

SIO 217A Atmospheric Thermodynamics

General Exam 2007

Remember to show your work. Here are some numerical values, some of which may be useful on this exam:

Average radius of Earth: 6370 km

Mean molecular weight of dry air: 29 g/mole

Mean molecular weight of water vapor: 18 g/mole

Gas constant for dry air: $287 \text{ J deg}^{-1} \text{ kg}^{-1}$

Gas constant for water vapor: $461 \text{ J deg}^{-1} \text{ kg}^{-1}$

Specific heat of dry air at constant pressure: $1004 \text{ J deg}^{-1} \text{ kg}^{-1}$

Specific heat of dry air at constant volume: $717 \text{ J deg}^{-1} \text{ kg}^{-1}$

QUESTION. Water is a unique compound that makes up 0 to 4% of the atmosphere.

Moist air is characterized by relative humidity.

- a. Consider moist air at a temperature of 10°C , a pressure of 800 hPa, and a relative humidity of 20%. The saturation vapor pressure at a temperature of 10°C is 12.3 hPa. Evaluate:
 - i. mixing ratio
 - ii. specific humidity
- b. What is supersaturation? Give an equation that defines supersaturation. What role does it play in the atmosphere?
- c. Aerosol particles play an important role serving as nuclei for cloud droplets. What is Köhler theory? Explain its assumptions and its implications. Draw a diagram showing the relationship Köhler theory predicts for cloud nucleation.
- d. Do you think the average mass of water vapor per unit mass of atmosphere in tropical regions is about the same as in polar regions, or more, or less, and why?