Name:_____

Atmospheric Chemistry 2024: Exam Question Assignments

Below is giving the final exam questions from 2019. Please read each question carefully. For each question:

1.) Describe the context of why the question would be important; for example, what field, or area of research, does the question address.

2.) Describe any previous class work or background information you have related to the questions; for example, what class or previous work would provide information related to the topic of the question.

3.) State if you know the answer to the question, know part of the answer, or have no idea how what the answer would be.

1.) Illustrate the amount of SO_4^{-2} dissolved within cloud drops when sulfur dioxide <u>does not</u> dissolved in and react within the drop but only H_2SO_4 dissolves. Illustrate how this compares to the amount of SO_4^{-2} dissolved within cloud drops when sulfur dioxide <u>does</u> dissolved in and react within the drop and also H_2SO_4 dissolves. Include discussion of how long it takes for conversion of SO_2.

2.) Describe the conversion of S(IV) to S(VI) in aerosol particles, cloud drops, and precipitation drops. What is the major result of the conversion? Where is the conversion important? How does conversion of S(IV) to S(VI) change the pH of rainfall?

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3.) Provide an equation for the characteristic time (τ) for diffusion of a solute q through a liquid drop in terms of the drop radius (r). Provide a value for the characteristic time for diffusion within a drop?

4.) Describe the naturally occurring stable isotopes of oxygen in the Earth's atmosphere. What determines the difference between the isotopes? What does the Rayleigh model of vapor depletion of isotopes of oxygen when temperature decreases (for example, in a raising cloud parcel of air) and the fraction of vapor is transferred from the vapor phase to the condensate? What atmospheric process can be investigated using atmospheric measurements of oxygen isotopes?

5.) Describe how Whispering Gallery Modes (WGM), from laser light interacting with vibration modes of molecules, are used in the study of levitating micro-droplet experiments. What size particles and type of particle are used in levitating micro-droplet experiments?

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6.) Discuss the presence and chemistry of neonicotinoid pesticides on atmospheric particles? Why are they important? What is an important measurable property of neonicotinoid pesticides? How long do neonicotinoid-treated seeds affect soil concentrations?

7.) Describe thermogenic methane in the atmosphere. What is the atmospheric life time of methane/ethane and how does it compare to hemispheric mixing times in the troposphere? Discuss the correlation between atmospheric methane and ethane in time.

8.) Based on your understanding of agricultural insecticides (pesticides) and atmospheric aerosol residence times, would you expect insecticides on aerosols particles to have seasonal cycles? Why or why not? Did the Raina et al. 2010 paper that reported on measurements of Organophosphorus Insecticides in the Western Canada Agricultural Region provide evidence of a seasonal cycle for Organophosphorus Insecticides?

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9.) Describe in terms of time and space, the total stratospheric ozone amount for the past 30 years. Provide typical values of the ozone amount, with units, at several key locations. Describe/define the unit of ozone amount used. Describe any season changes in stratospheric ozone.

10.) Describe the Chapman Mechanism for Stratospheric Ozone. How does the Chapman Mechanism agrees with observations. What is the reason for any disagreement between the Chapman Mechanism theory and observations.

11.) What is a box (Eulerian) chemical model? What are the major component of a one-box chemical model? What is a puff (Lagrangian) chemical model?

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12.) Describe in as much detail as possible how radioisotopes can be used to determine the residence time of atmospheric aerosols. List the source of specific radioisotopes that are used in determine atmospheric aerosols residence time. What are the residence times of atmospheric aerosols determined from different radioisotopes?

13.) Provide an illustration of the major atmospheric aerosol modes. Include the size interval of each mode, the sources for each mode, and the sinks for each mode.

14.) Illustrate with a graph the measured concentration of carbon dioxide concentration in the Earth's atmosphere from 1960 to the present. Make sure to label each axis and provide units. Include the location in the atmosphere where the concentration is made and where measurement is valid.

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15.) Use an illustration to show how particle size (both aerosol and droplets) changes with increases and decreases in relative humidity. Define what chemical/physical changes the occur at different relative humidities. Describe how changes in relative humidity affects the visibility in the Earth's atmosphere.

16.) Discuss the atmospheric mixing and residence time of a chemical compound (for example a particle) that is released at the Earth's surface. How does the vertical and horizontal atmospheric mixing change between summer and winter in the United States? How does the mixing change with different times of the day and how this daily affect by season.

17. Discuss the Haber Process (also called the Haber-Bosch Process) for making ammonia. What geochemical reservoir does the Haber Process remove nitrogen from and what geochemical reservoir(s) does the nitrogen end up in? Provide an estimate of the percentage increase in global nitrogen content in the land biota reservoirs and ocean biota reservoirs over the past 100 years? Describe why are the percentage increases similar or different?