Geology 101 Review Material (Midterm and Final)

1. How does the earth become compositionally zone?
You should have knowledge of the 6 evolutionary stages that show how the earth could evolve from a "homogeneous mixture of primordial dust (planetesimals) to the compositionally zoned planet containing an Fe-Ni core, Fe-Mg silicate mantle and Fe-Mg-Al Crust. Compositional zonation based on density.

When will the earth become compositionally zoned?… when the melting temperatures of silicate minerals and eventually iron and nickel are exceeded. Earth becomes molten and the lighter material are displaced outward and denser iron-nickel sinks to the core.

2. Physical properties of asthnosphere and lithosphere.
You should have knowledge of the composition and physical properties of the lithosphere and asthenosphere. Asthenosphere-lithosphere relationship is important to understanding plate tectionics.

3. Evidence of compositional characteristics of the internal structure of the earth.
-overall densisty of earth is 5.5 gm/cm^3 density of crust 2.6-3.0 gm/cm^3 provides some information regarding the density of the interior zones.

-meteorites are inferred to be composed of same material that earth was derived
-earth has a magnetic field supports the argument for the core being metallic and the outer core being liquid (i.e., convecting electrons surrounding metallic solid inner core will generate magnetic field).
-seismic properties (velocities, absorption of S-waves by outer core).
-Why do P-wave and S-wave shadow zones form? Why is the S-wave shadow zone larger?

4. What is isostasy? (from your text book rading)
-think about the lighter continents versus denser ocean crust floating on the asthenosphere.
-why is the oceans present over ocean lithosphere (think density)

5. Melting temperature versus geothermal gradient.
-why is the outer core liquid and inner core solid when the outer core's actual temperature is lower than the inner core's? Melting temp dependent upon composition and pressure. Actual temperature (geothermal gradient) is simply dependent upon pressure (depth). The two curves do not have the same slopes.

The outer core is liquid because the actual temperature is greater than the melting temperature of iron-nickel for this depth (pressure). The opposite is true for the inner core. You can use a similar argument for the parital melt of the ashenosphere.

6. Plate Tectonics.
-know the relationship of all three plate boundaries.
-what type of igneous rocks form at each respective plate boundary (i.e., basaltic/gabbroic magma at divergent margins from partial melt of asthenosphere; andesitic/dioritic magma at subduction zones from partial melt of ocean crust and associated marine sediment); granitic magma from partial melt of continental crust at collison boundaries.
-why do transform faults form? Is all the stress translations (think about bends in transform faults.

-How can we use paleomagnetism to prove that new ocean crust is being created at seafloor spreading (divergent margins) zones? polarity reversals form symetric stripes on either side of spreading ridge as new crust forms and diverges.

-You should be able to draw the structure of a typical subduction zone showing the trench, accrtionary wedge (forearc ridge); fore arc basin; volcanic arc; back arc basin. What physical features in Washington correspond to these respective subduction zone structures?
-How does the subduction angle and distance of volcanoes from the trench relate?
-Can you subduct a spreading ridge? (Think about the future of the Juan de Fuca spreading ridge and how the San Andreas fault formed). Where is the spreading ridge that was subducted under California today (maybe under Nevada and Utah?).

Think about the past and future palte configurations based on your knowledge of present palte motions (i.e., if the Atlantic Ocean getting bigger or smaller?).

7. Minerals
-be able to draw a silicate tetrahedron. Understand its charge balance $(SiO_4)^{-4}$ How does it achieve charge and chemical balance (shares oxygen atoms between tetrahedra; forms ionic and metallic bonds with other available cations).
-understand the differences between the silicate minerals. Why does quartz fracture and amphibole cleave?
-If I show you a diagram of pyroxene (single chain silicate) can you explain why its Si-O ratio is 1:3?
-Remember to read the section on nonsilicate minerals **in your text**.

8. Igneous Rocks and Processes
-know about the three composistional types of magma/lava (properties: silica vs Fe-Mg mineralogy, viscosity, explosive of eruption, landform type.
-Understand dry vs wet melts. Why does granitic composition magma rarely make it to the surface? (Granitic magma is a wet melt and the melting temp increases with decreasing pressure so that is solidifies as is rises to the surface, aas pressure decreases. Opposite is true for dry basaltic magma (it further melts as it rises to the surface).
-What type of tectonic setting do you find the different magma types.
-Bowen's Reaction Series (magmatic fractionation by partial melting and fractional crystallization).
-Be familiar with the igneous rock classification diagram in Chapter 3 of the text. Can you identify and igneous rock if I give you mineral composition and texture information (the diagram will be provided).

-Volcanic Landforms (shield, strato and pyroclastic volcanos, calderas, basaltic plateaus). How do they form and what are their compositional characteristics and tectonic setting.
-What does the linearity of hotspot volcanos tell you (absolute plate motions).
-Ophiolite Sequences

Plutons (how are they classified).
Volcanic Hazards
-tectonic setting and lava characteristics.
Compare the volcanic hazards on the Hawaii or Iceland versus Mt. Rainier or Mt. Vesuvius

9. Weathering and Soils:
-Understand the difference between mechanical and chemical weathering. Understand the respective processes (How do joints form? Frost weathering, bioturbation).

-Understand the chemical reactions involved in weathering. Do not memorize the reactions. Could generally explain what is happening if you given the reaction. (i.e., Where do H+ ions come from that are involved in a hydolosis reaction? How does carbonic acid form?, etc.).

--How do different weathering features form (Why spheroidal weathering patterns?).

-Soils: What is a soil. Know how soil forming factors (CLORPT) influence soil development.

10. Sedimentary Rocks

-Sediment to sedimentary rock (accumulation, compaction, cementation)
-How do we classify sedimentary rocks (clastic, chemical and biogenic).
-Know how different sedimentary structures form (i.e., symmetric ripples vs asymmetric ripples, graded bedding form because of turbidity currents).
How can sediementary rocks and structure help you understand the depositional environment (e.g., where does chert generally form?).

11. Stratigraphy and Geologic Time

-What is the Principle of Uniformitarianism? How did it evolve from catastrophism?
-How did early estimates attempt to date the age of the Earth?
-Underestand the principles of stratigraphy.
-Understand the three types of unconformities. How do they form and how do you recognize them in the field?
Read about the geologic time scale in the text book. Know how its major subdivisions are defined (do not simply memorize the subdivisions).

12. Radiometric Dating

-What is radioactivity? How do radioactive elements decay over time (exponential decay)? Understand the age equation (do not memorize) The number of existin daughter atoms in a closed system will be proportional to the number of existing parent atom as a function of the exponential decay (which is a constant) and time.
-Types of decay (simple, branch, chain).
-How is half-life and dating range related (Large half-live date older materials) Once an isotopic system has gone through 10 half-lives you reach the upper limit of dating (i.e., C-14 has a half-life of 5730 yrs. The upper limit of dating is 57300 yrs.)
-What our the assumptions of radiometric dating (e.g., closed system, measure N and D atoms accurately, etc)?
-Understand the isotopic systems we discussed in class (K-Ar, Fission Track, Radiocarbon).

13. Deformation

-What are the three types of defromation? What are the controlling factors of deformation (temp, confining pressure, time, rock type, strain rate).
-Brittle Fracture (classifying faults- normal, reversed, and strike-slip).
-Ductile Deformation [measurine folded rock (strike and dip), classifying folds.

14. Metamorphism and Metamorphic Rocks

15. Seismology, Earthquakes and Tectonic Hazards

-Earthquakes; (What are they?) P vs S waves; Location of epicenter; magnitude vs intensity
-Earthquakes and plate tectonics (EQ's and plate boundaries
- Earthquake damage, Prediction and Prevention