

KEY TO SAMPLE TEST NUMBER 4
THE EARTH AS A SYSTEM
PLATE TECTONICS AND GAIA

STRESS AND STRAIN

1. Ductile Deformation - 1B, 1C, 1D - ductile is when something thins, stretches, or changes shape as it deforms. These three items all do that.
2. Ductile Deformation - 2B - because the curve “curves” it is non-linear, which is characteristic of ductile things; think of the silly putty being stretched.
3. Shear Deformation - 1E - shear requires two forces operating in opposite directions so that something is either twisted, or stretched in one direction while being compressed in the other; like the box.
4. Shear Deformation - none of the choices
5. Non-linear deformation - 1B, 1C - non-linear will not happen with brittle substances, which deform very little before rupturing. Ductile substances are non-linear, the change size and shape as they deform.
6. Non-linear deformation - 2B
7. Confining pressure - 1B, 1C, 1D - confining pressure weakens materials, like in a pressure cooker; so brittle substances begin to behave ductilely.
8. Confining pressure - 2B
9. True - think of a balloon that has been blown up for a long time (days or weeks) (or a rubber band that has been stretched for a long time and then released); they do not return to their original shape, which is the definition of elastic limit.
10. False - heat weakens materials, turning them ductile, so a hot thing is more likely to stretch than break
11. False - hydrostatic stress allows the foliation, but it is directed stress that allows all the mica minerals to line up, and the minerals to separate into bands.
12. B-2B - this is non-linear, ductile deformation, line 2B.

STRUCTURAL GEOLOGY

Normal Fault (not oblique)

13. None
14. 2D
15. 3B

Reverse Fault (including oblique)

16. 1A, 1C
17. 2A
18. 3C

Vertical Faults (including oblique)

19. None
20. None
21. 3A

Right Lateral Motion (including oblique)

- 22. 1B
- 23. 2B, 2C
- 24. None

Shear Stress

- 25. 1B
- 26. 2B, 2C
- 27. 3C, 3D

Horst

- 28. None
- 29. None
- 30. 3B

INTERPRETING GEOLOGIC HISTORY

- 31. A - none - A cross cuts into B so there is no erosional relationship, necessary for an unconformity.
- 32. B - Nonconformity - A is deep forming diorite; C is surface forming sandstone; to get these two rocks in contact there must be lots of erosion; a nonconformity.
- 33. A - none - F cross cuts E; no erosion, no unconformity.
- 34. False - there is an unconformity between B and C; unconformities are considered “events” just like the formation of rock units.
- 35. False - A cross cuts B and B is therefore on the bottom.
- 36. False - C, D, and E are folded and H is not; therefore there had to be a period of folding in between.
- 37. False - C is a sandstone, B is a schist; sedimentary rocks cannot intrude.
- 38. True - If the folding had occurred after Fault Z would also be folded and it is not.
- 39. “A” is the correct sequence

PLATE TECTONIC THEORY

Feature A

- 40. 1E
- 41. None
- 42. None

Feature F

- 43. None
- 44. None
- 45. 3E

Feature D

- 46. None
- 47. 2E
- 48. None

Feature B

- 49. None
- 50. None
- 51. 3B

Feature I

- 52. None
- 53. 3B
- 54. None

Feature H

- 55. 1B
- 56. None
- 57. None

Feature G

- 58. 1D
- 59. None
- 60. None

- 61. True
- 62. False

THE WILSON CYCLE

- 63. True - this is the bimodal association typical of rift situations; mafic rocks come from the hot spot and felsic rocks come from the fractional melting of the lower continent because of the heat from the hot spot.
- 64. True - block faulted continents bring feldspar rich felsic rocks up for erosion producing arkoses.
- 65. True - the hot spot swells the continent upward, stretching it across the top, causing tension.
- 66. False - not really; the continent has stabilized and there is nothing really going on in terms of tectonics.
- 67. False - subduction zones are not hot spots; hot spots do produce mafic magmas but subduction zones produce intermediate igneous rocks, diorite and andesites.
- 68. False - volcanic arcs are dominated by igneous rocks which weather into lithic fragments. Plus intermediate igneous rocks have very low quartz content and so will result in very low quartz sediments.
- 69. False - Yes for Stages V and VII but not VIII. By stage VIII the melange belt is no longer active and is converting into a suture zone.

70. True - this is a zone of compression produced by the arc-continent collision. Ramp and flat thrusts are typical for this situation.
71. False - it is a cordilleran orogeny
72. True - because the cordilleran mountain that is the hinterland began as a divergent continental margin with a thick wedge of sediments it would already have been through one cycle of weathering and erosion increasing the quartz content. With this second cycle the quartz content can only increase some more. In Stage VI the hinterland in a lithic rich volcanic arc, unlikely to produce a lot of quartz.
73. True - the marginal (back arc) basin is block faulted continent; felsic igneous rock producing lots of feldspar.
74. False - shear is a twisting motion, or a lateral sliding motion as in a strike-slip transform fault. This is a collision with compression the principle stress.
75. True - shield volcanoes are typical of hot spots, and there are none here.
76. False - the rift system (Stages A-C) with its normal faults could easily produce fissure volcanoes.
77. True -
78. False - Not likely. The ultramafic parent, being a dense rocks of the ocean basins is most likely going to be subducted, so preservation is unlikely.

Location A

79. None
80. 2A - this is continental rock, and continents are felsic in composition.
81. None

:Location C

82. 1B - feldspar rich sediments derived from weathering of the feldspar rich felsic igneous rocks of the continent.
83. None
84. None

Location F

85. None
86. None
87. 3A - Oceanic rift zone with mafic magmas rising to the surface from the convection cells in the mantle. This is most likely a pillow basalt here.

Location G

88. None
89. 2C - this is oceanic lithosphere being metamorphosed by the invading intermediate batholiths; result is Barrovian metamorphism, and this spot is farthest away from the magma and so the lowest grade = greenschist.
90. None

Location J

- 91. None
- 92. 2D - these are the batholiths coming from the fractional melting along the subduction zone, and the fractional melting results in intermediate igneous rock = diorite.
- 93. None

Location P

- 94. None
- 95. None
- 96. 3C -

sorry this is as far as I got with the annotations.

Location Q

- 97. 1C
- 98. None
- 99. None

Location R

- 100. None
- 101. None
- 102. 3B

PLATE TECTONIC ROCK CYCLE

- 103. False
- 104. True
- 105. True
- 106. True
- 107. True

THE EVOLUTION BETWEEN LIFE AND EARTH: THE GAIA HYPOTHESIS

- 108. True
- 109. False
- 110. False
- 111. True
- 112. True
- 113. D
- 114. E
- 115. C
- 116. B
- 117. A - CO₂