Name ___KEY_____

Due Friday 1/25

GEOL 106 Writing #2 – Minerals & Rocks

1. What's a cation? Atom that has lost an electron, leaving it a positively charged ion

   Anion? Atom that has gained an electron, leaving it a negatively charged ion

2. What is atomic mass? Total mass of an atom in amu (atomic mass units); includes protons, neutrons, electrons (very minor mass)

   Atomic number? # of protons in an atom; unique for each element

3.
   a. How many protons does C always have? __**6**__What about H? _**1**__ What are their atomic numbers? C _**6**__; H __**1**___
   b. What are the atomic masses of each carbon isotope? _**12**_, _**13**_, _**14**_
   c. The average atomic mass of C is 12.011 on the periodic table. The abundance of each carbon isotope is ^{12}C, 98.90%; ^{13}C, 1.10%; ^{14}C, 0.0000000001%. Show a calculation that relates the abundance to the average atomic number. Briefly explain.

				cumul.
isotope	**%**	**fraction**	**amu**	**wt**
12	**98.9**	**0.989**	**11.868**	**11.868**
13	**1.1**	**0.011**	**0.143**	**12.011**
14	**1E-10**	**1.00E-12**	**1.4E-11**	**12.011**

12(0.989) = 11.868 = amu's of *C* that due to ^{12}C; 13(0.011) = 0.143= amu's of *C* that due to ^{13}C
>>>> 11.868 + 0.143 = avg mass (mass ^{14}C negligible compared to others)

4. What kinds of evidence tell us about the internal structure of minerals? How does the cleavage of a mica relate to the silica tetrahedra its internal structure?

Crystal growth faces are external evidence of internal structure (see Fig. 3.8), as are cleavage planes. X-ray diffraction and scanning tunneling microscopy (see Fig. 3.6 in lab book) are two methods not available to intro students that provide evidence of internal structure.

Cleavage planes in minerals are *planes of relatively weaker bonds* that allow minerals to preferentially break along those planes in the internal structure. In micas, due to weak bonds in one particular plane, there is one excellent cleavage plane along which the mineral clearly break most easily.

5. What's the difference between crystal faces and cleavage faces?

Crystal faces are the outer layers at which minerals ***grow***, and they are an expression of a mineral's internal structure. There may not be room for growth as minerals "bump into" each other during crystallization, so faces are not always well expressed. Cleavage faces result due to breakage along planes of weak bonds (for some minerals, not all); they should be expressed any time a mineral with cleavage is ***broken***.

6. Why do some minerals exhibit no cleavage?

They have no particularly weaker bonds in any particular direction.

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7. How do each of the three major rock types form? Include the source of the material and the rock-forming process.
Igneous rocks form from the hi-temperature (650-1200 °C) melting of other rocks (ign. mmorphic, or sed), following by cooling, possibly with crystallization of minerals if sufficient time is available

Metamorphic rocks form by solid state (no melting) recrystallization of minerals in other rocks (ign. mmorphic, or sed) due to high temperatures and or pressures.

Clastic sedimentary rocks form by weathering of other rocks (ign. mmorphic, or sed), transport of sediments by water, wind, or glaciers, deposition of sediments, (often) burial by other sediments, followed by compaction and lifhification. Chemical sedimentary rocks formby chemical weathering of other rocks (ign. mmorphic, or sed), transport of dissolved ions by water, chemical precipitation of minerals, (often) burial by other sediments, followed by compaction and lifhification.

8. What's the difference between magma and lava?
Magma is molten rock below the surface of the Earth. Lava is the same thing, above the surface of the Earth.

9. What do the terms intrusive and extrusive (used only for igneous rock) mean? What do they imply for the size of mineral grains expected in an intrusive or extrusive rock? Why?

Intrusive = molten rock cooled below the surface of the Earth, usually slowly enough to allow for growth of visible mineral grains. Crystals require adequate time and space to grow; slow cooling provides adequate time for mineral growth.
Extrusive = molten rock cooled above the surface of the Earth, usually rapidly enough that large mineral grains did not form.

10. Explain the meaning of the terms felsic, intermediate and mafic for igneous rocks.
These are chemical composition terms. Felsic rocks have more Si, Na, K, less Fe, Mg, Ca than more mafic rocks. Minerals can also be referred to with the terms for the same reason. E.g., quartz, muscovite, K-spar, and Na-rich plag are felsic. Olivine, biotite, hornblende (an amphibole), pyroxene, and Ca-rich plag are more mafic.

11. Explain the concept of the rock cycle in your on words.
All major classes of rocks (ign. mmorphic, or sed) can be transformed into all other major classes of rocks through tectonic processes and the processes listed in Question #7. There are some limitations. *E.g.*, you can't take a quartz sandstone and metamorphose it into a marble, because marble is primarily composed of recrystallized calcite ($CaCO_3$) , whereas sandstone is primarily composed of quartz (SiO_2).

12. Name and briefly explain the two major types of metamorphism.
Contact – solid state (no melting) recrystallization due primarily to high temperature. Usually occurs in a "halo" around intrusion of an igneous magma in the "country rock"
regional – solid state (no melting) recrystallization due both high temperature and high pressure. Due to the tremendous T and P experienced by rock due to plate collision during a mountain building (orogenic) event.