ESS 100 Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hot Air Balloon Calculations **Practice**

Let’s assume that these were the atmospheric conditions when a balloon was flown…

* Classroom temperature = 70°F
* Air pressure = 29.95 inHg
* Dewpoint = 50°F

1. Based on those numbers, what was the density of the air in the room? Use the calculator at <https://www.omnicalculator.com/physics/air-density> to find the answer.

 Air density = \_\_\_\_\_\_\_\_kg/m3

Let’s assume that these data were recorded for the balloon…

* Fill time using the shop vac = 45 seconds
* Envelope and Platform mass = 25g
* String and paper clip mass = 3g
* Fuel mass = 3g
* “Mass lifted” = 15g

Let’s also assume that the fill rate of the shop vac is \_\_\_\_\_\_\_\_ m3 per second.

2. Calculate the balloon volume. [$Balloon Volume = Fill Time ×Fill rate$]. Units should be m3.

For numbers 3-9, suppose that the balloon was actually hovering in the air, free from the ground, with the “lifted mass” attached to its string. In reality, this isn’t much different from what it was really doing.

3. a. If the balloon were really hovering in place, what would the balloon’s overall density be?

 b. How do you know this would be its density?

4. Calculate the balloon’s overall mass [$mass=density ×volume]$. Units should be kilograms.

5. Add up all of the mass in the balloon that was not hot air. $[Non Air Mass=Envelope and Platform Mass+String and Paper Clip Mass+Fuel Mass+"mass lifted"]$ Units should be in grams.

6. Convert the non-air balloon mass (from the previous question) to kilograms.

$$[grams ÷1000=kilograms]$$

7. Calculate the mass of the hot air in the balloon. $[Hot air Mass=Total Mass-Non air Mass]$

8. Calculate the density of the hot air in the balloon. $[Density=mass ÷volume]$

9. What was the temperature of the air in the balloon? Use the calculator at <https://www.omnicalculator.com/physics/air-density> to find the answer. Enter today’s pressure and dewpoint. Then use the “guess and check” method of trying different temperatures until you get the right air density. When you get the right air density, you have found the correct temperature of the hot air.

10. What was your balloon’s actual mass (not including the string, paper clip, and “mass lifted”)? $[Actual Mass=Hot Air Mass+Fuel Mass+Envelope and Platform Mass]$

11. What was your balloon’s actual density? $[Actual Density=Actual Mass ÷Volume]$. How does that compare to the density of the air?