ASSESSING CONCEPTUAL UNDERSTANDING OF GEOLOGIC TIME

Questions prepared and validated as part of an undergraduate honors theses by Jamil Rhajiak, 2009.

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1) Approximately how many years back in time did the Earth form?

(a) 4 hundred years
(b) 4 hundred-thousand years
(c) 4 million years
(d) 4 billion years
(e) 4 trillion years

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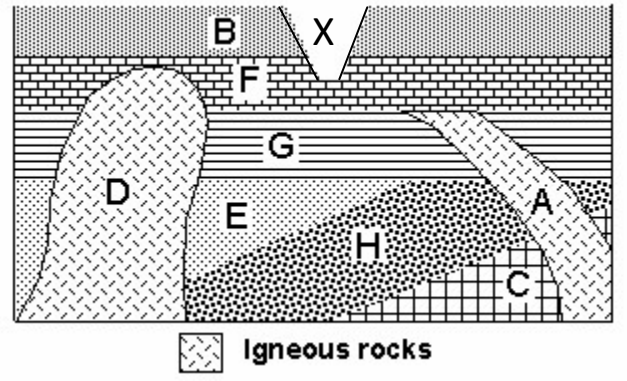
2) What is the **best** estimate of the age of F if A is 100 million years old and D is 70 million years old?



(a) 55 Myrs
(b) 85 Myrs
(c) 110 Myrs
(d) 170 Myrs
(e) same age as A
(f) same age as D

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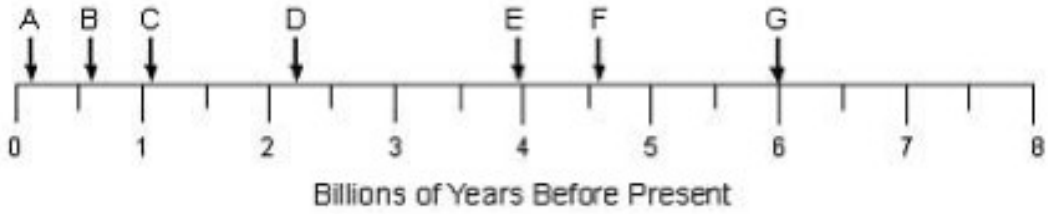
3) In point form, write a sequence of events that would produce the cross section from question 2:

4) **Carefully** examine the relative positions of the lettered arrows on the timeline below and estimate the ages represented by each arrow. Identify which letter corresponds most closely to the extinction of the dinosaurs.



(a) A
(b) B
(c) C
(d) F
(e) G

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5) Which method was **primarily** used to **establish** the Geologic Time Scale?

(a) Correlation of magnetic signatures in rocks
(b) Calculation of alpha decay of isotopes
(c) Calculation of beta decay of isotopes
(d) Correlation of fossils in rock units across vast distances
(e) Correlation of rock types across vast distances

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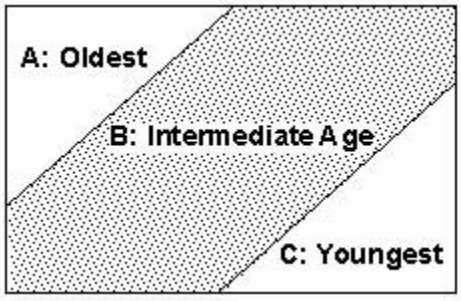
6) During fieldwork in western Canada, an experienced geologist sketched the cross section below showing three different units of tilted rocks and their relative ages. What could you **best** infer from this diagram?

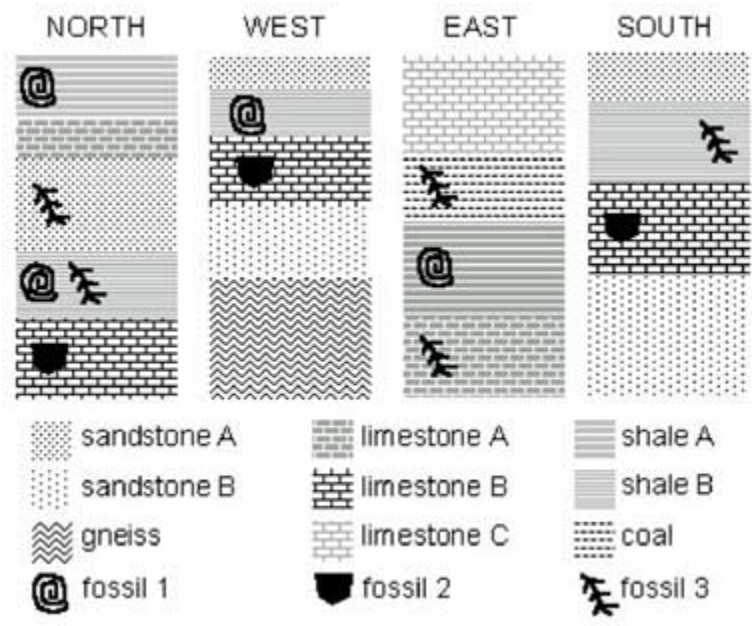


(a) Mountain building has overturned the rock units.
(b) Rock layer C formed first and so lies on the bottom.
(c) Rock layers B and C must be igneous rocks.
(d) The sequence of rock layers conforms to the principle of superposition.
(e) The sequence of rock layers conforms to the principle of original horizontality.

7) Which answer **best** describes what the surface of the Earth was like when the Earth first accreted as a planet?

(a) The Earth's surface was covered with solid rock
(b) The Earth's surface was covered with water
(c) The Earth's surface was covered with solid continental masses
(d) The Earth's surface was covered with melted rock
(e) The Earth's surface was covered with melted iron

8) An Index Fossil is a fossil that dates the strata in which it is found.
Four outcrops of rock are examined in different locations of British Columbia. The rock types and the fossils they contain are illustrated in the adjacent diagram. Which fossil would be the **best** choice to use as an index fossil for these rocks?



(a) fossil 1
(b) fossil 2
(c) fossil 3
(d) there are no index fossils
(e) all fossils make equally good index fossils

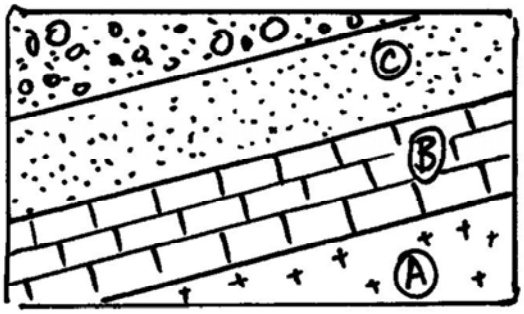
9) The isotope Einsteinium-253 has a half-life of 20 days. If you began an experiment with an 80-gram sample of Einsteinium-253, how much would remain after 60 days?

(a) 60 grams
(b) 40 grams
(c) 20 grams
(d) 10 grams
(e) not enough information provided

10) What do we call the feature left by a cycle involving deposition, then removal of previously-deposited sediment by erosion, then a return to deposition?

(a) A cross-cutting relationship.
(b) An inclusion.
(c) A turbidite sequence.
(d) A nonconformity.
(e) An unconformity.

11) Layer A is from the Ordovician, Layer C is from the Carboniferous. What geological time **Period** is **most likely** represented by Layer B?



(a) Lower Carboniferous
(b) Upper Ordovician
(c) Devonian
(d) Permian
(e) Paleozoic

12) How much time passed **between** the appearance and extinction of dinosaurs?

(a) 35,000,000 years
(b) 65,000,000 years
(c) 100,000,000 years
(d) 135,000,000 years
(e) 200,000,000 years

13) What technique do scientists use today to determine when the Earth first formed? Choose the **best** answer.

(a) Calculation of the cooling rate of metal spheres
(b) Comparison of different layers of rock
(c) Analysis of uranium and lead found in rocks
(d) Analysis of carbon found in rocks
(e) Correlation of fossils in different layers of rock

14) An archaeologist is studying layers of human settlement in an African cave. What method of radiometric dating should they use to determine the age of woody material found at an apparent fire pit in one of the layers?

(a) Potassium – Argon
(b) Argon – Argon
(c) Carbon – Nitrogen
(d) Rubidium – Strontium
(e) Carbon - Oxygen

15) Why is U^{238}-Pb^{206} dating **not** the best method for determining the age of the woody debris from the previous question? Choose the **best** answer.

(a) Uranium is only found in Canada, and the cave is located in Africa.
(b) Fire in the pit would cause the woody debris to reach closure temperature and all daughter nuclides would be lost.
(c) U^{238}-Pb^{206} dating would only reveal the time of formation of the woody debris, not the actual time of deposition.
(d) U^{238}-Pb^{206} dating is not accurate within the amount of time represented by the sample.
(e) Woody debris cannot be run through the analytical methods needed to determine U^{238}-Pb^{206} ratios.

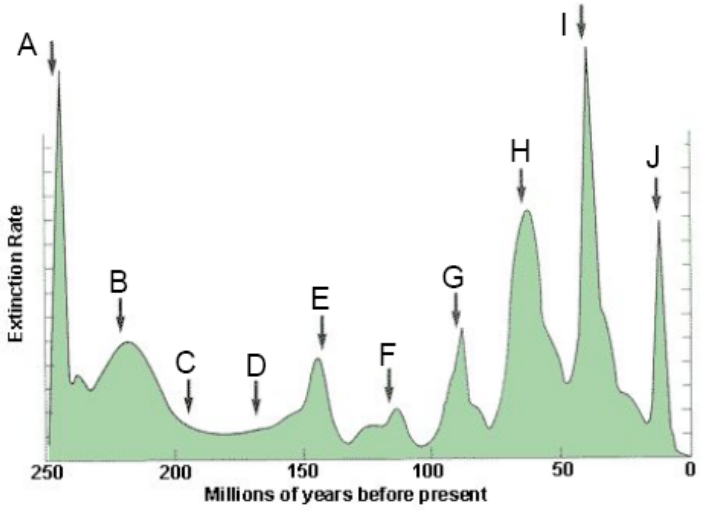
16) During the Triassic, the Tethys Ocean was representative of what paleo-geographic environment?

(a) Cold climate with global ice coverage.
(b) Temperate climate with deep ocean basins.
(c) Warm climate with shallow seas.
(d) Cold climate with shallow seas
(e) The Tethys Ocean did not exist during the Triassic.

17) In the general form of the age equation, $\mathbf{D = D_0 + N(e^{\lambda t}-1)}$, the symbol λ (lambda) represents:

(a) alpha decay
(b) radioactive half-life
(c) radioactive decay constant
(d) $(t^{1/2})*(\ln 2)$
(e) $(t^{1/2})/(\ln 2)$

18) Which of the following labeled events would correlate to the **base** of the Mesozoic and the **base** of the Cenozoic?



(a) A, G
(b) I, J
(c) A, H
(d) H, J
(e) E, I

19) Place the following tectonic events into **chronological order** (oldest – youngest):

Formation of Pangaea	Formation of the Himalayas	Opening of the Atlantic Ocean	Formation of the Appalachian Mountains
A	B	C	D

(a) A, B, C, D
(b) A, C, D, B
(c) B, D, A, C
(d) C, A, D, B
(e) D, A, C, B

20) **Compare** columns A and B. What early-adopted geological principle can be used to explain the features and processes?

A – Geological Features	B - Processes
Ripple Marks in Sedimentary beds	Streams feeding into lakes
Trace fossils in mudstones	Burrowing sea creatures
Exposed mountain roots	Chemical and physical erosion of mountains

(a) Catastrophism
(b) Lamarckism
(c) Uniformitarianism
(d) Gradualism
(e) Darwinism