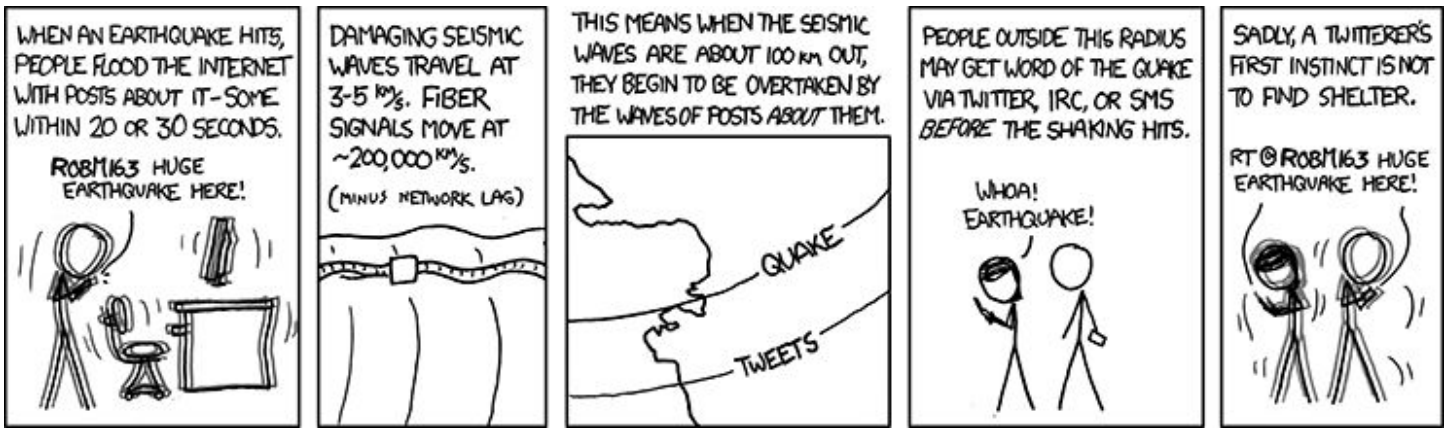

CARMEL SCIENCE OLYMPIAD
GEOLOGIC MAPPING TRYOUT
2019-2020

*Name:*_____

Grade (circle): 9 10 11 12

Directions: You will have forty minutes to complete this test. You will not be penalized for guessing and it is in your best interest to attempt all questions. You are allowed to use one non-programmable scientific calculator and a 2" binder. Tiebreakers are the Analysis Questions, in order.

For officer use only:

Score: _____/100 Rank: ___

Written by: Lalith Roopesh

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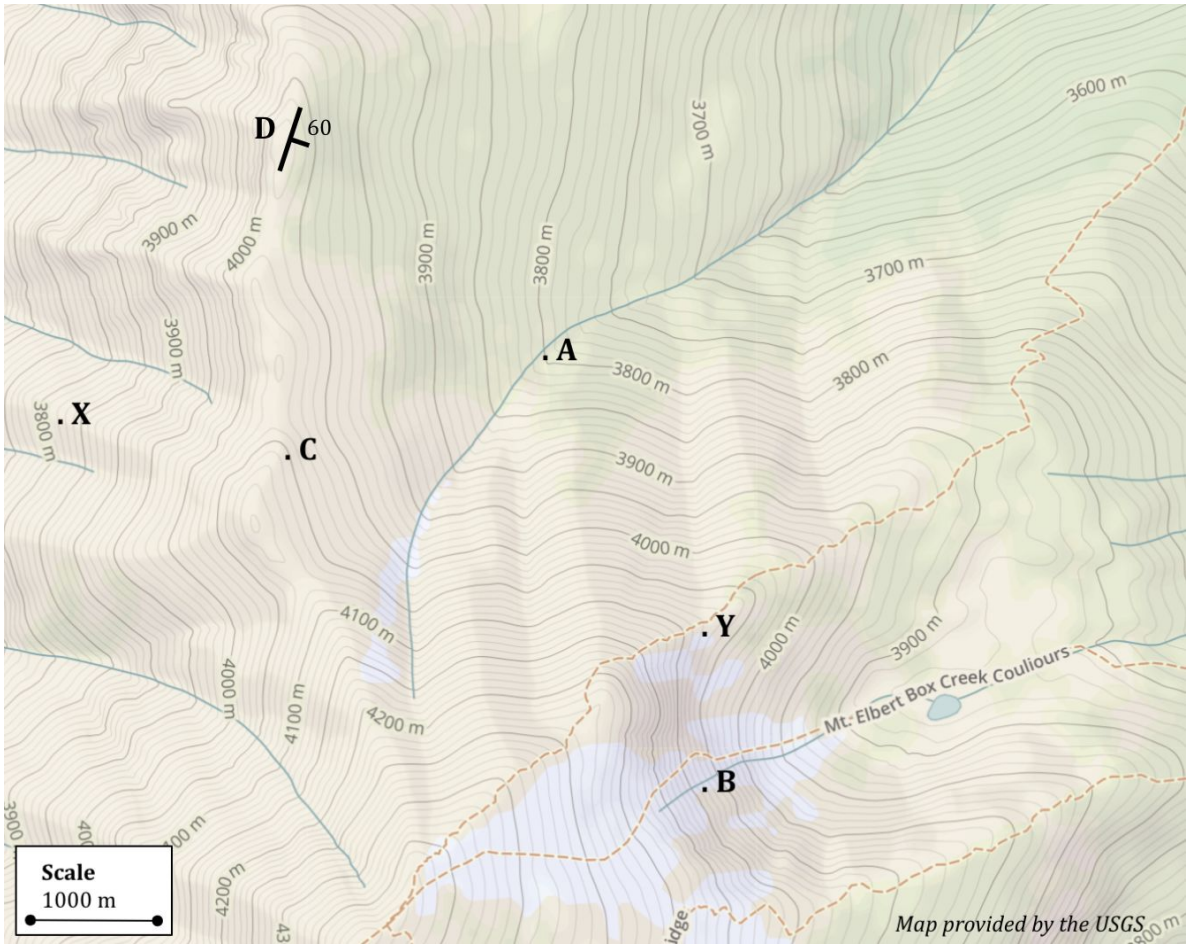
Section I: Analysis Questions

1. The following is a topographic map near Mt. Elbert, Colorado, the highest peak in the Rocky Mountains.



A. What is the contour interval of this map? (1)

B. In what direction is the river near Point A running? (1)

C. Besides elevation, name a rule for topographic maps that helps determine the answer to Part B. (2)

D. A bed outcrop is found at Points A, B, and C. Calculate the strike and dip of the bed. Show work. (4)

Strike: _____ Dip: _____

E. The Rocky Mountains lay far from any plate boundary and are not volcanic. Explain how they might have formed. (2)

F. Draw a vertical profile from Point X to Point Y. Make sure to make it accurate and label elevation. (9)

G. The terrain west of the Rocky Mountains are made from accreted fragments. What are these called? (1)

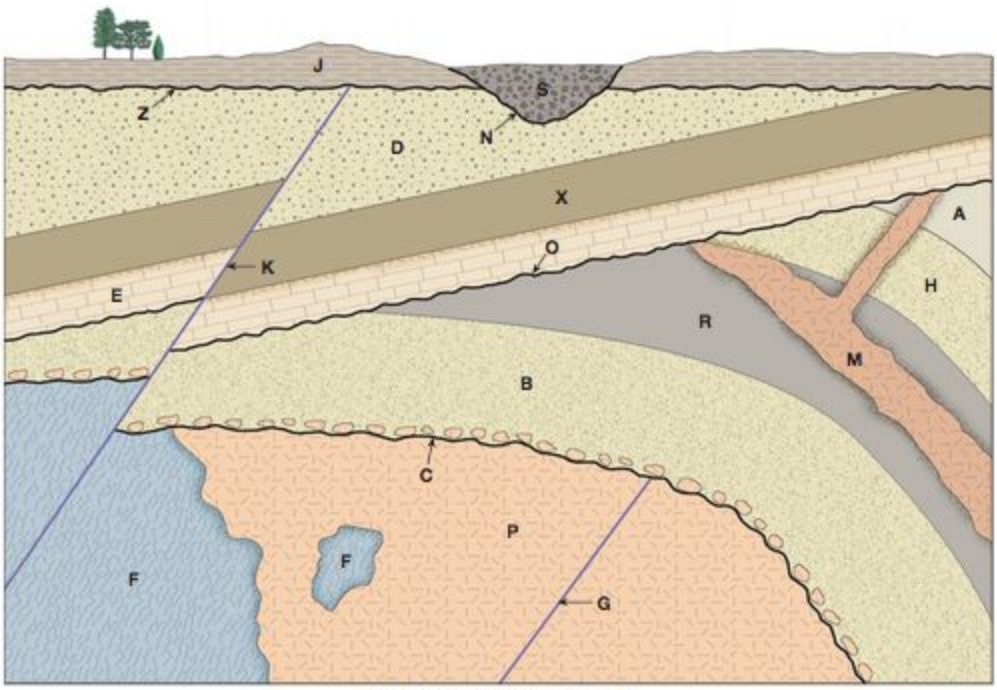
H. What type of fault was mainly created while these fragments were accreted? (1)

I. Calculate the grade from Point A to Point Y. (2)

J. What type of rock would you expect to see at Point C? Explain how it got there. (2)

K. A drill core at point D reveals a bed layer has a thickness of 200m. Calculate the layer's true thickness with the strike/dip notation shown. Assume point D gives the thickest drill core, and show all work. (2)

2. Refer to the geologic cross section below to answer the following questions.



A. Using their letters, put the geologic features in order from oldest to youngest. (6)

B. The geologic principles used to determine the answer to Part A are attributed to whom? (1)

C. Feature P is a large intrusion of igneous rock (a pluton). What type of pluton is it? (1)

D. Feature M is a similar intrusion of igneous rock (a pluton). What type of pluton is it? (1)

E. Features C and O are unconformities. What type of unconformities are they? (2)

F. What type of fault is Feature K? (1)

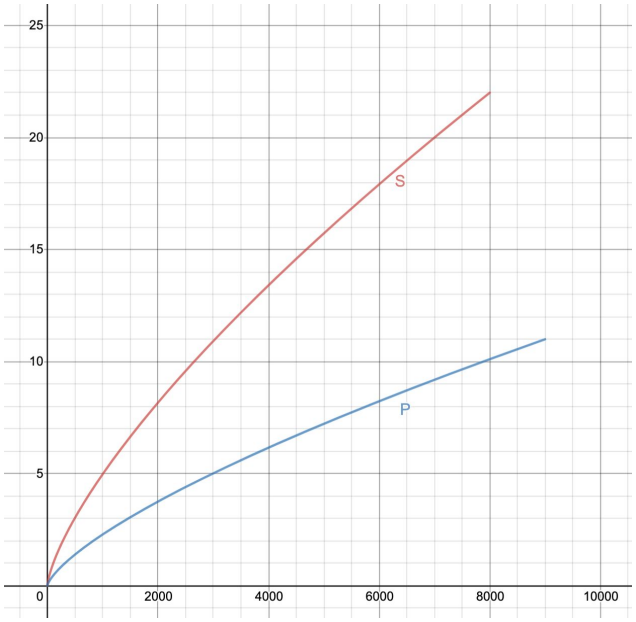
G. Feature G is a fault with no significant vertical movement. What type of fault is it? (1)

H. The edges of Feature M are lightly darkened. What phenomenon is this supposed to represent? (2)

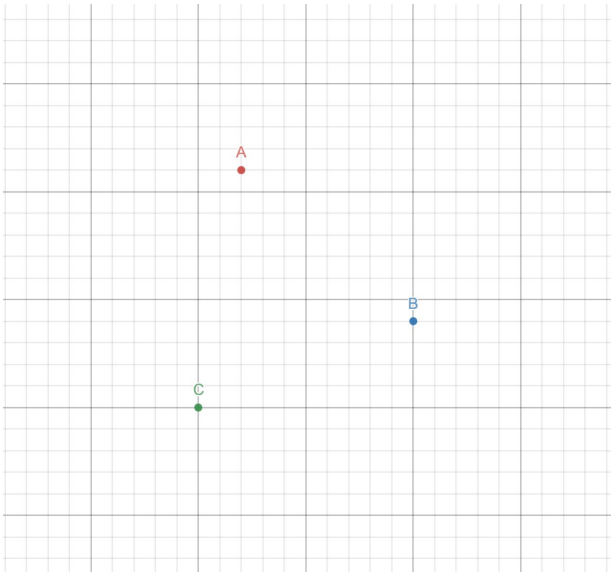
I. What is the deformation pattern shown by Features B, R, H, and A called? (1)

3. Use the following measurements from an earthquake to answer the following questions.

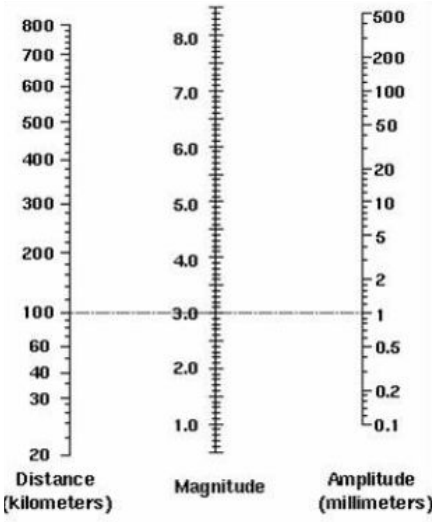
Time (s) - Distance (km) graph from Center C



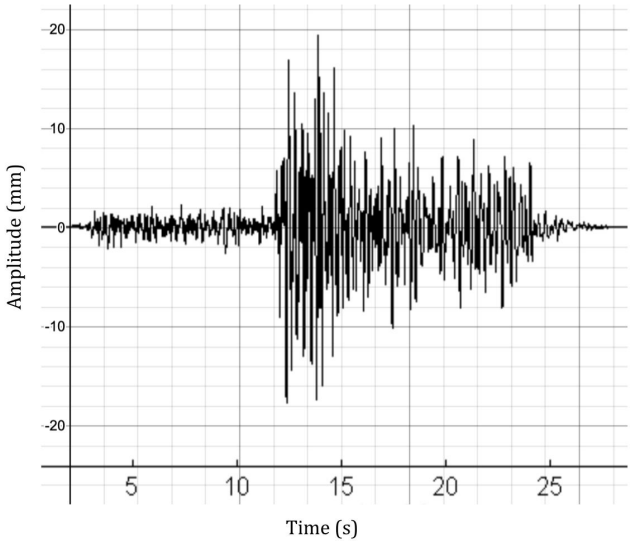
Map of Centers, 1 unit = 1 km



Richter Scale Nomogram



Data from Center D



A. Calculate the seismometer's distance to the epicenter. Show all work. (3)

B. Center A reports a distance of 6000 km and Center B reports 5700 km. Assuming Center C is (0,0), find the coordinates of the epicenter in units. For context, Center B is (10,4). (2)

C. Data from the unpictured Center D (which is about 200 km away form the epicenter) is shown. Use the nomogram provided to calculate the magnitude of the earthquake. (1)

D. The data shows that P waves are clearly faster than S waves. Explain why this happens, making sure to specify what type of wave they are. (2)

E. Center E (unpictured) picks up P waves from the earthquake, but not S waves. Center F (unpictured) picks up neither. What does that tell you about the relative position of these centers from the epicenter? (2)

F. An observer near the epicenter of the earthquake observes that the other plate is moving to the right. Fill out the following information about the fault.
   a. Type of stress (1)
   b. Type of fault (1)
   c. Fault sub-type (specific direction of movement) (1)

G. Another earthquake occurs in the same region several years later, with a 2.7 magnitude on the Richter scale. How many more times intense was the original earthquake than the second one? Show all work. (3)

H. Using the previous information and given that the fault has an azimuthal bearing of 030, calculate the strike and dip of the fault. Show all work. (2)

I. Knowledge of earthquakes today can be applied to studying earthquakes in the distant past because of the principle of _____, and is attributed to _____. (2)

Section II: Knowledge Questions

4. Match the following types of rock and rock types to the appropriate layers. Write in the appropriate letter. (6)

A. Continental crust	____ Ultramafic	____ Basalt
B. Oceanic crust	____ Mafic	____ Peridotite
C. Mantle	____ Felsic	____ Granite

5. Name the following geologic features based off of their descriptions (5)

A. All beds dip towards the center

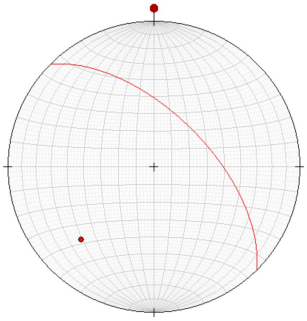
B. All beds dip away from the center

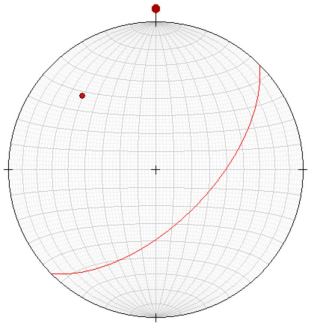
C. Has an axis; curves upward with oldest rocks in core

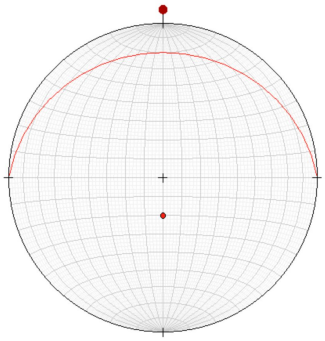
D. Has an axis; curves upward with youngest rocks in core

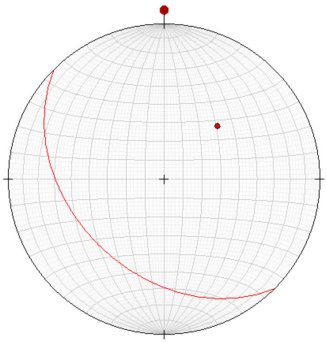
E. Has an axis; curves downward with youngest rocks in core

6. Determine the azimuthal (0-365) strike and dip from the following stereonets.









A: _____ (2) B: _____ (2) C: _____ (2) D: _____ (2)

E. What are the red dots on each stereonet called? (1)

F. What are the curved lines connecting the north and south poles called? (1)

G. What is the actual circular edge of the stereonet called? (1)

7. Match the following discontinuities to their descriptions. (5)

A. Conrad
B. Mohorovicic
C. Lehmann (Mantle)
D. Gutenberg
E. Lehmann-Bullen

_____ P waves are refracted and S waves completely stopped
_____ Discontinuity only found in/under continental areas where seismic wave velocity increases
_____ Deepest boundary where seismic waves are refracted
_____ Increase of seismic wave velocities under continental areas
_____ Crust-mantle boundary where P and S waves are refracted

8. Match the following sedimentary rocks to their type and how they formed. (4)

A. Gypsum	_____ Clastic	_____ Dehydration and deposition
B. Limestone	_____ Carbonate	_____ Precipitation from a solution
C. Chert	_____ Evaporite	_____ Compaction and cementation
D. Sandstone	_____ Chemical	_____ Deposition of crushed shells

9. You observe that the sea level is rising in a depositional beach environment. Assume the seaward side is east and the landward side is west.

A. In what direction do you expect the beach to "move" over time? (1)

B. What is the phenomenon in Part A known as? (1)

C. If the sea lowered, the beach would move in the opposite direction. What is this known as? (1)

10. The Burgess shale fossils are found in the Cambrian period, which means the rock layers at which they formed are extremely deep.

A. Some mechanism first had to bring those layers closer to the surface. What is this process called? (1)

B. Next, the rock had to be exposed. What term is the generalization of all things that can wear away the Earth's surface (*hint:* it is not erosion). (1)

C. Can the age of these fossils be determined through carbon-14 dating? Explain why/why not. (2)