Week 3 - Chemistry 14A

Summer A - 2019 (UA: Kate Santoso, Jonathan Pai, Riya Shah)

Practice Midterm

Q1A. A compound found in tea is believed to be a stimulant. Its molar mass is 194.19 g/mol and has a mass percentage composition of 49.47% C, 5.18% H, 28.86%N, and 16.49% O. What is its molecular formula?

Q1B. Calculate the volume needed to make 2.00L of a 0.100 M K_2CrO_4 from 1.75 M K_2CrO_4 stock solution.

Q1C. Write out and balance the following chemical reactions.

Iron rusts in air as a result of a reaction with oxygen that produces iron (iii) oxide (Fe_2O_3).

Isopropyl alcohol (C3H8O), more commonly known as rubbing alcohol combusts with oxygen to produce carbon dioxide and water vapor.

Q2A. Aluminum and hydrogen chloride, HCI, react to form aluminum chloride, $AlCl_3$ and hydrogen gas. If there are 54.3g of aluminum and 78.0g of HCI in the reaction container, determine the limiting reagent in the reaction and the mass of $AlCl_3$ produced.

Q3A. A newly discovered metal is determined to have a work function of 5.98 X 10^-18 J. If the ejected electron is traveling at 2.01 X 10^6 m/s, what is the wavelength of the incident photon?

Q3B. What is the minimum uncertainty in the speed of an electron confined to within the diameter of a tin atom which has a diameter of 145 pm?

Q4A. A lamp rated at 32W (1W = 1J/s) emits violet light of wavelength 420. Nm. How many photons of violet light can the lamp generate in 2.0s?

Q4B. Which member of each pair has the *smaller* first ionization energy? Circle your answer.

a) Ca or Mg b) Mg or Na c) Al or Na

Q4C. Give the ground-state electron configuration for iodine.

Q4D. For an electron in a d-orbital, what values can m_l have?

Q4E. What ion with a +1 charge is predicted to have the following ground-state electron configuration? [Ar] $3d^{10}4s^{2}4p^{3}$

Q5A Biological Application: DNA structure is one of the key features that is essential to organic life. However, DNA structure can be harmed by medical practices such as X-Rays where the DNA gets ionized, resulting in bond breakage and mutation. Assuming an X-Ray is 500. eV and targets a guanine base which would have a radiation threshold of 7.21x10^-17 J, what is the wavelength of the X-Ray radiation and how much excess energy was there that could have contributed to mutation?

Q6. When ultraviolet radiation is directed at an atom or molecule, electrons can be ejected from the valence shell, and their kinetic energies are measured. Because the energy of the incoming ultraviolet photon is known and the kinetic energy of the outgoing electron is measured, the ionization energy, I, can be deduced from the fact that the total energy is conserved.

Q6A. Explain, comment, and show that the speed of the ejected electrons and the frequency of the incoming radiation are related by $E = h\upsilon = I + \frac{1}{2} m_e v^2$.

Q6B. Calculate the ionization energy of a rubidium atom, given that radiation of wavelength 58.4 nm produces electrons with a speed of 2450 km/s. ($1J = 1kg.m^2/s^2$).