EAS 309 / B3090 Fall 2019

Exam #3 (Take-home).

This exam should be done by you, and you alone. *You may need to look in the book to find the answer for these questions. If you search the web for an answer, make a note of the website where you found it (in case the website is wrong!).*

1. Cloud in a Bottle (10 points)

The table below is meant to have the steps that I took to create a cloud in a bottle on the left, and the analogous physical process in the atmosphere on the right. I have filled in the first step, and a few others, your task is to fill in the blanks in the table.

| Cloud in a bottle | Cloud in nature |
|---|---|
| Add liquid water to the bottle | Imagine you have an air parcel situated over the ocean |
| Strike a match, blow it out, into the bottle | |
| Cork the bottle and start pumping | |
| The cork pops off | |
| Ta-dah!, a cloud forms | A cloud forms |

2. What chemical species in the atmosphere acts like nature's cleaning agent? **Give the symbol and the name (0.5 points each)**

_____ , _____

3. (1 point) What is one physical mechanism (i.e., not a chemical reaction) through which trace gases can be removed from the atmosphere?

_____

4. Use the following equation to answer the next 3 questions:

$$\Delta E = 4\pi R^2 \sigma - \frac{4}{3}\pi R^3 nkT \ln \frac{e}{e_s}$$

(2 points) What does the $\Delta E$ in the above equation represent? (The answer should be specific to the process represented in the equation)

(2 points) What does the first term on the right hand side represent in the above equation represent? (The answer should be specific to the process represented in the equation)

(2 points) What does the second term on the right hand side represent in the above equation represent? (The answer should be specific to the process represented in the equation)

(5) (4 points) Raolt's law states: e'=fe where

*e' = saturation vapor pressure of water adjacent to* ***a solution droplet*** *containing a mole fraction f of pure water.*

e = saturation vapor pressure of water adjacent to a pure water droplet of the same size at the same temperature.

*f* is mole faction of pure water.

What is the significance of this equation, with respect to cloud droplet formation?

(6) (2 points) Explain how to calculate the adiabatic LWC (include a diagram if you want)

(7) (2 points) Explain how entrainment impacts cloud optical thickness

(8) (3 points) Explain why Antarctica has a bigger ozone hole than the arctic

9. (4 points) If cloud droplet sizes start to decrease within a cloud, what are the two possible causes?

10. (2 points) Explain the <u>one</u> reason why the Wegener-Bergeron-Findeisen Process is so effective at growing ice.