Physics 262: Practice Final Exam
100 points

1. (20 points) The magnitude of the radius of curvature for a spherical, convex mirror is R.

   (a) (5 points) If an object is located at infinity, draw two principle rays showing the location of the image.

   (b) (5 points) What is the location of the image, s'?

   (c) (5 points) If a planar-concave lens is used instead of the spherical mirror, what would the index of refraction of the material, n, have to be in order to give the same focal length? The magnitude of the radius of curvature is also R.

   (d) (5 points) For the two cases above, state if the images are real or virtual. State if they are erect or inverted.

2. (20 points) Two spaceships pass by each other. From earth, the velocities are measured to be $(0.5c)\hat{x}$ and $-(0.5c)\hat{x}$.

   (a) (10 points) What is the velocity of the spaceship in the other spaceship's reference frame?

   (b) (10 points) On one spaceship, a child throws a 0.1 kg baseball at 10 m/s in the direction of the approaching space ship. What is the kinetic energy of the baseball as seen in the other ship?

3. (20 points) A particular diffraction grating has 10^4 lines per centimeter. A detector is located 1 m from the grating. Approximately how far apart would the hydrogen $n_i = 3 \rightarrow n_f = 2$ and $n_i = 4 \rightarrow n_f = 2$ spectral lines be spaced at the detector.

4. (10 points) Two events A and B have a positive spacetime interval. Show the two events on Minkowski diagram. Is there any frame of reference in which A and B can reverse temporal order in which they occur?

5. (10 points) Consider the electron in the hydrogen atom ground state. The Bohr model and the result of the Schrödinger equation solution predict different values of the orbital angular momentum. What are the predicted angular momentum in each of these cases? Which is correct?

Continued on back.

6. (10 points) If the earth is treated as an ideal black body radiator, estimate the amount of power radiated from earth by black body radiation. $R_{earth} = 6400$ km.

7. (5 points) Write a mathematical expression for a plane wave that is traveling in the x direction and is linear polarized along the z axis. The maximum value of the electric field is E_{max}.

8. (5 points) Which transitions are not allowed in the hydrogen atom? Why not?

   $4s \rightarrow 3s$
   $4s \rightarrow 3p$
   $4p \rightarrow 3s$
   $4d \rightarrow 1s$