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Exercise 1

a) Define the following radiometric quantities and write explicitly their units of measurement:
   - radiance,
   - irradiance,
   - radiant exitance.

b) Explain what a black body is and write the formula for the spectral radiance of a black body as a function of the wavelength. Explain the importance of that formula.

c) Plot qualitatively the spectral radiance of the black body for a temperature of -10 °C and for a temperature of 6000 °C.

d) Starting from the result of point b), derive the Rayleigh-Jeans formula and explain when and why it can be useful.

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Exercise 2

a) Describe a simple aerial photographic system based on a single lens camera.

b) Explain the meaning and the importance of the speed of a photographic film.

c) Explain the meaning and the importance of the resolution of a photographic film.

d) Obtain a formula for the scale of the images collected by the camera (as a function of lens parameters and platform position).

e) Obtain a formula for the coverage on the ground of the images collected by the camera (as a function of lens and film parameters and platform position).

f) Obtain a formula for the spatial resolution on the ground (as a function of lens and film parameters and platform position). What is the spatial resolution on the ground if the film resolution is 100 lp/mm, the camera altitude is 5 km and the lens focal length is 150 mm?

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Exercise 3

a) Explain the law of gravitation.

b) Explain the meaning and importance of the following types of satellite orbits: polar, geosynchronous, geostationary.

c) By assuming a circular satellite orbit and starting from the basic laws of mechanics:
- obtain a formula for the satellite orbital velocity as a function of its altitude;
- obtain a formula for the satellite period as a function of its altitude.

d) Starting from the results of point c) calculate the period and velocity of the IKONOS satellite flying at an altitude of 680 km (universal gravitational constant $G=6.67\times10^{-11}$ $m^3kg^{-1}s^{-2}$, Earth's mass $M=5.974\times10^{24}$ kg, Earth's radius R=6371 km).