ESCI 241 – Meteorology
Answers to Selected Exercises for Lesson 2

1. The specific heat of water at constant pressure is 1 cal g\(^{-1}\) °C\(^{-1}\).
   a. What is the heat capacity at constant pressure of 2 kg of water?
      
      **Answer:** 2000 cal °C\(^{-1}\)

   b. How much energy must be added to 2 kg of water to increase the temperature by 3°C?
      
      **Answer:** 6000 cal

2. How much heat is released by the condensation of 3 kg of water vapor? (The latent heat of vaporization is 600 cal kg\(^{-1}\).)
      
      **Answer:** 1800 cal

3. A 3 kg block of aluminum has a heat capacity (constant pressure) of 2691 J K\(^{-1}\). A 0.5 kg block of beryllium has a heat capacity (constant pressure) of 912 J K\(^{-1}\). Which one has a higher specific heat at constant pressure?
      
      **Answer:** beryllium

4. A 1.5-kg parcel of dry air is at a temperature of 15°C and a pressure of 1013 mb.
   a. How many moles of air are in the parcel? (The molecular weight of air is 28.96 g/mol)
      
      **Answer:** 51.8 mol

   b. What is the volume of the parcel?
      
      **Answer:** 1.22 m\(^3\)

   c. 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 J kg\(^{-1}\) K\(^{-1}\)).
      
      **Answer:**
      \[
      \Delta T = \frac{Q}{C_v} = \frac{50,000 \text{ J}}{1076 \text{ J K}^{-1}} = 46.5 \text{ K}
      \]
      so the new temperature is 61.5°C
d. If 50 KJ of heat are added to the parcel while its pressure is held constant, what is the new temperature of the parcel? (The specific heat of air at constant pressure is 1005 J-kg\(^{-1}\)-K\(^{-1}\)).

**Answer:**
\[ \Delta T = \frac{Q}{C_p} = \frac{50,000 \text{ J}}{1508 \text{ J/K}} = 33 \text{ K} \]
so the new temperature is 48°C