Tutorial #07

PH100: Mechanics and Thermodynamics

1. Two non-interacting particles nil and fn2 move toward each other with velocities vx and v2. Their paths are offset by distance b, as shown in the sketch. Let us investigate the equivalent one body description of this system.

2. A satellite of mass m orbits the earth in a circle of radius ro. One of its engines is fired briefly toward the center of the earth, changing the energy of the satellite but not its angular momentum. The problem is to find the new orbit.

3. A furnace has walls of temperature 1600°C. What is the wavelength of maximum intensity emitted when a small door is opened?

4. Calculate max for blackbody radiation for (a) liquid helium (4.2 K), (b) room temperature (293 K), (c) a steel furnace (2500 K), and (d) a blue star (9000 K).

5. Calculate the temperature of a blackbody if the spectral distribution peaks at (a) gamma rays, \lambda = 1.50 \times 10^(-14) m; (b) x rays, 1.50 nm; (c) red light, 640 nm; (d) broadcast television waves, 1.00 m; and (e) AM radio waves, 204 m.

6. The wavelength of maximum intensity of the sun's radiation is observed to be near 500 nm. Assume the sun to be a blackbody and calculate (a) the sun's surface temperature, (b) the power per unit area emitted from the sun's surface, and (c) the energy received by the Earth each day from the sun's radiation.

7. (a) A blackbody's temperature is increased from 900 K to 2300 K. By what factor does the total power radiated per unit area increase? (b) If the original temperature is again 900 K, what final temperature is required to double the power output?

8. (a) At what wavelength will the human body radiate the maximum radiation? (b) Estimate the total power radiated by a person of medium build (assume an area given by a cylinder of 175-cm height and 13-cm radius). (c) Using your answer to (b), compare the energy radiated by a person in one day with the energy intake of a 2000-kcal diet.