

ESCI 340 – Physical Meteorology
Answers to Selected Exercises for Radiation Lesson 7

1. Calculate the difference in solar radiation at the top of the atmosphere between perihelion and aphelion.

Answer: ~ 7%

2. a. Find the amount of energy received per square meter in one day at the top of the atmosphere at the latitudes and times in the table below. Assume that $d = d_m$.

Date	Latitude	H	Energy per area per day
Equinox	0	$\pi/2$	$3.75 \times 10^7 \text{ J m}^{-2} \text{ d}^{-1}$
	60N	$\pi/2$	$1.88 \times 10^7 \text{ J m}^{-2} \text{ d}^{-1}$
	90N	$\pi/2$	0
Summer Solstice	90N	π	$4.71 \times 10^7 \text{ J m}^{-2} \text{ d}^{-1}$
	0	$\pi/2$	$3.44 \times 10^7 \text{ J m}^{-2} \text{ d}^{-1}$
	90S	0	0

4. Using the data in the table below, find the solar heating rates (in °C/day) at 5, 15, 25, and 35 km. You can find density by assuming a scale height of 8.1 km and a surface density of 1.23 kg/m^3 . Use $c_p = 1005 \text{ J}\cdot\text{kg}^{-1}\cdot\text{K}^{-1}$.

Altitude (km)	F_{net} (W/m ²)
0	275
10	335
20	345
30	349
40	350

Answer:

Altitude (km)	Density (kg/m ³)	$\partial F/\partial z$ (W/m ³)	Heating Rate (°C/d)
5	0.663	6×10^{-2}	7.8
15	0.193	1×10^{-2}	4.4
25	0.056	4×10^{-3}	6.1
35	0.016	1×10^{-3}	5.4