Study guide for the metamorphic 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 topaz in a sample. Check the properties and look!
2. Be able to identify common metamorphic rocks by eye (e.g., schist, gneiss, slate, amphibolite, quartzite, 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 metamorphic and igneous labs. This can be done with a book like Tröger or DHZ, but it will slow you down. No computers.
5. Be able to assign protoliths to common metamorphic rocks based on rock mineralogy and textures (e.g., shale, sandstone, limestone, rhyolite, basalt).
6. Be able to interpret mineral textures in terms of reactions (rimming relationships, remnant inclusions inside porphyroblasts, etc.).

Theoretical

1. Be able to correlate mineral assemblages in thin section with related phase diagrams.
2. Be able to accurately calculate the temperature and pressure at any depth, given the depth, rock density, geothermal gradient, and surface temperature.
3. Know the difference between a *P-T-time* path and a metamorphic field gradient.
4. Be able to sketch reasonably accurate *P-T-time* paths for rocks during metamorphism if given a set of P and T estimates or a set of simple tectonic events (crustal thickening, thrust faulting, magma intrusion, etc).
5. Understand how continuous and discontinuous reactions work.
6. Be able to plot phases on ternary phase diagrams, given their chemical composition.
7. Be able to tell which reaction is causing particular continuous and discontinuous phase changes in a ternary diagram, particularly in muscovite projection.
8. Be able to schematically identify or illustrate divariant, univariant, or invariant reactions on P-T or ternary phase diagrams.
9. Know how to make projections of phase diagrams, and the reasons for making them.
10. Understand the concept of metamorphic isograds and know the more common metamorphic grades or zones.
11. Be able to use an appropriate petrogenetic grid (a P-T diagram showing reaction lines) to determine the range of P and T that a particular, pertinent assemblage could have formed in.
12. Know the definitions of common geological terms, such as those we used frequently in class and lab (porphyroblast, porphyroclast, augen, foliation, lineation, etc.).
13. Understand and be able to explain the stress-strain curves of brittle faults, the two types of ductile faults, and the effect each type of fault tends to have on fault width.
14. Understand melting processes sufficiently to be able to, given a phase diagram, estimate the composition of liquid produced during partial melting, and the sequence of phase exhaustion during partial melting (equilibrium or fractional).