Earth Systems 3209
Public Exam Review Ch. 2
Solutions

1. B
2. A
3. C
4. D
5. C
6. D
7. B,D
8. B
9. D
10. D
11. C
12. C
13. A
14. B
15. A
16. A
17. B
18. B
19. A
20. B
21. A
22. A
23. B
24. B
25. A
26. A
27. D
28. C
29. A
30. D
31. C
32. B
33. A
34. C
35. D
36. C
37. A
38. D
39. D
40. A
41. B
42. C
43. B
44. D
45. D
46. C
47. A
48. B
49. C
50. C
51. B
52. D
53. A
54. D
55. B
56. A
57. B
58. B
59. C
60. C
61. D
62. D
63. B
64. C
65. A
66. A
67. B
68. D
69. D
70. C
71. D
72. B
73. A
74. C
75. C
76. D
77. C
78. C
79. D
80. C
81. A
82. D
83. D
84. C
85. C
86. C
87. D
88. A
89. C
90. A
91. B
92. B
93. C
94. C
95. B
96. C
97. C
98. B
99. B
100. C (Ch. 21)
101. A
102. C
103. A
104. B
105. A
106. D
107. B
108. A
109. C
110. D
111. C
112. A

113	Chemical elements are the building blocks of minerals whereas minerals are the building blocks of rocks. Minerals are pure solids, where all the molecules have the same definite chemical composition and structure, whereas rocks are a mixtures often appearing multicolored.
114	By definition, a mineral is any substance that forms from an inorganic source. Coal is the product of decayed vegetative plant life which is considered to be organic in origin. For this reason coal is not a mineral, but is classified as an organic sedimentary rock.
115	In order for a substance to be a mineral it must satisfy the following conditions; 1) occur in nature 2) be inorganic (no carbon source from a living material) 3) be solid 4) have a definite chemical composition 5) have a definite molecular structure Ice satisfies all of the above conditions, whereas coal is composed of carbon which originated from an organic, living source.

116	A mineral is any Earth material that possesses the following characteristics: 1. solid; 2. inorganic; 3. naturally-occurring; 4. definite chemical composition; and 5. definite chemical structure. A rock is any Earth material that is solid and is a consolidated mixture of minerals. It is significant to note that the definition of a rock is not "perfect" and somewhat problematic since it is possible for a pure mineral to be a rock. In relation to rocks that are comprised of a mixture of minerals, there are two main differences between such rocks and a mineral, which include: chemical composition; and chemical structure. A minerals has a specific chemical composition while the chemical composition of a rock can vary since it is comprised of more than one mineral. As well, a mineral has a characteristic chemical structure while the chemical composition of a rock can vary since it is comprised of more than one mineral. Since rocks often contain more than one type of mineral, they will not have a characteristic crystal structure. For example, a mineral such as potassium feldspar is a solid, naturally-occurring, inorganic, crystalline material with a unique chemical composition and structure, whereas a rock such as granite is a consolidated mixture of minerals (e.g., potassium feldspar, quartz, mica).
117	Cleavage is the ability of a mineral to break along planes of weak chemical bonding. The strength of the bonds between carbon atoms in graphite planes are weaker than they are in diamond. carbon atoms in graphite are arranged in a different structural pattern than diamond (sheets as opposed to macromolecule, tetrahedral)
118	One example of two minerals with the same composition is graphite and diamond, both are composed of carbon. The physical properties, hardness and cleavage, are very different for the two forms of carbon mainly because: (i) the arrangement of the carbon atoms: Diamond has its carbon atoms arranged in a tetrahedral network and graphite has its carbon atoms arranged in hexagonal sheets. (ii) the strength of bonding between the atoms: Diamond has its carbon atoms bonded strongly in all directions while graphite has its carbon atoms bonded relatively strong within the hexagonal sheets with weak bonding between the sheets.
119	Silicate minerals have silicon and oxygen as the main elements comprising their composition. Silicate minerals are classified according to the arrangement of the atoms. Common arrangements include sheet silicates, single and double chains, and network (3-D) silicates. The arrangement of the atoms will determine the type of cleavage a particular silicate will display. Example: Sheet silicates (Micas) have cleavage in one direction, chain silicates (feldspars) have cleavage in two directions, and Network silicates (Quartz) have no cleavage.

120	(i) Diamond (hardness of 10) has a higher value of hardness than graphite (hardness of 1). (ii) Diamond and graphite both contain carbon but have very different hardness because of the strength of bonding between carbon atoms and the arrangement of carbon atoms. The carbon atoms in diamond are arranged in a tetrahedral pattern and exhibit stronger bonding; whereas, the carbon atoms in graphite are arranged in a hexagonal layers with weak bonding between the layers. The high hardness of diamond on Moh's hardness scale in comparison to graphite is mainly due to the stronger bonding and the more stable atomic structure.
121	Moh's scale uses a series of ten minerals as a standard to determine hardness of materials (Example: fingernail (2.5), copper penny (3.5), iron nail (4.5), glass (5.5 - 6), steel file (6.5). To determine hardness attempt to scratch the mineral with objects of known hardness. If the object scratches the mineral, then the object is harder than the mineral. If the object does not scratch the mineral then the mineral is harder than the object.
122	Fracture is the breaking of a material along irregular planes which usually result in smooth curved surfaces (conchoidal fracture) as seen in the mineral quartz. Fracture can also display splintering or irregular jagged breaks in the Mineral, whereas, cleavage is the breaking of minerals along smooth, flat, parallel planes as predetermined by atomic structure and strength of bonding. Mica cleaves in one direction.
123	A single mineral may have different colors due to the presence of impurities. Examples include various colors of quartz, fluorite, calcite, etc.... Also different minerals can have the same color. Examples include minerals such as halite, gypsum, calcite, etc....
124	Streak is more reliable than colour because streak gives the true colour of a mineral in powdered form while the colour of a mineral may vary. The streak of any one mineral, regardless of its apparent colour will always be the same, whereas, any one mineral may vary in colour because of impurities contained within the mineral.
125	Hardness is more reliable than colour when identifying minerals according to physical properties. The hardness of a mineral, regardless of its colour, will always be the same. Whereas, the colour of one mineral may vary. For example, Quartz exist in a variety of colours, but it has a hardness of seven on Moh's hardness scale.
126	A scientist could rely on a number of different physical properties to identify minerals, however, the four most reliable include the following; hardness, cleavage, specific gravity and streak. The streak, which is the true color of the mineral in powdered form may not be of much use in this case since the minerals in question are colorless and transparent. Hardness, which is the resistance of a mineral to scratching would be one property used to help identify the colorless mineral. Cleavage, which is the minerals ability to split or break along definite planes of weak bonding would be another property used to identify the colorless mineral. Specific gravity, which is the weight of a mineral compared to that of an equal volume of water could also be used to identify the colorless mineral. Other properties can be used depending on the minerals in question, such as, fluorescence, and acid test.
127	The best tests that could be used to distinguish between quartz and calcite include: 1) Hardness test would indicate that quartz is harder than calcite (hardness of 7 and 3, respectively). 2) Cleavage test would indicate that quartz has no cleavage (fracture) while calcite has a perfect cleavage in three directions. 3) Acid test indicates that calcite (carbonate) reacts or fizzes when exposed to acids, whereas, quartz would not react or fizz. 4) Crystal form would show calcite having a rhombohedral structure while quartz displays a hexagonal structure.

128	Moh's scale ranks the hardness of a mineral from softest, value of one (1), to hardest, value of ten (10) and assigns a mineral to each hardness value. When identifying an unknown mineral, hardness is a property often used. Items of known hardness, such as a finger nail (2.5), copper penny (3.5), iron nail (4.5), steel knife (5.5), and glass (>6.0) can be used to identify the hardness of the mineral. These objects can be scratched across the mineral and if it scratches the mineral, the mineral is softer than the hardness value assigned to each object. The relative hardness can be narrowed down by scratching the mineral repeatedly by the different items of known hardness. Also, the hardness of a mineral can be determined by scratching the mineral with minerals of known hardness as identified by Moh's hardness scale. If the mineral of known hardness fails to scratch the unknown mineral it is softer and the next hardest mineral on Moh's scale can be used until a scratch is made in the unknown mineral. (This method fails to identify objects of known hardness).
129	Specific gravity would be a better property for identifying an unknown mineral rather than luster. This is because specific gravity is consistent for each mineral regardless of the size and shape of the sample as well as its location of discovery on Earth's surface. In contrast, many minerals can have the same luster (e.g., metallic, non-metallic, earthy, pearly, dull), thereby making this property much less effective for identifying individual minerals and much more effective for simply grouping minerals. As an example, the minerals pyrite and chalcopyrite both have a yellowish, metallic luster; however, pyrite has a specific gravity of 5.2 and chalcopyrite has a specific gravity of 4.2.
130	(i) Cleavage - ability for a mineral to break along smooth, flat, parallel surfaces. (ii) Streak - the true color of the mineral in powdered form when it is rubbed along an unglazed tile. (iii) Hardness - resistance of a mineral to scratching.
131	Cleavage within minerals depends on strength of bonding between atoms and the general arrangement of the atoms. These two minerals display different cleavages due to the fact that mineral "A" has atoms arranged in sheets and splits in one direction only, whereas, mineral "B" has atoms arranged in a cubic arrangement and splits in three directions at 90 degree angles.
132	Since the density of water is 1 g/cm^3, Specific Gravity of a material is equal to the material density. $\text{Density} = \frac{\text{Mass of sample}}{\text{Volume of water}} = \frac{150\text{g}}{75\text{ mL} - 45\text{ mL}} = 5\text{ g/mL}$
133	Specific gravity compares weight of mineral to weight of equal volume of H_2O. (i) find the mass of the mineral; using a weigh scale or balance (ii) find the volume of the mineral; water displacement method (iii) find the weight of mineral in water; suspend mineral from spring scale and weigh immersed in water (iv) use the formula; S.G. = density = m/v or; $\text{S.G.} = \frac{\text{weight of mineral in air}}{(\text{weight in air}) - (\text{weight in } H_2O)}$

134	As outlined in the core lab on determining specific gravity, a minerals specific gravity is equal to the density of that mineral. To find the density, the mass is divided by the volume. $\text{Specific Gravity} = \text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{129.6\ \text{g}}{18.0\ \text{cm}^3} = 7.2\ \frac{\text{g}}{\text{cm}^3}$
135	Silicate minerals consist of silicon and oxygen (SiO_4) bonded with metals, whereas, carbonate minerals consist of carbon and oxygen (CO_3) bonded with metals.