In the space below, explain the difference between "composition" & "physical" layers. Explain a detailed example of each. [4]

Composition layers involve a multiple layers of the Earth's physical layers, while physical layers are each individual layer of the earth. Example of composite is the mantle. It includes multiple layers even as the lithosphere. Example of physical layer is the atmosphere. It is a single physical layer within the earth.

Match each description to a letter from the diagram above. [8]

E inner core  G core  B mantle  A lithosphere
H mesosphere  D crust  C asthenosphere  F outer core

The Mohorovicic Discontinuity is found between layers... [1]

The Wiechert–Gutenberg Discontinuity is found between layers... [1]

The Mohorovicic & Wiechert–Gutenberg Discontinuities are defined by a distinct change in... [1]

a. seismic wave velocity  b. pressure  c. temperature  d. water content  e. disconometer

Which layer is completely broken into tectonic plates? [1]

a. crust  b. asthenosphere  c. mantle  d. lithosphere  e. core  f. mesosphere

Upon which soft layer do the tectonic plates move due to convection currents in the layer? [1]

a. crust  b. asthenosphere  c. mantle  d. lithosphere  e. core  f. mesosphere

How are the inner and outer core different from one another? [2]

inner is solid, outer core is liquid

The inner core is hotter than the outer. How can their physical difference be explained? [3]

The inner core's pressure overpowers its greater heat and keeps it solid.
The Pacific plate is currently moving toward the... [1]
   a. northeast   b. northwest   c. southeast   d. southwest   e. north   f. south

During the formation of the Emperor Chain, the Pacific plate was moving toward the... [1]
   a. northeast   b. northwest   c. southeast   d. southwest   e. north   f. south

**Draw an arrow** on the globe in the image above to show the current direction of Pacific Plate motion. [1]

Use the data below to make reasonable estimates of rate of Pacific plate movement in the last million years compared to the rate of Pacific plate movement around 3 million years ago. Explain all your assumptions and show your work on the next page. Report your rates in cm / year. [12]

N.b., 1 mile = 1609 m

<table>
<thead>
<tr>
<th>Islands</th>
<th>Distance apart (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kauai to Oahu</td>
<td>63</td>
</tr>
<tr>
<td>Oahu to Molokai</td>
<td>22</td>
</tr>
<tr>
<td>Molokai to Maui</td>
<td>7.5</td>
</tr>
<tr>
<td>Maui to Hawaii</td>
<td>26</td>
</tr>
</tbody>
</table>
Work for last million years:

D apart
Kauai to Oahu = 63 (1609) = 101367 m = 1.01367 x 10^8 cm
Oahu to Molokai = 22 (1609) = 35398 m = 3.5398 x 10^7 cm
Molokai to Maui = 7.5 (1609) = 12067.5 m = 1.20675 x 10^7 cm
Maui to Hawaii = 26 (1609) = 41534 m = 4.1534 x 10^7 cm

\[
\begin{align*}
\frac{1.01367 \times 10^8 \text{ cm}}{1,000,000 \text{ years}} &= 1.01367 \times 10^2 \text{ cm/year} \\
\end{align*}
\]

Assuming the plate is slowing down by a rate of 0.7 cm/year

Work for about 3 million years ago:

D apart
Kauai to Oahu = 63 (1609) = 101367 m = 1.01367 x 10^8 cm
Oahu to Molokai = 22 (1609) = 35398 m = 3.5398 x 10^7 cm
Molokai to Maui = 7.5 (1609) = 12067.5 m = 1.20675 x 10^7 cm
Maui to Hawaii = 26 (1609) = 41534 m = 4.1534 x 10^7 cm

Assuming the rate of movement will be greater than 11.01367 x 10^2 cm/year.

How do the rates compare to each other? [2] The rates slow down and decrease from 3 million years ago to the last million years.

In general, how does the current Pacific rate compare to the rate of plate movement in the Atlantic basin? [2] The current Pacific rate is slower than the movement of the current Atlantic plate.
Use the geologic cross-section below to answer the questions on this page.

Write the letters to indicate the relative ages of the rock units or geologic events from oldest to youngest on the lines below. [12]

oldest > ____________________________ > youngest

a. fault    b. dike    c. sill    d. disconformity e. nonconformity f. angular unconformity

a. fault    b. dike    c. sill    d. disconformity e. nonconformity f. angular unconformity

a. fault    b. dike    c. sill    d. disconformity e. nonconformity f. angular unconformity

Evidence in the cross-section clearly shows that the rock sequences deposited between D and E most likely occurred during a(n)... [1]

a. volcanic eruption c. earthquake e. tectonic uplift event
b. marine regression d. marine transgression f. ice age or interglacial period


Strata A has uplifted so that it was located about at the same depth where E would be deposited.
Use the idealized tectonic diagram below to answer the questions on this page.

**Boundary 1**
- a. strike-slip fault on a transform boundary
- c. reverse fault on a divergent boundary
- e. reverse fault on a convergent boundary

**Boundary 2**
- a. strike-slip fault on a transform boundary
- c. reverse fault on a transform boundary
- e. reverse fault on a convergent boundary

**Boundary 3**
- a. strike-slip fault on a transform boundary
- c. reverse fault on a divergent boundary
- e. reverse fault on a convergent boundary

**Location 1** is most likely to experience shallow earthquakes and low-viscosity eruptions. [1]

**Location 2** is nearest a passive continental margin. [1]

**Location 3** is most likely to develop a composite volcano. [1]

**Location 4** is most likely to be the focus of the strong and dangerous thrust-fault earthquakes. [1]

**Location 5** is most likely to experience an andesite eruption event. [1]

**Location 6** is most likely to have a well-developed rift. [1]

**Location 7** would show the youngest basaltic rocks if samples were collected from all locations and radiometrically dated. [1]

**Location 8** is most likely to have a well-developed subduction trench. [1]

DRAW IN 2 convection cells on the diagram that drive the plate motion. [4]
The paleogeographic reconstruction above shows the breakup of Pangaea and most nearly represents ______ years ago. [1]

- a. 90 billion
- b. 5 million
- c. 5 trillion
- d. 90 million
- e. 0.5 billion
- f. 5 billion

The location at 10°S 10°W is in which stage of the Wilson Cycle? [1]

- a. early rifting
- b. youthful
- c. mature
- d. closing
- e. fracturing
- f. triple junction

Draw arrows on the map to show the relative plate motion between modern-day Africa and South America. [2] Between these arrows is a(n) _______ plate boundary. [2]

On the map above, label the land masses that we now know as Greenland, India, and Australia. [6]

On the map above, label the Northern Mid-Atlantic Ridge and East Pacific Rise and the subduction zone that will eventually result in seafloor fossils and volcanic materials high in the Himalayas. [6]

On the map above, place a star [2] in a location that is an actively accreting terrane at the time represented by the map. Explain WHY this is happening. [2]

South America broke off from the African western coast and is now attaching to a smaller strip of South America. [6]

In modern times, describe 2 features that would make this area recognizable as an accreted terrane. [4]

1. Different composition of the strata, thus showing that the two pieces could not have formed connected and must have been accreted terrane.
2. Different fossils, as there would be different organisms based on ecology, thus different levels would suggest the two pieces formed separately and then connected at a later point in time.
The images above both show tectonic deformation. Image 1 shows the Conway River near Kaikoura, New Zealand after a powerful earthquake on 11/14/16. Image 2 shows the Stanley Formation of the Ouachita Mountains southwest of Hot Springs, Arkansas.

**Image 1 shows... [1]**
- a. ductile deformation due to compression
- c. ductile deformation due to extension
- b. brittle deformation due to lateral forces
- d. brittle deformation due to isostatic rebound

**Image 1 shows the direction of river flow... [1]**
- a. toward the top of the photo
- c. toward the bottom of the photo
- b. into the lake
- d. uphill

**Image 2 shows... [1]**
- a. ductile deformation due to compression
- c. ductile deformation due to extension
- b. brittle deformation due to lateral forces
- d. brittle deformation due to isostatic rebound

**Image 2 shows a(n)... [1]**
- a. thrust fault  b. syncline  c. normal fault  d. anticline  e. strike-slip fault  f. triple junction

The natural hazard that produced the situation in image 1 also created major problems with... [1]
- a. volcanic eruptions
- b. landslides
- c. tsunamis
- d. sinkholes
- e. isostatic rebound

**Draw arrows** on each image showing the directions of forces that created the tectonic situation. [2]

Explain how both of these photos could be related to orogenic events. [3]

Both photos include deformation which is caused by the uplift of mountains which changes surrounding geology in orogen.
The Continental Drift Hypothesis was proposed by (c) Wegner in 1912. [1]

Seafloor Spreading was proposed by (c) Wegner in 1960. [1]

In 1963, (c) Wegner explained the magnetic striping of the seafloor with seafloor spreading. [1]

In 1977, (c) Wegner produced a seafloor map showing mid-ocean ridges and trenches. [1]

e. Tectonic motions are driven by all of the following EXCEPT... [1]
   a. slab push  b. mantle convection  c. sealevel rise  d. slab pull  e. hot spot clusters

Which of the following is most likely to cause isostatic rebound? [1]
   a. entering an interglacial period  b. entering a glacial period  c. sediment loading into a region
   d. volcanic flood basalts  e. Milankovitch Cycles  f. solar and lunar tidal forces

e. A failed triple junction is called a(n)... [1]
   a. backarc basin  b. landbridge  c. hypsometry  d. sinkhole  e. aulacogen

e. Mass wasting refers to... [1]
   a. volcanic eruptions  b. trash production  c. aulacogens  d. soil & rock motion due to gravity

Which natural hazard typically results from a combination of volcanism and mass wasting? [1]
   a. earthquake  b. lahar  c. tsunamis  d. sinkholes  e. aftershock  f. orogeny

An orogenic event directly creates... [1]
   a. mountains  b. abyssal plains  c. a craton  d. sinkholes  e. a supercontinent

The low part of a rift valley is a(n)... [1]
   a. craton  b. ophiolite  c. trench  d. horst  e. graben  f. landbridge

Which magma characteristic below will make a volcanic event more explosive? [1]
   a. high iron content  b. high water content  c. low silica content  d. high temperature

d. Gondwanaland and Laurasia made up... [1]

d. Evidence for the earliest supercontinent, (c) Rodinia, comes from the 3.6 billion-year-old Yilgarn Craton in Australia. [1]