KEY TO SAMPLE TEST NUMBER 2
THE ROCK RECORD - PART ONE
MINERALS AND IGNEOUS ROCKS

THE ELEMENTS AND THEIR CHEMISTRY

1. False - the number of valence electrons is equal to the actual number of electrons in the valence shell.
2. False - atoms always strive for a full valence shell.
3. False - bonding is related only to the number of valence electrons.
4. False - silicon does have 4 valence electrons, and does bond covalently with oxygen, but it does not bond with metallic cations. In a silica tetrahedron it is the oxygen that bonds with cations.
5. True - the periodicity is 1-8, 1-8, etc. which is equivalent to the number of valence electrons. The only exception may be the transition elements with their subshells, but even these are arranged by valence electrons.
6. False - their subshells allow the shell itself to hold more than 8 electrons, but still the outermost shell, the valence shell, only holds a maximum of 8.
7. False - "V" has 1 valence electron, "W" has two valence electrons. Both these elements would rather give up electrons than gain them and thus will not have an affinity.
8. True - "X" Silicon is a small atom with 4 valence electrons that needs four more to satisfy the octet rule. Each of 4 oxygens, element "U" can provide one of these to create the silica tetrahedron. Element "V" has one valence electron and would much rather bond with something that has 6 or 7 valence electrons.
9. False - the electrical charge is determined by the number of electrons it has taken on or given up during chemical bonding.
10. Accidental repeat of question 4
11. True

THE STATES OF MATTER AND MINERALS

12. False - some solids may be glass, which by definition is not a crystal.
13. False - the complex attractor exists as any phase transition.
14. False - liquids take on the shape of the container but do not expand to fill the container.
15. False - a mixture is a collection of different compounds that can be mechanically separated; no chemical bonding, no exchange of electrons.
16. False - on two counts. First not all crystals break (cleave) along the plains they grow because some crystals do not cleave, e.g. quartz. Second, some crystals can grow into shapes in addition to the ones they cleave along.
17. False - olivine does have no cleavage, but not because of covalent bonds. Olivine consists of silica tetrahedra held together ionically by iron and magnesium. It is the fact that no planes of weakness exist that keeps olivine from cleaving.
18. True - as the silica tetrahedra keep polymerizing from isolated, to single chain, to double chain, to sheet the covalent bonds keeps increasing.
19. False - sodium does substitute for calcium but not because they have the same charge but because they are almost the same size.

BOWEN'S REACTION SERIES AND ROCK FORMING MINERALS

20. 2C
21. No answer
22. 1A
23. No answer
24. No answer
25. 2A
26. 1C
27. No answer

IDENTIFYING ROCKS FROM BOWEN'S REACTION SERIES

28. No answer
29. Plagiogranite = 2B
30. No answer
31. Diorite = 2A
32. No answer
33. Peridotite = 2C
34. No answer
35. Syenite = 2D
36. Gabbro = 1A
37. No answer
38. Alkaligranite = 1B
39. No answer

EXTRUSIVE AND INTRUSIVE IGNEOUS ROCKS

40. True - A dike is discordant
41. False - A stock is typically felsic in composition, no columnar jointing.
42. False - 2C is a cinder cone inside a caldera.
43. False - 3B is an eroded laccolith; laccoliths are composed of gabbro, an intrusive rock not extrusive.
44. False - 1A is a batholith; batholiths are felsic in composition.

Location 3A -

45. No Answer
46. D - Pipe
47. No Answer

Location 1A -

48. A - Batholith
49. No Answer
50. No Answer

Location 3B -

51. No Answer
52. B - Laccolith

53. No Answer

PHASE DIAGRAMS

54. False - one component, H_2O
55. True - temperature and pressure
56. False - chaotic attractor

57. 1A, 1D
58. No Answer

59. No Answer
60. 2B

61. 1C
62. 2B

63. 1A
64. No Answer

SOLID SOLUTION PHASE DIAGRAM

65. D - 1420 degrees
66. C - 40%Q
67. E - 1520 degrees
68. E - none of these; "r" increases with increasing temperature, the composition of the melt or crystal does have some control over exactly what the critical temperature is, but it is up.
69. True - we could never get pure P or pure Q. This is a solid solution series and as long as there is a mixture of P and Q to begin with there will always be a mixture to end with. The relative proportions will change but not the fact of mixture.

BINARY EUTECTIC PHASE DIAGRAM

70. True - melting always begins at the eutectic point, almost by definition. And at the eutectic point all phases exist simultaneously, melt of mixed P and Q, crystal P, and crystal Q.
71. False - in a binary eutectic diagram with immiscible crystal phases the first crystal to come out is pure P or pure Q. Even at the eutectic P and Q crystalize out separately. You can never get a solid solution mix of P and Q.
72. False - the last crystal to come out will be pure P since it is the most abundant component and therefore has the most to crystallize.
73. False - fractionation can take place at any time in the process.
74. E - 100% of Q must melt before P melts alone. If Q is 20% then P is 80% and they both begin melting simultaneously at the eutectic until all the least abundant is gone, which is Q.
75. True - the olivine/pyroxene crystal combination is of two immiscible crystals and that is what a binary eutectic phase diagram describes.
76. False - this is an example of extensibility not logical fertility. Logical fertility deals with making predictions about unknown things, extensibility with applying known principles

to already known observations.

BOWEN'S HYPOTHESIS

First in fractionation sequence.

77. 1A - the parent rock with a basically mafic composition, but a sampling of every element.
78. No answer

Second in fractionation sequence

79. No Answer
80. 2A - a mafic igneous rock

Last in fractionation sequence

81. No Answer
82. 2D - an alkaligranite is the last in the fractionation sequence.

FRACTIONAL EVOLUTION OF IGNEOUS ROCKS

83. C - diorite/andesite
84. A - alkaligranite

ATTRACTORS AND IGNEOUS ROCKS

85. True - the last rock is both an evolutionary and a local attractor. It is local because in any step in the process the next attractor is always local, and it is evolutionary because it is the logical end point of the fractionation sequence.
86. False - a local attractor is a closed system. It is the end point of the processes, after all the fractionation has occurred.
87. True - complete melting takes the system out of the complexity realm and into the realm of a chaotic attractor.
88. True - the largest crystals are found just above the center because the last of the liquid is pushed above the center by the mush of crystal accumulating in the lower half of the sill. The last liquid is the slowest to cool and therefore produces the largest crystals.
89. False - olivine only concentrates in a layer near the bottom because of gravity settling. Olivine is found, of course, in the chill zones, but not concentrated there.
90. True - generally. High specific gravity crystals do settle leaving lower specific gravity crystals to crystallize out at the top. They are not a pure concentration of low specific gravity crystals, but a concentration nonetheless.
91. False - Bowen's hypothesis did not fail; he did accurately predict that fractionation would lead to the evolution of igneous rocks. It was his specific mechanism of fractionation that did not work well, crystallization vs melting.

WHERE IGNEOUS ROCKS ARE FOUND

Location 1 -

92. D - basalt
93. No answer

Location 2
94. D - basalt
95. No answer

Location 3
96. B - andosite
97. No answer

Location 4
98. A - alkaligranite
99. D - plagiogranite

Location 5
100. No answer
101. A - unite; D - peridotite

Location 8
102. E - diorite
103. D - plagiogranite