Modern Physics Problem Set 6

Due: Oct 23, 2025

Problem 1

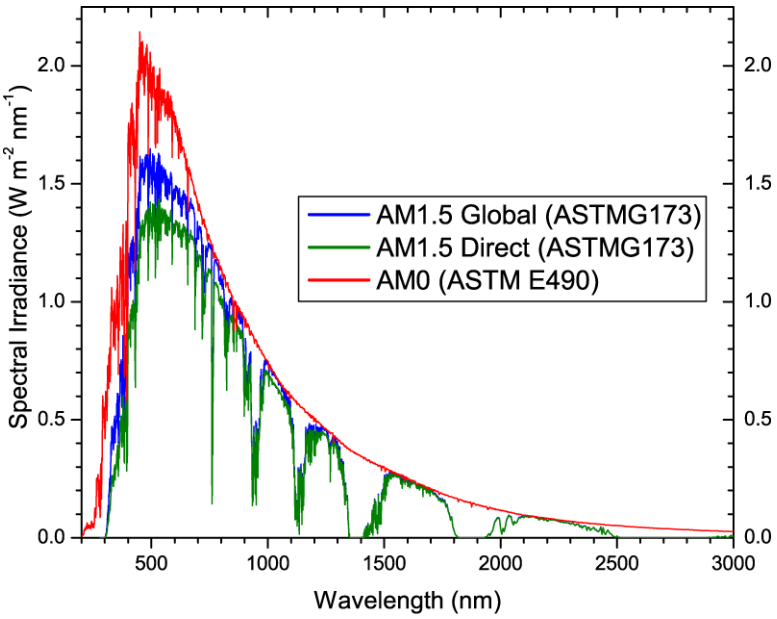

Figure 1: Solar spectrum. The curve labeled AM0 (air-mass zero) is the spectrum measured at the top of the atmosphere.

Use the spectrum in Figure 1 to estimate the temperature of the sun's visible surface.

Problem 2

A blackbody is heated from $T_1 = 2000\,\mathrm{K}$ to $T_2 = 3000\,\mathrm{K}$.

1. By what factor does $R = \sigma T^4$ change?
2. By what factor does $\lambda_{\max}$ change?

Problem 3

A square plate of side $0.2\,\mathrm{m}$ at $T = 1200\,\mathrm{K}$ radiates as a blackbody. Find the total power emitted from one side of the plate.

Problem 4

An incandescent filament's spectrum peaks at $\lambda_{\max} = 1.10\,\mu\mathrm{m}$. Estimate the filament temperature and comment on visible efficiency (the fraction of power emitted in the visible part of the spectrum).

Problem 5

Monochromatic light of wavelength $400\,\mathrm{nm}$ ejects electrons from a metal surface, and a stopping potential of $0.6\,\mathrm{V}$ is required.

1. Determine the metal's work function.
2. Predict the new stopping potential if the wavelength is reduced to $300\,\mathrm{nm}$.

Problem 6

Light of several wavelengths is shone on a clean sodium surface ($\phi = 2.28\,\mathrm{eV}$). The stopping potential for each wavelength is measured:

Wavelength (nm)	300	400	500
V_s (V)	2.9	1.3	0.24

1. Plot V_s versus $1/\lambda$.

2. From the slope and intercept, determine Planck's constant h and the threshold wavelength.