

Exercises

1. A 1.5-kg parcel of dry air is at a temperature of 15°C and a pressure of 1013hPa.
 - a. How many moles of air are in the parcel? (The molecular weight of air is 28.96 g/mol, $R=8.3145 \text{ J/mol.K}$) Answer: 51.80 mol
 - b. What is the volume of the parcel? Answer: 1.22 m³
 - c. What is the specific volume of the parcel? Answer: 0.82 m³/kg
 - d. If 50 KJ of heat are added to the parcel while its volume is held constant, what is the new temperature of the parcel? (The specific heat of air at constant volume is $717 \text{ J kg}^{-1}\text{-K}^{-1}$). Answer: 61.5°C

Notes

to solve (a,b,c) check lecture 5, and to solve part d , find c_v and don't use C_v directly)

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2. A parcel of dry air is at a temperature of 15°C and a pressure of 1013 hPa. Heat is added to the parcel to cause it to expand. It expands at constant pressure to 1.5 times its original volume.
- What is the new temperature of the parcel? Answer: 159°C
 - How much work (per unit mass) was done by the parcel during this expansion?(use gas constant for dry air 287.1 J/kg K Answer: 41.5 kJ/kg
 - What was the change in specific internal energy of the air parcel?
Answer: 103 kJ/kg (use $\Delta u = 5/2 * R_d * \Delta T$)
 - What was the amount of heat per unit mass that was added to the air parcel? Answer: 144.6 kJ/kg

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3. An air parcel is at a temperature of 15°C and a pressure of 1013 hPa . Heat is added to the parcel to cause it to expand at constant temperature until its volume is 1.5 times its original volume.
- What is the new pressure of the air parcel? Answer: 675.3 hPa
 - How much heat per unit mass was added to the air parcel? (use the gas constant for dry air) Answer: 33.5 kJ/kg
 - How much work per unit mass was done in expanding the air parcel? Answer: -33.5 kJ/kg
 - What was the change in specific internal energy of the air parcel?
Answer: 0

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4. A dry air parcel at an initial temperature of 20°C and a pressure of 950 hPa is forced to rise adiabatically up a mountain slope. The top of the mountain is at a pressure of 720 hPa .
- What is the temperature of the air parcel when it reaches the top of the mountain? Answer: -2°C (use one of the poision equations).
 - What is the work done by the air parcel? Answer: -15.8 kJ/kg