Base your answers to questions 1 through 3 on the table below and on your knowledge of Earth science. The table shows the elements and their percent compositions by mass in the five minerals present in a rock sample.

Minerals Present in	Element (percent by mass)									
Rock Sample	AI	Ca	Fe	н	К	Mg	Na	0	Si	Ti
Amphibole	6.2	3.0	29.7	0.2	-	3.7	1.8	31.7	12.8	10.9
Plagioclase feldspar	9.7	-	-	-	14.2	-	-	46.3	29.8	-
Garnet	10.9	-	33.8	-	-	-	-	38.7	16.6	-
Muscovite mica	20.3	-	-	0.5	9.8	-	-	48.2	21.2	-
Quartz	-	-	-	-	-	-	-	53.2	46.8	-

Elements and	Their	Compositions	by	Mass	in	Five	Minerals
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- 1. All five of the minerals listed in the table are silicate minerals because they contain the elements silicon and oxygen. State the name of *one* other mineral found on the "Properties of Common Minerals" chart that is a silicate mineral.
- 2. Identify one mineral in this rock sample that can scratch the mineral olivine.
- 3. Identify one use for the mineral garnet.

Base your answers to questions 4 and 5 on the generalized cross section of the Grand Canyon represented below and on your knowledge of Earth science. Some rock layers have been labeled. The rock layers have *not* been overturned.



- 4. Describe how the calcite that composes the Redwall limestone can be distinguished from the quartz that composes that Tapeats sandstone.
- 5. The Vishnu group is composed mostly of schist. Explain how this rock formed.

Base your answers to questions 6 and 7 on the geological cross section shown below and on your knowledge of Earth Science.



6. State the name of the metamorphic rock at location A.

7. Identify *one* characteristic that could be used to determine if the intrusive igneous rock has a mafic composition or a felsic composition.

Base your answers to questions 8 through 11 on the diagram in your answer booklet and on your knowledge of Earth science. The diagram represents several common rock-forming minerals and some of the igneous rocks in which they commonly occur. The minerals are divided into two groups, A and B. Dashed lines connect the diagram of diorite to the three .minerals that are commonly part of diorite's composition.



- 8. A sedimentary rock sample has the same basic mineral composition as granite. Describe *one* observable characteristic of the sedimentary rock that is different from granite.
- 9. Identify *one* other mineral found in some samples of diorite that is *not* shown in the diorite sample in the diagram.
- 10. Describe *one* characteristic of the minerals in group A that makes them different from the minerals in group B.
- 11. On the diagram draw *five* lines to connect the diagram of granite to the symbols of the minerals that are commonly part of granite's composition.

RR#7 - Free Response

12. Base your answer to the following question on the three diagrams below and on your knowledge of Earth science. The diagrams represent stages in the formation of a large depositional feature formed as a river deposited sediment over time in the ocean. Letter *A* represents a location in the ocean.



Formation of a River Depositional Feature

Large amounts of dissolved calcite were carried by the river into the ocean and precipitated onto the ocean floor. Identify the sedimentary rock composed only of calcite that most likely formed.

Base your answers to questions 13 through 15 on the table and photograph below and on your knowledge of Earth Science. The table shows the approximate mineral percent composition of an igneous rock.

Mineral	Percentage of			
\mathbf{N} ame	Mineral Present			
plagioclase feldspar	55%			
biotite	15%			
amphibole	30%			





- 13. Identify *two* processes that formed this rock.
- 14. Identify two elements that are commonly found in all three minerals in the data table.
- 15. Identify this igneous rock.

RR#7 - Free Response

Base your answers to questions **16** through **18** on the diagram of Bowen's Reaction Series below, which shows the sequence in which minerals crystallize as magma cools and forms different types of igneous rocks from the same magma. The arrow for each mineral represents the relative temperature range at which that mineral crystallizes.



Bowen's Reaction Series

- 16. Identify *one* similarity and *one* difference between the igneous rocks andesite and diorite.
- 17. Describe the temperature conditions shown in Bowen's Reaction Series that explain why olivine and quartz are *not* usually found in the same igneous rock type.
- 18. According to Bowen's Reaction Series, how is the chemical composition of plagioclase feldspar found in basaltic rock different from the chemical composition of plagioclase feldspar found in granitic rock?

Base your answers to questions 19 through 21 on the magnified views shown below of the minerals found in an igneous rock and in a metamorphic rock. The millimeter scale indicates the size of the crystals shown in the magnified views.



19. Describe the texture shown by this metamorphic rock that indicates it could be schist.

Biotite

20. Based on the minerals present, identify the relative color and density of this igneous rock compared to mafic igneous rocks with the same crystal size.

Potassium feldspar

21. Identify the environment of formation of this igneous rock based on the size of its intergrown crystals.

Carbon

Carbon may be the most important element on our planet because it is the chemical building block of all living things. The element carbon is formed in dying stars and scattered when the stars explode. Our solar system formed from such star remnants. Pure carbon comes in several forms, which include the minerals graphite and diamond (hardness = 10), and the fossil fuels bituminous coal and anthracite coal. Almost all diamonds are mined from igneous rocks that originate at an approximate depth of 150 kilometers under immense pressure. Most graphite is formed through the metamorphism of organic material in rocks closer to Earth's surface.

Complete the table belowto show the properties of the minerals diamond and graphite.

Property	Diamond	Graphite
color	variable	
luster	nonmetallic	
hardness		

Base your answers to questions 23 and 24 on the passage below.

Carbon

Carbon may be the most important element on our planet because it is the chemical building block of all living things. The element carbon is formed in dying stars and scattered when the stars explode. Our solar system formed from such star remnants. Pure carbon comes in several forms, which include the minerals graphite and diamond (hardness = 10), and the fossil fuels bituminous coal and anthracite coal. Almost all diamonds are mined from igneous rocks that originate at an approximate depth of 150 kilometers under immense pressure. Most graphite is formed through the metamorphism of organic material in rocks closer to Earth's surface.

- 23. Explain why graphite and diamond have different properties.
- 24. Identify two uses for the mineral graphite.

22.

Base your answers to questions **25** through **27** on the chart below, which shows some physical properties of minerals and the definitions of these properties. The letters *A*, *B*, and *C* indicate parts of the chart that have been left blank. Letter *C* represents the name of a mineral.



- 25. Identify *one* mineral that could be represented by letter *C*.
- 26. State the definition represented by letter *B*.
- 27. Which physical property of a mineral is represented by letter *A*?

RR#7 - Free Response

Base your answers to questions **28** and **29** on the diagram below of a mineral classification scheme that shows the properties of certain minerals. Letters A through G represent mineral property zones. Zone E represents the presence of all three properties. For example, a mineral that is harder than glass, has a metallic luster, but does not have cleavage, would be placed in zone. Assume that glass has a hardness of 5.5



- 28. State the name of *one* mineral listed on the *Properties of Common Minerals Table* that could *not* be placed in any of the zones.
- 29. In which zone would the mineral potassium feldspar be placed?

30. Base your answer to the following question on the map below. The map shows the approximate area in a portion of North America where some sedimentary rock layers composed of gypsum, halite, and potassium salt minerals are found in Earth's crust.



Identify the sedimentary rock composed of halite and explain how this rock is usually formed.