Phys. 221-501 Optical and Thermal Physics – special section for physics majors, Fall 2010

See “Hints on how to solve the homework assignments” in CRH221-fl10.html.

Homework assignments – 10 points per set; 1 pt. per problem, except for those problems labeled as double credit. (Mostly from Young & Freedman, University Physics, 12th edition. 2008 Pearson Education Inc. publishing as Addison Wedsey, 1301 Sansome St., San Francisco, CA, 94111. Assignments are from “Exercises”, “Problems”, and “Challenge Problems” (for double credit) of this book. Problems preceded with a letter S are supplementary advanced-level problems given at the end. They are also for double-credit.

Set 1, on Chap. 33 - Problems 9, 19, 25, 27, 41, 45, 47, 49; 65 (double credit).

Set 2, on Chap. 34 - Problems 5, 15, 39, 47, 51, 53, 89, 103; S1 (double credit).

Set 3, on Chap. 35 - Problems 23, 35, 37, 41, 43, 51, 55, 59; 61 (double credit).

Set 4, on Chap. 36 - Problems 11, 17, 25, 31, 33, 47, 55, 65, 71; 74 (double credit).

Set 5, on Chap. 13 - Problems 19, 27, 45, 49, 55, 63, 77, 89; 97 (double credit).

Set 6, on Chap. 15 - Problems 9, 15, 23, 31, 47, 53, 59, 65, 77; 82 (double credit).

Set 7, on Chap. 16 - Problems 15, 27, 33, 39, 43, 49, 65, 67; 79 (double credit).

Set 8, on Chap. 17 - Problems 15, 25, 45, 69, 83, 97, 103, 109; 122 (double credit).

Set 9, on Chap. 18 - Problems 29, 35, 43, 55, 59, 61, 65, 75, 81, 86. (No double credit.)

(Do not try problem 63 in this chapter, which requires the knowledge of Chapter 14.)

Set 10, on Chap. 19 - Problems 9, 23, 35, 41, 47, 53, 59, 67; 69 (double credit).

Set 11, on Chap. 19 - Problems 55, 57 (both double credit),

and on Chap. 20 - Problems 11, 15, 19, 27; 53 (double credit).

Set 12, on Chap. 20 - Problems 31, 35; 41, 43, 49, S2 (the last HW set)

(The last four problems are double credit.)
Prob. S1:

A glass rod (index of refraction $n = 1.50$) of 5 cm lateral diameter has semi-spherical end surfaces of radius $R = 2.5$ cm. (See figure.) The tip-to-tip length of this rod is 10 cm. Without using any equations associated with thin lenses including the lens maker’s equation, calculate: (a) the location of the final image of a little bug located at 1.0 cm to the left of the left tip of the rod. (b) Determine whether the final image is virtual or real, upright or inverted, and give reason. (Work in the paraxial approximation.) (c) Calculate the combined lateral magnification of this thick lens by calculating the individual lateral magnification factors of the two refracting surfaces separately, and then multiplying them together. Compare your result with the ratio of the lateral size of the final image with the lateral size of the original object, i.e., $s_2'/s_1$. (The subscripts refer to the two refracting surfaces.)

Prob. S2:

Four moles of a diatomic ideal gas undergoes a cycle made of one isobaric-, one adiabatic, and one isothermal process as shown. (All these processes are assumed to be idealized reversible processes.) The temperature at $a$ is 360 K. Calculate: (a) the temperatures at $b$ and $c$; (b) the entropy change $\Delta S_{ab}$ for the process $ab$ according to the formula $\Delta S = \int_1^2 \frac{\Delta Q}{T}$; (c) the entropy change $\Delta S_{ca}$ for the process $ca$ according to the same formula for $\Delta S$. The molar heat capacity of this gas is that with the vibrational degree of freedom frozen, and the rotational and translational degrees of freedom not frozen. (d) Find an independent way to directly predict the sum $\Delta S_{ab} + \Delta S_{ca}$ and explain your reasoning. Now add up your results in part (b) and (c) to get also $\Delta S_{ab} + \Delta S_{ca}$ and see whether the two calculations of this sum agree.