GEO 143 Geology of the Pacific Northwest Rocks and Minerals
LAB 4: Minerals

Name: _____ Date: _____

Minerals are inorganic, solid, naturally occurring substances that have a characteristic chemical compositions, distinctive physical properties, and crystalline structures.

Chemical composition is the chemical elements that make up any given mineral. For instance, the mineral *quartz* is silicon dioxide SiO_2; the mineral *galena* is an ore of lead, and its chemical formula is PbS, a lead sulfide; and the mineral *calcite*, which is used as an antacid and in fertilizers, is calcium carbonate $CaCO_3$.

** Rocks are aggregates of one or more minerals **

Mineral Properties

1. *Density:* The mass in grams per cm^3. One of the quantitative properties that is a good aid for identification. It requires a pure sample for proper determination. Generally, mots minerals have a density of above 2 g/cm^3 and a maximum of a little over 22 g/cm^3.

2. *Cleavage* and *fracture*: Some minerals have zones of weaknesses upon which they preferentially break. Cleavage is a flat break that results in a flat surface. Fracture is an irregular break resulting in an irregular or curved.

3. *Hardness*: A measure of resistance to scratching. T he Mohs Hardness Scale ranges from 1 to 10.

4. *Color*: Typically, if a mineral sample is one color, it is likely all one mineral. Different colors in one sample may indicate the presence of *accessory minerals* that commonly occur together and may aid in identification.

5. *Streak*: The color of a substance after it has been ground to a fine powder.

6. *Luster*: The description of how the surface of a substance reflects light on a fresh surface, either *nonmetallic* or *metallic*, and often modified by other descriptive terms (e.g. greasy, glassy, waxy).

7. *Diagnostic properties*: Characteristics that are perhaps unique to a particular mineral and differentiate it from other minerals (e.g. magnetism, reaction to acid, ultraviolet fluorescence, crystal morphology, if the mineral occurs in well-formed crystals, etc.).

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LAB 4: Minerals

Mohs Hardness Scale

Mohs hardness	Mineral
1	Talc
2	Gypsum
3	Calcite
4	Fluorite
5	Apatite
6	Potassium feldspar
7	Quartz
8	Topaz
9	Corundum
10	Diamond

Common objects have the following Mohs hardness:

Fingernail	2.5
Copper wire or penny	3.5
Iron nail	4.5
Glass, masonry nail, knife blade	5.5
Streak plate	6.5

We will start getting acquainted with some of the important rock-forming minerals. These are minerals which form a major part of the crust of the earth. Among these are quartz, potassium feldspars, plagioclase feldspars, biotite and muscovite, amphiboles, pyroxenes, and olivine. A few other minerals of interest are added to this list: garnet, calcite, pyrite, gypsum, hematite, and magnetite.

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LAB 4: Minerals

Name	Density, g/cm^3	Cleavage/ fracture	Hardness (Mohs)	Color	Streak	Luster	Other properties
Graphite	1.9 – 2.3	Perfect 1, Conchoidal	1-2	Steel grey to black	black	Metallic, earthy	brittle
Fluorite	3 – 3.3	Perfect 4, Conchoidal	4	All colors	white	vitreous	brittle
Quartz	2.65	No cleavage, irregular fracture	7	colorless, white, brown, pink. purple	white	nonmetallic	
Potassium feldspar	2.54-2.62	perfect cleavage planes at near 90°	6	white, pink, gray, green	white	nonmetallic	No striations
Plagioclase feldspar	2.62-2.76	perfect cleavage planes at near 90°	6	white, gray, colorless	white	nonmetallic	very thin, perfectly parallel lines on some surfaces.
Biotite	2.8-3.2	perfect cleavage	2.5-3	brown, black, dark green	whiteto off-white to tan	nonmetallic	very easy to cleave
Muscovite	2.76-2.88	perfect cleavage	2.5-3	light color	white	nonmetallic	very easy to cleave
Amphibole (hornblende)	3.0-3.4	perfect cleavages at 60 and 120°	5-6	dark green, black, dark brown	whiteto off-white	nonmetallic	cleavage angles and dark color
Pyroxene (augite)	3.2-3.4	perfect cleavages at near 90°	5-6	black, dark green, brown	whiteto off-white	nonmetallic	cleavage angles and dark color
Olivine	3.27-4.37	no cleavage, irregular fracture	6.5-7	yellow- green to olive-green	white	nonmetallic	color, lack of cleavage
Garnet	3.5-4.3	no cleavage, irregular fracture	7-7.7	red, red-brown, yellow, black, green	white	nonmetallic	lackof cleavage, hardness
Calcite	2.7	rhombohedral cleavages	3	Colorless, white, gray, pink, yellowish	white	nonmetallic	Hardness, cleavage, acid response: fizzes
Pyrite	5.0	No cleavage	6-6.5	brassy yellow	dark gray	metallic	Luster, color, hardness
Gypsum		perfect cleavage	2	colorless, white, gray	white	nonmetallic	Hardness, cleavage
Hematite	up to 5.25	cleavage in coarse metallic hematite	1.5-6	red-brown togray, depending on coarseness	red-brown	metallic or nonmetallic	Streak color
Magnetite	5.1-5.2	No cleavage	6	Silvery grayto black	Dark gray	metallic or nonmetallic	magnetic!

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LAB 4: Minerals

We will spend some time getting acquainted with the rock-forming minerals. Some properties are more useful than others, such as hardness, density, and cleavage properties. Color, streak color and luster have less importance but may be useful in specific cases.

1. How might you distinguish plagioclase feldspars from potassium feldspars?

2. How might you distinguish biotite from amphibole (hornblende)?

3. Now try your hand at 4 of the unknown mineral samples (U-1, U-2, U-3, and U-4). For each unknown, list the properties you used to determine their identities, and then try your best to assign a mineral name to the sample:

   U-3

   U-8

   U-5

   U-2

GEO 143 Geology of the Pacific Northwest Rocks and Minerals
LAB 4: Minerals

4. You and your group were hired as consulting geologists and asked to make an appraisal of some metallic "golden" ore samples a prospector has brought in for evaluation. You have a laboratory with an accurate balance (scale) at your disposal, as well as the ability to test for hardness. Your client says she has a claim where she produced 200 kg of this material.

Let's go through the table below and determine which mineral (U-4) he actually brought in. Is she rich now? _____ How much money can she expect to make? _____

Recall that density = mass/volume

Example:

Weight of sample in air: 4.55 g

Weight of sample in water: 1.44 g, therefore, the volume of displaced water is 1.44 ml

4.55g/1.44 ml = 3.11 g/ml is the density

Name	Density, g/cm^3	Cleavage/ fracture	Hardness (Mohs)	Color	Streak	Other diagnostic properties	Value
Gold	19.3	None, malleable!	2.5-3	golden	greenish-black		$50.00/gram
Pyrite	5.02	irregular fracture	6-6.5	pale brass-yellow	greenish or brownish black		$25.00/100 kg
Marcasite	4.9	irregular fracture	6-6.5	brassy yellow, often with greenish hue	greenish-black		$25.00/100 kg
Pyrrhotite	4.58-4.65	irregular fracture	4	brownish bronze	black	Magnetic!	$35.00/100 kg
Chalcopyrite	4.1-4.3	irregular fracture	3.5-4	Golden yellow, often tarnished	greenish-black		$250.00/100 kg

Density determination:

To accomplish this, fill the beaker about ¾ full with water and set it aside. Place the sample on the balance and obtain its mass in grams. Next, place the beaker filled with ¾ of its volume in water balance and obtain its mass in grams. Use the supplied string, make a slipknot and attach the sample to it. Now suspend the sample in the water, making certain it is completely submerged. Do not let it touch the bottom or the sides of the beaker. O btain mass in grams. Subtract the mass of the beaker and just the water from the mass of the beaker, water, and the suspended sample. This the mass of the water displaced by the sample! Calculate the volume of the sample by dividing the mass by the density. The density of water is 1.00 g/cm^3. Divide the mass of the sample by the volume to obtain the density of the sample in g/cm^3.