Questions Chapter 1:

From the text, section 1.7: 1, 3, 4, 5, 10, 11, 14, 15, 16, 18, 19, 21, 22, 23, 25

Question 1.
The 1992 concentration of atmospheric methane was 1.74 ppmv, and the rate constant for the reaction between CH_4 and OH is 3.6 x 10-15 cm^3 $molec^{-1}$ s^{-1}. Calculate the rate, in Tg per year, of methane destruction by reaction with hydroxyl radical, the concentration of which is 8.7 x 10^5 molec cm^{-3}.
The atmospheric mass = 5.1 x 10^{21} g;
Average molar mass of air = 29.0 g $mole^{-1}$ Tg = 10^{12} g. (Ans. 480 Tg)

Question 2.
Given that the atmospheric concentration of N_2O currently is 310 ppbv, and its annual increase amounts to 0.25%, calculate the extent to which the input rate exceeds the output rate. Give your answer in Tg of N_2O in total atmosphere.
The mass of atmosphere is 5.1 x 10^{21} g; average molar mass is 29.0 g mol^{-1}. (Ans. 6 Tg)

Question 3.
Do you think that volcanic eruptions dwarf human sources of carbon dioxide?
To answer this question consider these data:

a. The density of volcanic material ranges from less than 1000 kg/m^3 for pumice and ash to nearly 3000 kg/m^3 for some basalts. A good average for Mt. Pinatubo (a second largest volcanic eruption of the 20th century) is 2000 kg/m^3. Assuming a volume of the erupted material to be 6.84 x 10^9 m^3, calculate how much did the entire eruptive mass weigh? (Ans. 1.37x10^{13} kg)

b. Gas content of volcanic magma typically ranges from less than 0.5% by weight to around 3%; use 1% as a good conservative estimate for Mt.Pinatubo and calculate what was the weight of all the gas emitted by Mt. Pinatubo. (Ans. 1.37x10^{11} kg)

c. The dominant volcanic gas the world over is H2O,and usually the second most abundant is O_2, with a ratio of about 95%-99% H_2O to 1%-5% of O_2; For Pinatubo, the U.S. Geological Survey estimates CO_2 content at 15%. What is the approximate weight of CO_2 from the Mt. Pinatubo eruption?
(Ans. 2.06x10^{10} kg)

d. The total anthropogenic CO_2 is approximately 7.7 billion tonnes (1 tonne = 1000 kg) per year. What percentage of this number is the calculated CO_2 content of the Pinatubo eruption? (ans. 0.3%)

e. How many Mt. Pinatubos would have to erupt to produce 10% of the total annual anthropogenic CO_2?
(ans. 33.3)

f. On the basis of these calculations, do you conclude that volcanic eruptions dwarf human

sources of CO_2? Discuss.

Question 4.
How many kilograms of coral rock would be needed to 'soak up" the CO_2 produced by 1kWh (kilowatt-hour,kWh) of electricity? (Ans. ~2 kg)
Data:
Coral reef rock is made of calcium carbonate.
Producing electricity from coal emits about 900 g of CO2 for each kWh used by consumers.

Question 5.
How much would each 1°C increase in seawater temperature cause the sea level to rise? Express your answer in centimeters. (ans. 73 cm)
Data:
The average ocean depth is 3850 m.
The coefficient of thermal expansion of sea water is 0.00019 °C. Hint: this means that for each 1 degree increase in the temperature, the volume of water will expand by this fraction. Since oceans basins are constrained by their bottoms and sides, the only way to go is up.