Name: Section:
ID #:

AS 1 Homework # 1 30 points

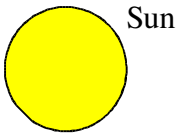
Put all answers to the following questions in the boxes. Show work in the space provided to receive partial credit.

1)

A. (3 points) Suppose we are on an Earth-like planet located at the midpoint between the sun and Earth. What is the solar flux, S, coming in at the top of this planet's atmosphere? Assume the solar flux coming in at the top of the Earth's atmosphere, S_0, is 342 W/m^2.

S=

B. (3 points) For the moment, suppose this planet has no atmosphere. Assume also that this planet's surface, like that of Earth, is reflective of incoming solar radiation resulting in a planetary albedo of 30%. The planet itself also emits radiation according to its temperature. Fill in the schematic diagram that illustrates these flows of radiation, using arrows and labels to indicate upward and downward radiation fluxes.



Planet's Surface

C. (4 points) With no atmosphere, the surface energy balance is simply:

energy absorbed at surface from the sun = energy emitted by the surface.

Using this equation, calculate the surface temperature of this planet.

Temperature=

D. (4 points) What is the wavelength at which most of the energy is radiated from the planet and what form of radiation is this?

Wavelength=
Radiation type:

E. (4 points) How does this compare to the wavelength and form of radiation emitted by the planet Earth?

Earth's wavelength=
Radiation type:

F. (2 points) Is the surface temperature of this planet hotter or cooler than that of Earth?

2)

A. (2 points) The surface temperature in problem 1 was calculated assuming NO atmosphere. Suppose we now introduce an atmosphere to this planet. Like Earth's atmosphere, this planet's atmosphere contains greenhouse gases. What is the equilibrium energy balance equation at the top of the atmosphere?

B. (4 points) Use the equation in part A to calculate the radiation flux emitted by the atmosphere.

Flux=

C. (4 points) The flux you calculated in part B is directed both upwards to space and downwards to the surface. Using this radiation flux and the surface equilibrium energy balance, calculate the new surface temperature when the planet has an atmosphere containing greenhouse gases. Hint: The surface equilibrium energy balance is:

energy absorbed at surface from sun + energy absorbed at surface from atmosphere =
energy emitted by the surface

Temperature =