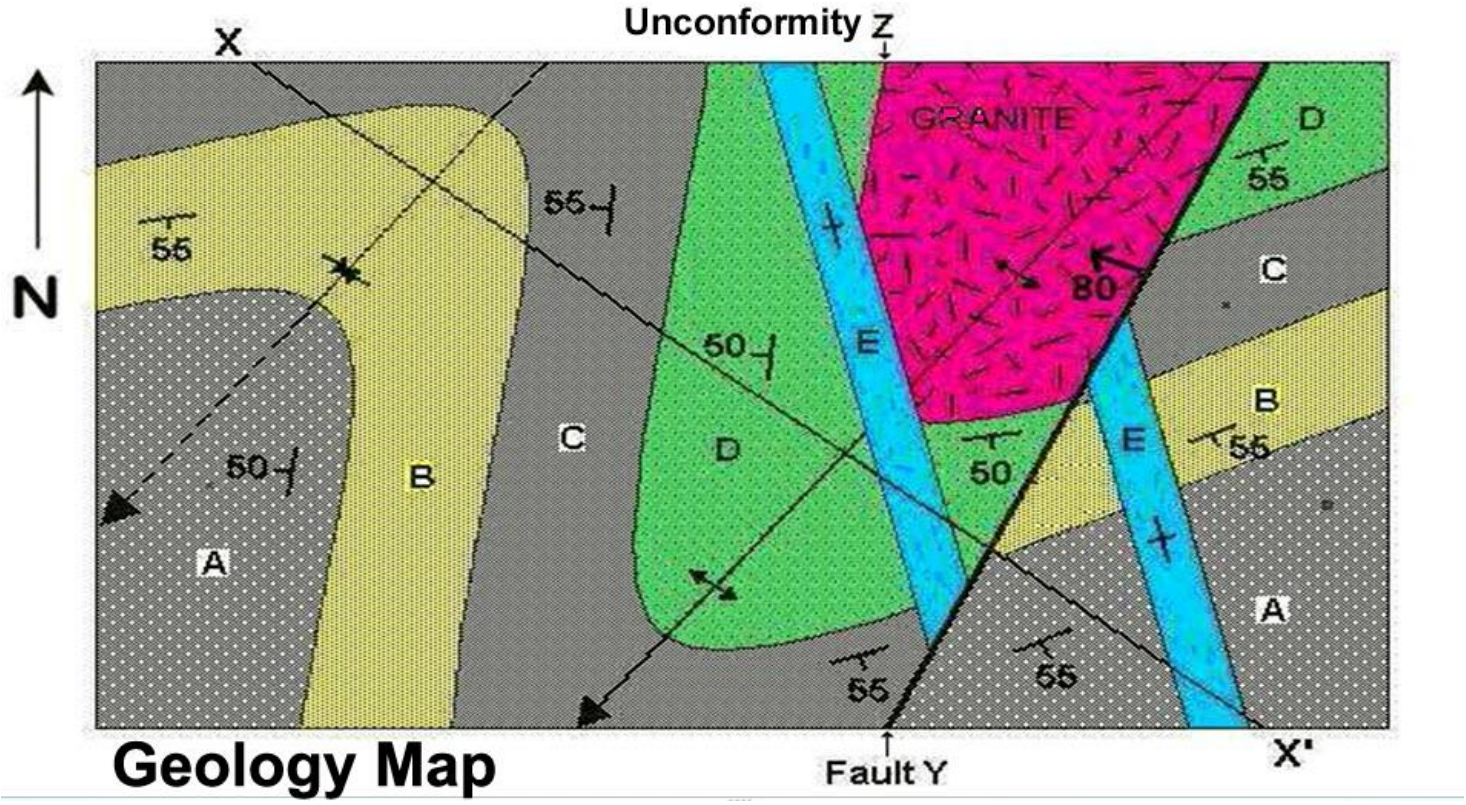
- **a.** True
- **b.** False

45. These folds were most likely created at which type of plate boundary?

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

Part VII – Reading and Interpreting a Simplified Geologic Map

Directions: The simplified geology map below contains several geologic features that include the following: Sedimentary beds "A", "B", "C", and "D"; Basalt dike" E"; Granite pluton; Fault "Y"; and Unconformity "Z". Use the map below to answer the list of questions 47 through 57:



46. What is the *oldest* rock unit on this map?

- **a.** Formation “A”
- **b.** Formation “B”
- **c.** Formation “C”
- **d.** Formation “D”
- **e.** Granite pluton
- **a. + b.** Basalt dike

47. What is the *youngest* rock unit on this map?

- **a.** Formation “A”
- **b.** Formation “B”
- **c.** Formation “C”
- **d.** Formation “D”
- **e.** Granite pluton
- **a. + b.** Basalt dike

48. Which of these three geologic elements is youngest: Dike "E", Granite pluton, or Fault "Y"?

- **a.** Dike “E”
- **b.** Granite pluton
- **c.** Fault “Y”

49. Which stratigraphic principle best helped you answer question 48 above?

- **a.** Superposition
- **b.** Cross-cutting
- **c.** Inclusion

50. Which of the following is the correct temporal order of the geologic features on this map? (The oldest one being the first in the order.)

- **a.** "A", "B", "C", "D", "E", "Z". Granite, "Y"
- **b.** "D", "C", "B", "A", "E", "Z", Granite, "Y"
- **c.** "D", "C", "B", "A", Granite, "Y", "E", "Z",
- **d.** Granite, "Z", "A", "B", "C", "D", "E", "Y"
- **e.** Granite, "E", "Z", "Y", "A", "B", "C", "D",
- **a + b.** Granite, "Z", "D", "C", "B", "A", "E", "Y",

51. What type of unconformity is "Z"? Hint: The unconformity is floored by granite.

- **a.** Disconformity
- **b.** Angular unconformity
- **c.** Nonconformity

52. What is the strike and dip of Fault "Y"?

- **a.** East-West
- **b.** North-South
- **c.** Northeast-Southwest
- **d.** Northwest-Southeast

53. Which side of Fault "Y" is the hanging wall? The side with the granite? Or the side without the granite?

- **a.** The side with the granite
- **b.** The side without the granite

54. What type of fault is Fault "Y" if the slickenside grooves are <u>horizontal</u> (parallel to strike)?

- **a.** Reverse fault
- **b.** Thrust fault
- **c.** Normal fault
- **d.** Left lateral strike-slip fault
- **e.** Right lateral strike-slip fault

55. What is the strike of Dike "E" ?

- **a.** East-West
- **b.** North-South
- **c.** Northeast-Southwest
- **d.** Northwest-Southeast

56. What type of fold occurs in the western part of map? (Fold with rock unit "A" at its core) Note whether it's an anticline or a syncline AND whether its horizontal or plunging.

- **a.** Horizontal syncline
- **b.** Horizontal anticline
- **c.** Plunging syncline
- **d.** Plunging anticline

57. Which direction are the folds plunging? (Hint: Check the fold axis lines for an arrow)

- **a.** Southwest
- **b.** Northeast

58. What kind of dip angles do the limbs of the folds have? Low-angle, Moderate-angle? Or High angle dips?

- **a.** Low-angle dips
- **b.** Moderate dips
- **c.** High angle dips

59. From which directions were the crustal forces being applied to create the two folds shown on the map? NW-SE? NE-SW? N-S? or W-E?

- **a.** East-West
- **b.** North-South
- **c.** Northwest-Southeast
- **d.** Northeast-Southwest

60. What is the tectonic setting most likely to have formed this deformed rock package? Divergent? Convergent? Or Transform?

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