Unit 1 Workbook

Name: _____ **Block:** _____

Questions for Section A: Earth Materials (Introduction to Geology)

1. Describe geology as a discipline.

2. Describe at least three aspects of geology that make it different from other sciences.

3. Differentiate between rocks and minerals.

4. Describe the formation of igneous, sedimentary, and metamorphic rocks.

5. Draw and label a rock cycle diagram.

6. Research and briefly describe 3 careers associated with geological technologies and sciences.

7. Why is the study of geology important?

8. How are each of the following sciences involved in Geology?

   a. astronomy

   b. biology

   c. chemistry

   d. physics

9. Why are sedimentary rocks so abundant at the Earth's surface when igneous rocks make up most of the crust?

10. How does the Principle of Uniformitarianism help us understand the history of the Earth?

11. What exceptions are there to Uniformitarianism?

12. What geologic processes occur relatively slowly and which geologic processes would occur relatively quickly? (Give typical rates to back up your answers.)

13. Describe how the time factor complicates our attempts to understand geologic processes.

14. According to Hutton's "Principle of Uniformitarianism" the Earth's sedimentary rocks
    a) were all formed recently
    b) are continuously being formed
    c) ceased being formed billions of years ago
    d) were deposited when the planet first formed.

15. Which statement below would be most consistent with a uniformitarian view of the Earth?
    a) Entire plant and animal populations have been destroyed and created many times.
    b) Violent volcanic eruptions have created the mountains we see today.
    c) By studying modern day volcanic eruptions we can understand those of the past.
    d) Fossils of marine animals are found high in the mountains today because the oceans once covered all the mountains.

16. Which statement below is most <u>inconsistent</u> with how we now understand uniformitarianism?
    a) Catastrophic geologic events occasionally happen.
    b) Irreversible changes may occur on the Earth
    c) The chemical and physical laws operating today happened in the same way in the geologic past.
    d) The processes that formed rocks in the geologic past no longer occur today.

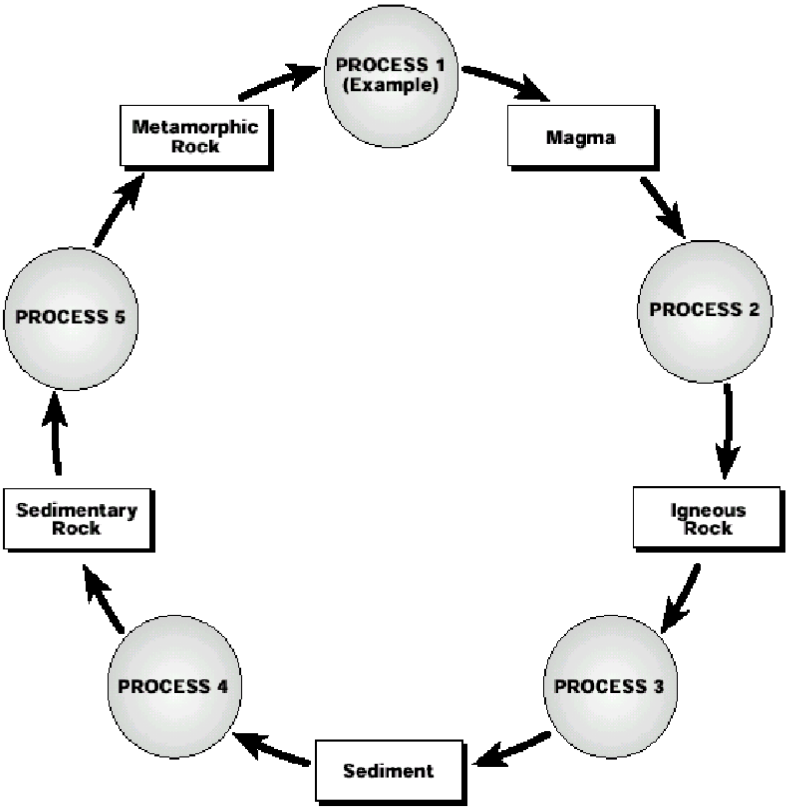
17. Differentiate each of the following as either a rock or mineral:

slate _____	hematite _____	shale _____
pumice _____	gneiss _____	feldspar _____
sandstone _____	basalt _____	quartz _____
hornblende _____	limestone _____	granite _____

18. Although the Scotsman James Hutton first put the concept forth, it was Charles Lyell who gave a name to **uniformitarianism**. In the years since, it has been recognized as a fundamental principle in Geology. Using the principle of uniformitarianism, explain the occurrence of ripple marks in Precambrian sandstone.

19. Describe the Nebular Model of the formation of the Solar System.

Use the following rock cycle diagram to answer question 20.



20.

	Name and description of the process	Geologic details about the environment where the process would occur
EXAMPLE PROCESS 1	***Fusion and Melting*** *The rock has been heated to such a high temperature that it has started to melt.*	*The process occurs deep in the earth's crust or in the upper mantle where the temperature is sufficient for melting.*
PROCESS 2		
PROCESS 3		
PROCESS 4		
PROCESS 5		

21. A geologist collected four rock samples in the land area shown in diagram 1. Unfortunately, the labels fell off each sample. All that was left to identify each sample were field-note descriptions and a magnified view showing the microscopic make-up of each rock.

Diagram 1

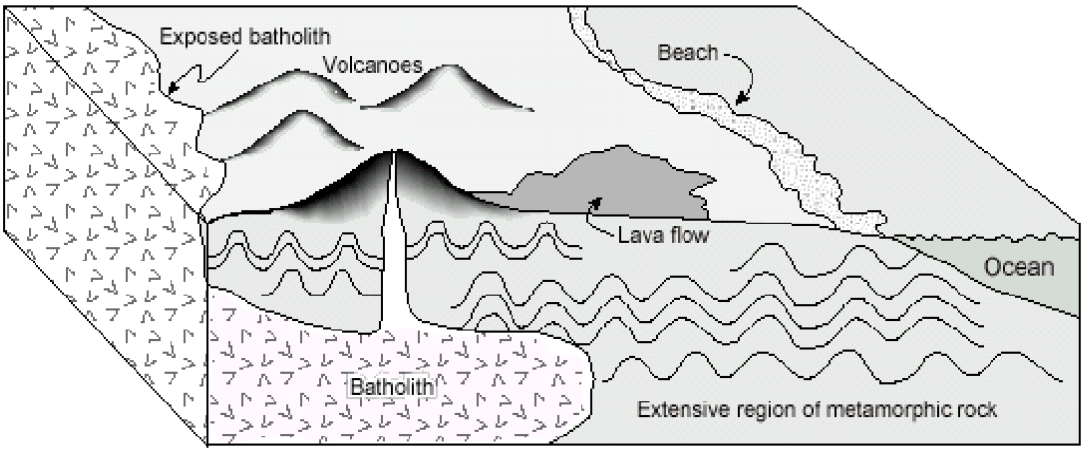
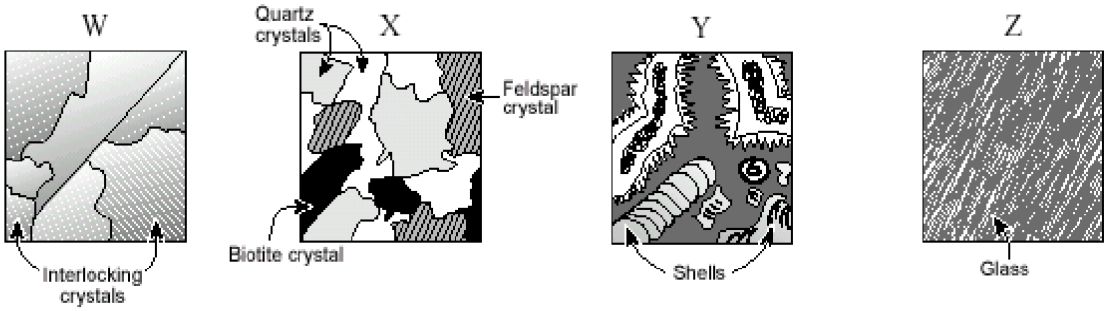


Diagram 2

Magnified view (x30) of rock samples



a) Complete the following table using information from diagram 2 and the description of each rock sample below.

SAMPLE	EXAMPLE	W	X	Y	Z
Description	large pebbles in a fine-grained matrix rounded pebbles	tightly interlocking crystals hardness of 7 crystalline granular texture	large interlocking crystals light-coloured clear, beige, pink and black crystals	made from shells and shell fragments cemented together reacts with dilute acid	glassy texture dark slightly opaque conchoidal fracture
Type of rock	sedimentary				
Specific rock name	conglomerate	*quartzite*	*granite*	*limestone*	*obsidian*

b) For each rock sample, place its corresponding **letter** on diagram 1 in a location where it would **most likely** form.

c) The texture of a rock tells a great deal about how that rock was formed. Pick **two** of the rocks from a) and, with reference to **texture**, describe how each rock was formed.

Rock sample:

How rock sample was formed:

Rock sample:

How rock sample was formed:

22. If you were given a few rock samples to identify, briefly describe how would you distinguish between the igneous, sedimentary and metamorphic rocks?

Questions for Section B: Earth Materials (Minerals)

23. Outline the importance and abundance of various elements in the earth's crust.

24. Define and explain how to use the following properties used in identifying minerals:

simple crystal shape

cleavage

fracture

hardness

specific gravity (relative density)

colour

streak

lustre

reaction to dilute HCl

magnetism

double refraction

taste

25. Give the definition of a mineral.

26. Distinguish between an element and a compound.

27. Explain how to identify a mineral. What diagnostic tests must be done to identify a mineral?

28. Why is colour a poor diagnostic test to identify a mineral? Why is streak a better test? Which mineral is a good example of this?

29. What are some important uses of minerals?

30. Which of the following is the most common element in the Earth's crust?
    a. Silicon
    b. Oxygen
    c. Aluminum
    d. Iron

31. Which one of the following statements is true about the property of cleavage in minerals?
    a) All minerals, except quartz, have cleavage.
    b) The type of cleavage a mineral possesses depends on its composition, ferromagnesian minerals do not have cleavage.
    c) The directions of cleavage is always parallel to the faces or planes of well-formed crystal shapes
    d) The directions of cleavage correspond to planes of weakness in the crystal structure of a mineral

32. Why does mica break in thin sheets, yet quartz has no cleavage?
    a) Mica forms at lower temperatures than does quartz
    b) The silica tetrahedra in mica are arranged in a different pattern than in quartz.
    c) Mica has larger silica tetrahedra than does quartz
    d) Mica contains more iron and magnesium than does quartz.

33. Which mineral group is the most common in the Earth's crust?
    a) oxides
    b) carbonates
    c) sulphates
    d) silicates

34. Which of the following can be best used to distinguish between calcite and quartz?
    a) Streak
    b) Colour
    c) Hardness
    d) Specific Gravity

35. Halite and calcite can both occur as clear crystals. The best property to distinguish between the two minerals would be
    a) cleavage
    b) hardness
    c) colour
    d) streak.

36. Two minerals X and Y look very similar. Both have a metallic lustre and a golden yellow colour. Mineral Y can scratch glass, while mineral X cannot. Mineral Y is most likely
    a) chalcopyrite
    b) galena
    c) hematite
    d) pyrite

37. A certain mineral has a vitreous lustre and some of it is coloured purple. Its hardness is less than 5, and is usually identified by its large number of cleavage planes. The mineral is most likely
    a) quartz
    b) calcite
    c) fluorite
    d) apatite

38. Imagine that you have been given samples of the ten index minerals of the Moh's hardness scale. The samples are labeled with code letters. Use the following clues to determine the identity of each mineral.
    Mineral A scratches minerals E and I but can be scratched by mineral J
    Mineral C can be scratched by every other mineral
    Mineral E can scratch mineral I
    Mineral F can scratch only mineral C
    Mineral B can scratch mineral F, but it can be scratched by all other minerals
    Mineral H can scratch every other mineral
    Mineral D can be scratched only by mineral H
    Mineral G can be scratched by minerals H and D; it can scratch mineral J

39. This mineral appears somewhat transparent and thin and it can be scratched by a fingernail and is very common in metamorphic rocks. The mineral is
    a) quartz.
    b) calcite.
    c) gypsum.
    d) muscovite mica.

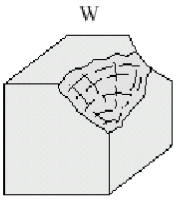
40. The minerals gypsum and talc are very similar in appearance. Which of the following mineral properties **best** distinguishes them from each other?
    a) Streak
    b) Colour
    c) Hardness
    d) Reaction to acid

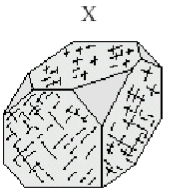
41. A soft black mineral breaks off in flakes. This mineral is most likely
    a) hornblende
    b) galena
    c) biotite mica
    d) olivine

42. Which of the following can best be used to distinguish between hematite and pyrite?
    a) Streak
    b) Lustre
    c) Hardness
    d) Hydrochloric acid

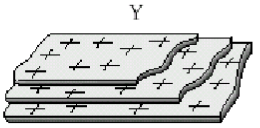
Use the diagrams to the right to answer questions 43 to 45.

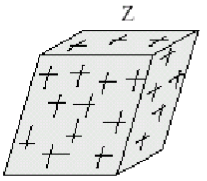
43. Which of the diagrams to the right **best** illustrates the mineral calcite?
    a) W
    b) X
    c) Y
    d) Z





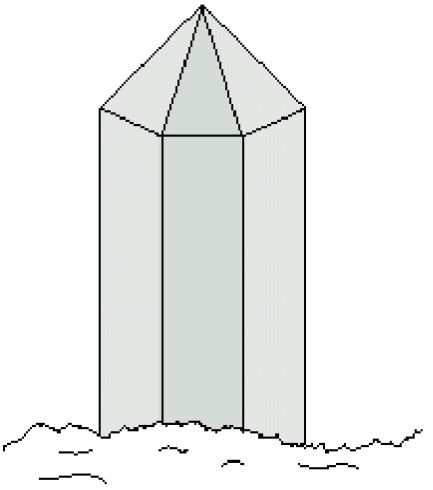
44. Which of the diagrams to the right best illustrates the mineral mica?
    a) W
    b) X
    c) Y
    d) Z





45. Which of the following statements best describes how mineral W breaks?
    a) Conchoidal fracture
    b) Cleavage in one plane
    c) Cleavage in 6 planes
    d) Cleavage in multiple planes

46. The mineral shown in the diagram can easily scratch glass and has a conchoidal fracture. The mineral is
    a) quartz.
    b) calcite.
    c) galena.
    d) feldspar.



47. In how many directions does quartz have perfect cleavage?
    a) none
    b) 3
    c) 4
    d) 6

Questions for Section C: Earth Materials (Igneous Rocks and Processes)

48. Describe factors affecting cooling rate and crystal size.

49. Relate texture to rate of crystallization for extrusive (volcanic) and intrusive (plutonic) igneous rocks.

50. Identify and classify the following igneous rocks according to their texture (coarse or fine grained, vesicular, glassy, fragmental-pyroclastic), cooling rate and composition (felsic, intermediate, mafic): granite, diorite, gabbro, peridotite, andesite, tuff, rhyolite, basalt, volcanic breccia, obsidian, pegmatite, pumice, porphyry.

Name	Texture	Cooling Rate	Composition

51. Describe and explain the order of crystallization of minerals from a magma (Bowen's reaction series.)

52. A fine-grained igneous rock, when examined using a microscope, is found to contain 30% dark ferromagnesian minerals. Which other minerals would you expect to find in this rock?
    a) plagioclase feldspar only
    b) plagioclase feldspar and muscovite
    c) potassium feldspar, muscovite and quartz
    d) plagioclase feldspar, potassium feldspar and quartz

53. Which mineral would most likely be the last to crystallize from a silicate melt?
    a) Quartz
    b) Olivine
    c) Amphibole
    d) Biotite mica

54. Which rock has the same mineral content as granite (is its compositional equivalent)?
    a) Basalt
    b) Quartz
    c) Rhyolite
    d) Gabbro

55. In order to produce a granitic composition from an initially basaltic magma through the process of fractional crystallization, which must occur?
    a) Basaltic magma must assimilate rocks of intermediate composition
    b) Silica must be removed from the melt through crystal settling, leaving the melt enriched in Fe, Mg, and Ca
    c) The basaltic magma must cool very slowly and evenly, with removing any components.
    d) Fe, Mg, and Ca must be removed from the melt through crystal settling, leaving the melt enriched in silica.

56. If pressure is held constant and water (or any mineral) is added, what will happen to the melting temperature of igneous material of any composition?
    a) Nothing; the melting temperature will not change.
    b) The melting temperature will increase if water is added.
    c) The melting temperature will decrease if water is added.
    d) The direction of change in melting temperature varies depending on the composition.

57. The chemical composition of molten rock from a deep magma chamber may be changed by a number of different processes as it moves upward toward the surface. Describe how two of these, Wall Rock Assimilation and Fractional Crystallization can change the chemical composition of the magma.

    Wall Rock Assimilation:

    Fractional Crystallization:

58. Distinguish among the following:

	Composition	Flow Behaviours	Where formed	Rock/Feature Formed
Lahar				
Pyroclastics				
Ash Flow				
Pillow Lava				
Aa Lava				
Pahoehoe Lava				
Columnar Joints				

59. Draw a diagram distinguishing between batholiths, sills, dikes, xenoliths, stocks, and plutons.

60. Distinguish among the following volcanic features:

Feature	Magma Composition	Type of Eruption	Magma Viscosity	Shape of Feature	Location Relative to Plates	Other Details
Shield Volcano						
Cinder Cone						
Composite Volcano						
Volcanic Dome						
Lava Plateau						

61. Distinguish between a sill and a buried lava flow:

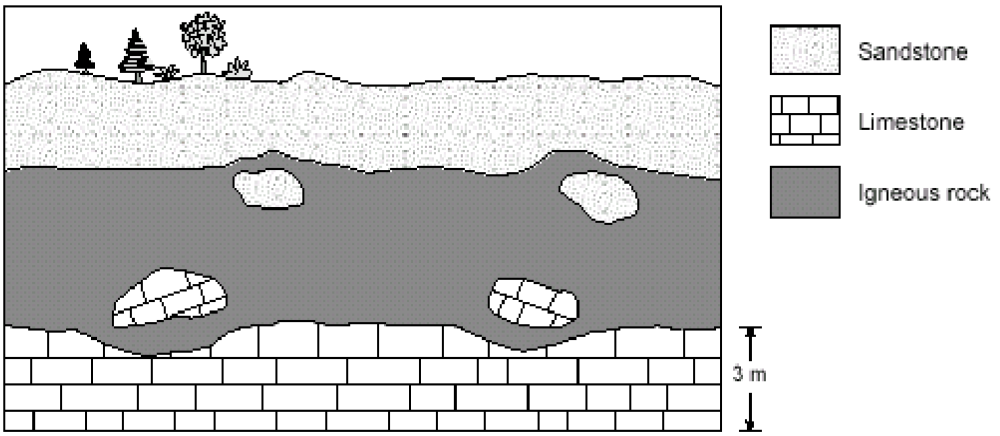
Sill	Lava Flow

62. Describe pyroclastic material. What various materials may be ejected from an explosive volcano?

63. Distinguish between lava and magma. (Which is where? Which has dissolved gas? Why?)

64. What clues do vulcanologists look for to predict future volcanic eruptions?

65. Explosive volcanoes such as Mt St. Helen's and Mt Fuji often erupt lava which is
    a) mafic and has a low viscosity.
    b) felsic and has a low viscosity.
    c) mafic and has a high viscosity.
    d) felsic and has a high viscosity.



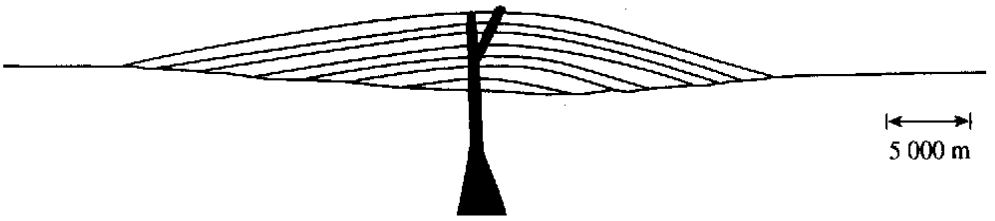
66. The igneous layer in the cross section of the picture above is best described as a
    a) sill.
    b) dike.
    c) stock.
    d) buried lava flow.

67. The rough, jumbled blocky or jagged surface of a lava flow is called:
    a) aa
    b) pahoehoe
    c) lahar
    d) nuée ardente

68. Why do more viscous lavas generally erupt more violently and explosively than do less viscous lavas?
    a) Because more viscous lava erupts less frequently than less viscous lava.
    b) Because more viscous lava tends to be cooler than less viscous lava
    c) Because more viscous lava trap gases so pressure builds up in the magma chamber
    d) Because more viscous lava contains very little gas and other volatile materials.

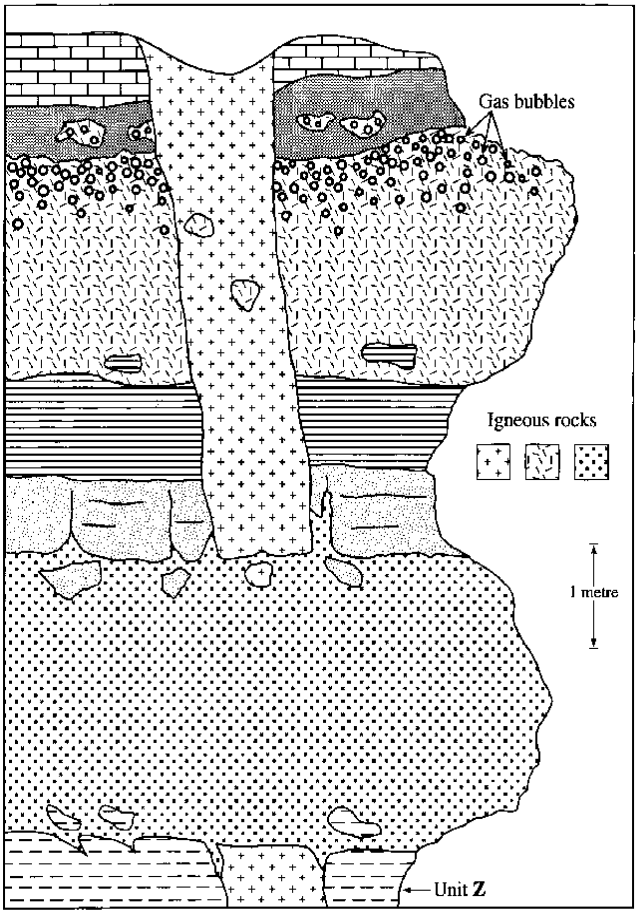
Use the following sketch of a cross section of a volcano to answer questions 69 and 70.

69. What type of volcano is shown in the sketch?
    a) Cinder cone
    b) Shield volcano
    c) Volcanic dome
    d) Composite volcano



70. This type of volcano most commonly forms at
    a) mid-ocean ridges
    b) island arc volcanoes
    c) subduction at continents
    d) hot spots, or mantle plumes

Use the following sketch of a rock cross section to answer question 71.



71. a) On the cross section sketch, label the following igneous rock bodies: sill, lava flow, dike

    b) Describe two features shown on the cross section which distinguish the sill from the buried lava flow.

    c) The rock which composes the sill is mostly coarse-grained and contains 50% dark-grey plagioclase and 50% dark ferromagnesian minerals. What is the name of the rock?

    d) Describe the variation in crystal size that would be found in the sill from top to bottom.