**Homework #8: Optical Microscopy**

*Chem 6614 Chemical Instrumentation Due Wednesday 3 May*

*Your name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_/20 pts*

8.1 Which lens combination produces the shortest focal length ?

a) plano-plano b)concave-convex c)double convex d) double concave e) plano-convex

8.2. Material X of unknown refractive index nd(x) receives 40o air

 a beam of sodium D light at the incident angle shown.

 a) Given the refracted angle shown (25.27o), what is the value material X

 of nd(x) ? Show work. 25.27o

 nd(x) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 b) what material is X most likely made of ? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8.3. Why is both the simple magnifier image and the compound microscope image referred to as a

 `virtual image’ ?

8.4. What is the difference between a phase object and an amplitude object ? (2 pts)

8.5. What is the `default’ distance for the human eye ? \_\_\_\_\_\_\_\_\_\_\_ inches or \_\_\_\_\_\_\_\_\_\_\_ cm

8.6 What prevents us from serially placing many objectives between an object and the eyepiece to

 produce unlimited magnification ? In other words, why can’t we see atoms with a typical optical

 microscope ? (2 pts)

8.7a. Of the objectives listed below, which is the most expensive (=best) lens system? \_\_\_\_\_\_\_\_\_

8.7b. Of the objectives listed below, which is the least expensive (=crappiest) lens system?\_\_\_\_\_\_\_\_\_\_

8.7c. Which objective(s) below is spherically-corrected at the Na-D line and chromatically corrected at Na-D

 and either red or blue wavelengths ? \_\_\_\_\_\_\_\_\_

a)D-plan-achromat b) S-plan-apochromat c) E-achromat d) S-plan-achromat

8.8. What is the role of oil in an oil immersion objective ?

8.9. What two inventions located in ASC’s BH-2 Olympus Phase scope allow resolution of phase objects ?

8.10 The numeric apertures of higher magnification objectives are always higher than lower magnification

 Objectives. Why don’t we just use the higher magnification objectives since their light gathering power

 is greater ? (Hint: what physical trade-off occurs as we move to higher magnification?)

8.11 The individual particles of silica packing of an HPLC column are said to be separated by ~0.2 μm.

 Assuming you are working with an objective with NA=0.60, and with orange light with λ=500 nm,

 can you resolve the particles in the packing ? (2 pts show work) YES NO

Why: ( a calculation)

8.12. You wish to observe an un-stainable strain of *staph aureus fongmoronicus* whose diameter is roughly

 0.5 μm. Given that the human eye can distinguish objects down to about 0.1 mm, and given that

 you’ve got a 10X eyepiece , suggest :

 Magnification ~NA

1. An objective and likely NA to use (check BH-2 for likely NA) \_\_\_\_\_\_\_\_\_\_\_X \_\_\_\_\_

 1 pt 1 pt

1. Would you want to use a phase scope ? Yes No explain why or why not below (1 pt)