Study guide for the igneous rock exam

Practical

1. Know your optical mineralogy and how to determine common properties of minerals in thin section: isotropic, uniaxial, biaxial, optic sign, 2V, sign of elongation, extinction angle of elongate crystals (e.g., micas, amphiboles, pyroxenes, apatite, chlorite), sign of dispersion of the 2V, estimated birefringence (interference order, color), pleochroism, relative refractive index of adjacent minerals. Why? These are basic mineral ID techniques to identify minerals you aren't familiar with. Your boss wants to know if there is sphalerite in thin section. Check the properties and look!
2. Be able to identify common plutonic and volcanic rocks by eye without a rock classification chart: basalt/gabbro, andesite/diorite, rhyolite/granite, pumice, etc.
3. Be able to make a reasonably accurate identification of large (>1 mm), common minerals in hand samples.
4. Be able to identify in thin section all of the minerals seen in the Igneous Minerals Lab. This can be done with a book, like Tröger or DHZ, but it will slow you down. No computers.
5. Be able to estimate mineral modes in thin section and to approximately classify rocks according to that mode with a rock classification chart.
6. Be able to interpret mineral inclusions and other common textures in terms of a simple crystallization or reaction sequences under magmatic and/or subsolidus conditions. Did enstatite overgrow olivine, or the other way around? Do the textures indicate rapid cooling or slow cooling?

Theoretical

1. Know the differences between different types of igneous bodies (e.g., batholith, sill, dike, lava flow, ignimbrite, ash, etc.).
2. Understand the tectonic settings in which different magmas are commonly found: tholeiitic, calc-alkaline, alkaline; mafic, intermediate, felsic.
3. Know the typical mechanisms by which melting takes place, and what causes melting in different geologic environments.
4. Understand the effect of source composition and mineralogy on magmas that are produced by partial melting. What do you get if you melt mantle lherzolite, basalt, common granite, or shale.
5. Understand the effect common magmatic processes have on the major and trace element compositions of evolving magmas (wall rock assimilation, magma mixing, fractional crystallization, crystal addition).
6. Know the lever rule and how to apply it in 2 and 3 component chemical systems.
7. Know the basic workings of these liquidus systems: An-Di, Fo-Sil, An-Ab, An-Di-Fo, An-Fo-Sil.
8. Know some of the textures produced by mineral unmixing (exsolution, e.g., perthite), and why unmixing takes place.
9. Understand and be able to make and read normalized rare earth element diagrams.
10. Understand and be able to make reasonable interpretations of major element chemical variation diagrams: common phases involved, crystallization sequence, control lines.
11. Know, in general, how compatible and incompatible elements behave during ideal fractional and equilibrium melting, fractional and equilibrium crystallization, and mixing.