Mineral Self Instruction Lab
Geology 100 – Harbor Section

Name _____

Your goal for this lab is to become familiar with the physical properties of minerals and use them for identification. Physical properties are determined by the chemical and crystalline properties of the given mineral. However, many properties of many common minerals are not always the same. The most variable property is color, because the ability of a substance to absorb or reflect light is greatly affected by minute quantities of impurities. Rely on color with caution and defer to other characteristics where possible. Your textbook has a mineral properties appendix.

Once you have become familiar with the physical properties, you will use them to identify several of the common rock-forming and ore minerals.

Minerals have many physical properties that depend on their chemistry and crystal structure. They are listed in approximate order of importance. Make sure you understand each property. Sample numbers refer to minerals in the top drawer of the lab benches (we're focusing on #'s 1-22 & 25 now, but 23, 24, and 26-28 are metamorphic minerals that we'll take up later).

Luster
Cleavage and **fracture** (the most important characteristics for many identifications!)
Hardness
Color and **streak**
Density and **specific gravity**
Effervescence (acid test: but you can do without it in most cases)
Crystal form (useful only where crystals have had the space to grow)
Magnetism (for magnetite)
Smell and taste?

Commonly, the first property used to distinguish between many minerals is **luster**, especially the difference between metallic and non-metallic minerals. Other lusters are described as vitreous, greasy, and pearly.

Look at the luster examples at the side lab bench and then match the following samples from the mineral drawers with a luster.

2	_____	A. vitreous
14	_____	B. greasy
15	_____	C. metallic
22	_____	D. earthy

Magnetism is helpful for identifying magnetite and a few other iron bearing minerals. Which of the samples is most highly attracted to the magnet?

Cleavage is the tendency for a mineral to break along flat planar surfaces controlled by the crystalline alignment of the atoms. It is defined by **3** characteristics

1) the number of cleavage planes,
2) the angular relationship between the planes, and
3) the quality of the cleavage (poor, good, perfect).

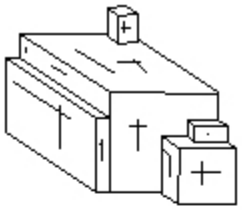
The number of cleavage planes and their angular relationship determines the shape of a broken piece of mineral. Use the information below to learn the distinctive shapes formed by the variety of cleavage directions and angular relations. See examples at the back of the lab.

Platy Cleavage

» one perfect cleavage
» mica minerals

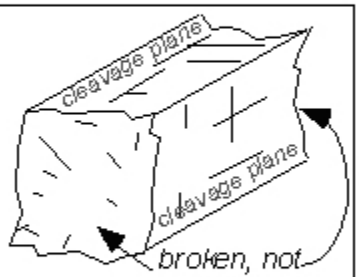
Cubic Cleavage

» **3 planes at 90°**
» cube shapes and stair steps
» Galena, Halite



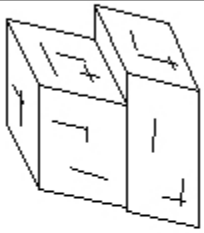
2 Cleavages at 90°

» elongate boxes with rectangular cross sections
» square stairsteps
» feldspars, Augite



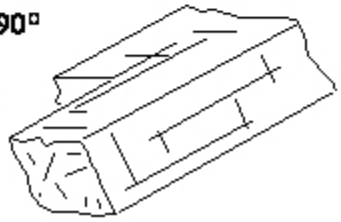
Rhombehedral Cleavage

» **3 planes not at 90°**
» "Rhomb" shapes
» Calcite



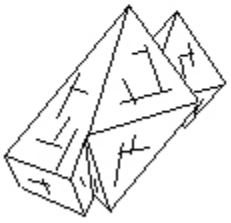
2 Cleavages not at 90°

» elongate boxes with parallelogram cross sections
» angled stairsteps
» Hornblende



4 Cleavage Directions

» pyramidal shapes
» Fluorite



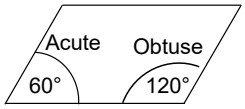
A few minerals with one or more good to perfect cleavage have a distinctive characteristic called striations, which appear like record album grooves along the cleaved surface when viewed in reflection. Striations are a diagnostic characteristic of plagioclase feldspar (e.g., albite or labradorite).

Fracture occurs where a mineral break along irregular surfaces not determined by a regular crystal weakness. One diagnostic type of fracture is called **conchoidal fracture**. It is smoothly curved surface, like when small chips are removed from a piece of glass.

For the following samples from the drawers, determine the number of cleavage planes and their quality (easy to ID = "perfect", uncertain = "poor"). Where there is more than one direction, determine the approximate angle between the cleavage directions (90°). Use the names from the boxes above where applicable. Some may have no cleavage planes (just fracture). Describe the fracture if it is conchoidal. I will set out some examples of cleavage in a tray somewhere in the lab, as well as two minerals in a box you can break with a hammer.

•Make sure that you are examining a single crystal and not aggregates of crystals.

•Watch out for crystal faces! They grow according to the atomic structure, but can differ greatly from cleavage properties (only way you'll know is to break them in the field….please don't break the samples in the drawer)



Samples with 2 cleavage planes not at 90° are described by two angles (for example,120° and 60°) that sum to 180°.

1 This is a crystal displaying crystal faces not cleavage planes. If there is a broken end, how does it look?

2 _____

3 _____

4 _____

5 _____

6* _____

7* _____

8 & 9 _____

10 _____

11 _____

12 _____

14 _____

19 _____

25 _____

*For samples 6 and 7, examining the samples carefully using the binocular scope (side/back of lab) and hand lens will help you determine the angle of the cleavage planes.

Describe the surface of cleavage planes on sample 4.

What are these features called?

Which sample is best described as having conchoidal fracture?

Hardness is defined on a relative scale known as Moh's Hardness Scale. Minerals should be scratched against each other and compared to fingernails (H=2.5), pennies (H=3.5), glass (H=5.5), and steel picks/knifeblades (H=5.5-6).

• PLACE GLASS PLATE ***FLAT*** ON LAB TABLE WHEN SCRATCHING!!

Memorize these minerals in the **Mohs Hardness Scale**.

1. Talc	2. Gypsum	3. Calcite	4. Fluorite	5. Apatite
6. Orthoclase	7. Quartz	8. Topaz	9. Corundum	10. Diamond

Place the following samples and objects in order from softest to hardest (some may be too close to determine, indicate with "=")

fingernail, penny, glass plate, samples 2, 3, 7, 10, 12, 13, 20

Streak is the color of a mineral when it is ground to a powder size using a ceramic streak plate. Describe the two colors and lusters of the two types of sample 17. What about 22?

Now describe their streak (rub your thumb across the powder streak).

How does this streak differ from samples 21,15, and 18?

Most nonmetallic minerals have a clear or colorless streak, which is not helpful. Try a few.

Many of the metallic minerals are described by a high **specific gravity**. Compare the "heft" of similar-sized samples of #16 (S.G.≈7.6) or #17 (S.G.≈5) with # 2 or #5 (S.G.≈2.7).

Estimate the specific gravity of sample #7.

Use the mineral properties and binary key on the following page. A binary key looks like an inverted tree. Determine the answer to the first question and take the appropriate branch. Continue following the branches until you have identified the mineral. The binary key is a simplified example for our samples. Most of the samples are single large crystals, not common in nature. Caution: some may have small inclusions of other minerals.

MINERAL	DISTINGUISHING CHARACTERISTICS
1	
2	
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20	
21	
22	
25	

Once you have identified the minerals in one drawer, look in other drawers to test yourself. Physical properties do vary for samples with the same name. In addition, some drawers have good crystals or cleavage whereas others may not.

You are responsible for identification of the following minerals and learning their chemical nature or formulas as given below. Additional minerals come when we study metamorphic rocks.

Silicates

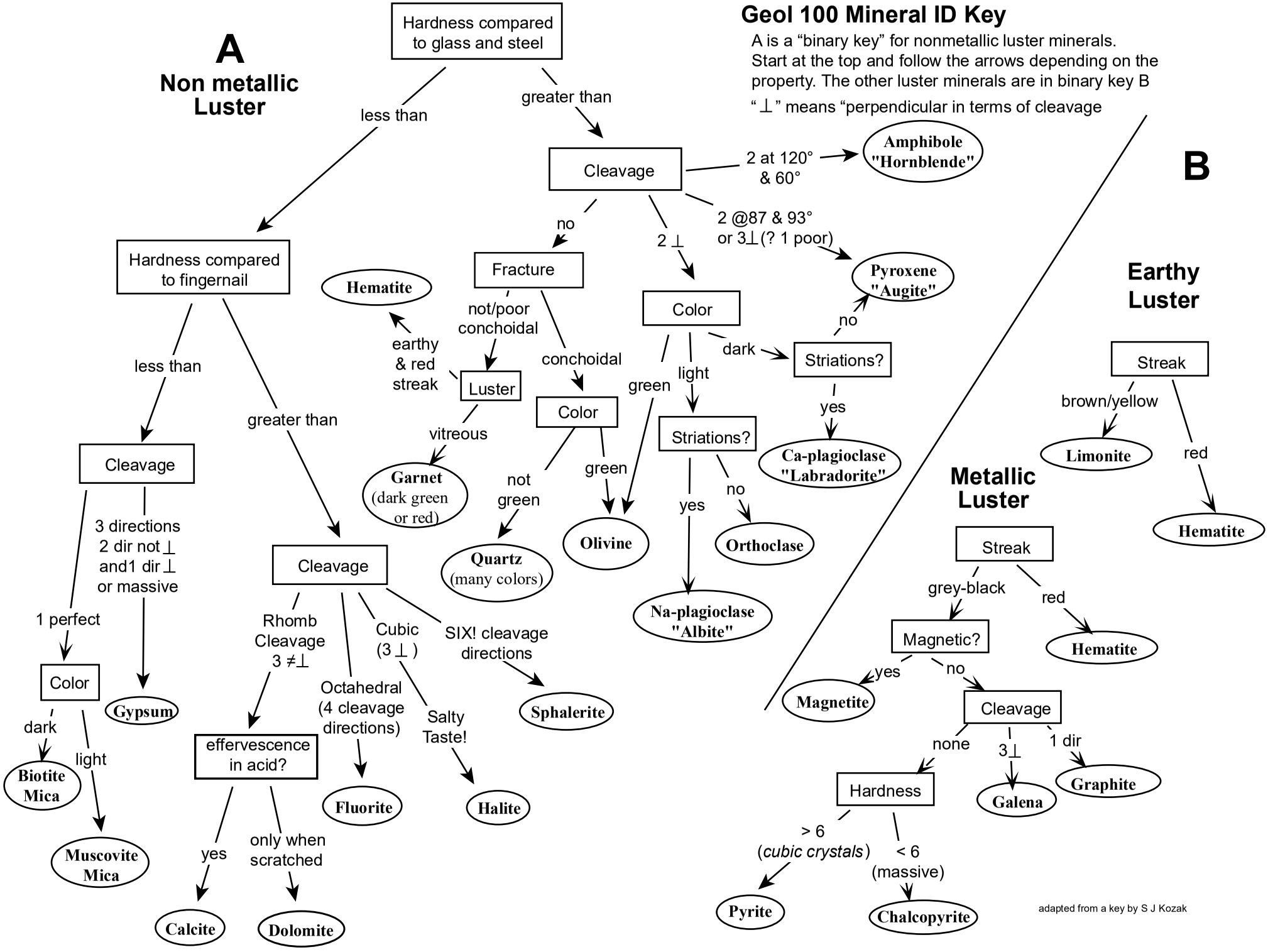
Quartz	SiO_2
Feldspars	
Orthoclase (K-feldspar)	$KAlSi_3O_8$
Albite	$NaAlSi_3O_8$
Labradorite	$CaAl_2Si_2O_8$
Micas	
Biotite	Mg, Fe sheet silicate
Muscovite	K sheet silicate
other silicates	
Talc	hydrated Mg sheet silicate
Hornblende (an amphibole)	Ca, Mg, Fe silicate
Augite (a pyroxene)	Ca, Mg, Fe silicate
Olivine	$(Mg, Fe)_2SiO_4$
Garnet	igneous/metamorphic silicate

Other anions

Gypsum	Calcium sulfate
Pyrite	FeS_2
Chalcopyrite	$CuFeS_2$
Galena	PbS (lead ore)
Sphalerite	(Zn,Fe)S
Magnetite	Fe_3O_4
Hematite	Fe_2O_3 (an iron oxide and iron ore)
Limonite	iron oxi-hydroxide
Calcite	$CaCO_3$
Dolomite	$CaMg(CO_3)_2$
Halite	NaCl
Fluorite	CaF_2

Geol 100 Mineral ID Key

A is a “binary key” for nonmetallic luster minerals.
Start at the top and follow the arrows depending on the property. The other luster minerals are in binary key B
“⊥” means “perpendicular in terms of cleavage



ANSWERS:

• **Luster** :

2 vitreous
14 vitreous
15 metallic
22 earthy

Magnetism: sample 18 is the most magnetic. others might have minor magnetism

Cleavage

1 - None: watch out for crystal faces
2 - None: watch out for crystal faces
3 - 2@90°, both good-perfect
4 - 2@90°, both good
5 - 2@90°, (careful, sometimes these specimen have more than one mineral crystal) good-poor
6* - 2@90°, 1 good 1 poor
7* - 2 @ 124° and 56° (1 good, 1 poor)
8&9 - 1 perfect ("micaceous" or "platy" cleavage)
10 - 3 ≠ 90° all good-perfect (Rhombehedral)
11 - 2@90°, both good-perfect
12 - 3 @ 90° all good-perfect (Cubic)
14 - 4 perfect cleavage, none at 90°
19 - none ! There are some cubic CRYSTALS (they grew, rather than broke into that shape).
25 - 3 ≠ 90° all good-perfect (Rhombehedral)

Hardness

Soft 13, fingernail, 12, 10, penny, glass, 7 , 20=3, 2 **Hard**

Streak

The luster of 17 is either earthy or metallic, and the color is silver or red but the streak of both 17's is maroon or "*blood*" red. Sample 22 is earthy with a yellow-brown streak. The rest of the *metallic* minerals have a grey or black streak. Most vitreous minerals have colorless streak.

Specific Gravity

The SG of #7 should be about 3- 3.5. Do you agree?

Mineral ID *(do not share this answer key with students in other Geol 100 classes!)*

1 Olivine (euhedral xstal)
2 Quartz
3 Orthoclase (K-feldspar)
4 Albite (Na-Plagioclase)
5 Labradorite (Ca-Plag.)
6 Augite (a pyroxene)
7 Hornblende (an amphibole)
8 Biotite (a mica)
9 Muscovite (a mica)
10 Calcite
11 Orthoclase (K-feldspar)
12 Halite
13 Gypsum
14 Fluorite
15 Galena
16 Chalcopyrite
17 Hematite
18 Magnetite
19 Pyrite
20 Garnet
21 Sphalerite
22 Limonite
25 Dolomite