

Chem 14A Midterm Practice

Go to Dr. Lavelle's Website for the "**Constants and Equations**" sheet.

Disclaimer: This practice test is a *supplement* to your studying, not a replacement. It was *not* created by Dr. Lavelle and does *not* necessarily cover everything you need to know. Full solutions will not be posted. **SEE LAST PAGE**

1. Isopropyl alcohol, used in rubbing alcohol, is a compound containing only C, H, and O. What is the empirical formula of isopropyl alcohol if you find that 0.255 g of the compound gives 0.561 g of CO₂ and 0.306 g of H₂O when burned completely in excess oxygen?

2. Glycogen is used as energy storage and can be broken down into glucose when needed. Glycogen's mass composition is C 43.2% H 6.35% O 50.4% and has a molar mass of about 667 g.mol⁻¹. What is its molecular formula?

3. Ammonia (NH_3) reacts with oxygen (O_2) to form air pollutant nitrogen oxide (NO) and water. Determine the theoretical yield of NO if 21.1 g NH_3 is reacted with 42.2 g O_2 .

4. What volume of 0.0380 M KMnO_4 is needed to prepare 250 mL of 1.50×10^{-3} M KMnO_4 ? (Hint: In these types of problems, the volume containing solute is diluted with water to the final volume, in this case 250mL)

5. (Spring 2018 Midterm) Potassium permanganate, KMnO_4 , is an inorganic chemical compound used for cleaning wounds. 5.00 g of KMnO_4 is dissolved in a 150.00 mL flask of water. If 20.00 mL of this solution is removed and placed in a new 2nd 250.00 mL flask and filled with water, what is the concentration of the solution in the 2nd flask? (5pt)

Molar Masses: K (39.10 g/mol) Mn (54.94 g/mol) O (16.00 g/mol)

6. a) A new element GarBreadium is discovered to have molar mass $3.157 \text{ g}\cdot\text{mol}^{-1}$. The GarBreadium atom travels at an average speed of $1.35 \times 10^3 \text{ m}\cdot\text{s}^{-1}$ at room temperature. What is the average wavelength of the GarBreadium atom at room temperature?

6. b) If a Helium atom traveled at the same speed as a GarBreadium atom, which would have a longer de Broglie wavelength? Explain without numerical calculations.

6. c) True/False: Longer wavelengths correspond with higher frequency.

6. d) True/False: The GarBreadium atom exhibits measurable wavelike properties.

7. Write a balanced combustion reaction for solid nicotine ($\text{C}_{10}\text{H}_{14}\text{N}_2$). (Hint: The reaction produces N_2 gas)

8. a) Write an equation using **words only** that captures the conservation of energy in the photoelectric effect. Describe the conceptual change that arose from the photoelectric experiment and discuss how intensity plays a role.

8. b) A newly designed laser pointer with a certain frequency is pointed at a sodium metal surface. An electron is ejected from the metal surface with wavelength 1.10 nm. What is the frequency of the light from the laser pointer? The work function of sodium is $150.6 \text{ kJ}\cdot\text{mol}^{-1}$.

8. c) Can students see the laser pointer color?

9. a) Write the electron configuration (abbreviated form) of Ni^{3+} .

9. b) Write the electron configuration (abbreviated form) of Chromium.

9. c) What element has a cation with a +1 charge and electron configuration $[\text{Ne}]$?

9. d) What ion has a +2 charge and electron configuration $[\text{Ar}] 3d^7$?

9. e) What is the subshell notation (e.g. 2p) and the total number of orbitals having the quantum numbers $n=3$, $l=2$, for a given element?

9. f) How many electrons can have the quantum numbers $n=3$, $l=1$?

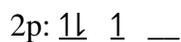
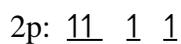
9. g) Circle two ions that are isoelectronic with F^-



9. h) Which elements can have valence electrons with the quantum numbers $n=2, l=1$?

9. i) Write the full electron configuration for oxygen in the ground state and state the number of unpaired electrons.

9. j) Which rule does each electron configuration structure violate when filling the 2p state?



10. a) Which atom has a larger atomic radius, Aluminum or Silicon? Explain why and be sure to mention the effect of electrons on size of atoms.

10. b) Arrange S^{2-} , Cl^- , and P^{3-} in order of increasing ionic radius.

10. c) Which has a higher electron affinity, chlorine (Cl) or Neon (Ne)?

10. d) Rank the following in order of increasing ionization energies: C N O F

11. a) An excited hydrogen atom undergoes an electronic transition from $n=3$ to $n=1$. Calculate the frequency of the photon emitted.

11. b) If a hydrogen electron goes from $n=6$ to $n=4$, will ΔE be negative or positive? Will the energy of the photon emitted be negative or positive?

12. a) Draw the lowest energy Lewis structure for $(\text{NH}_2)_2\text{CO}$.

12. b) Draw the lowest energy Lewis structure for ClO_4^- .

12. c) Draw the lowest energy Lewis structure for N_2O with N as the central atom.

13. This question draws from several concepts. This will *not* look like any of your actual midterm questions but is intended to help you connect concepts.

a) Lyndon finds a newfound love for bananas. He buys 4 bunches of bananas but Hannah steals them and quickly eats them all in one hour. As a result, Hannah has potassium ions shooting out of her body. Lyndon thinks hes premed, and brings her into a lab, but instead of examining her health, he measures the wavelength of each potassium ion to be 11.23 nm. What is the kinetic energy of one potassium ion?

b) Matt walks in, hoping to absorb some of the potassium ions in the air to alleviate his cramps. He thinks to himself, "I wonder what the frequency of the potassium ion is?" and divides the speed of light by the wavelength to obtain a frequency of 2.671×10^{16} Hz for each potassium ion. Is he correct? Explain.

c) Lyndon gets so angry at Matt's mistake that he throws a rock at him that weighs 2.8g with a whopping speed of $373.23 \pm .34$ m/s. What is the indeterminacy of position of the rock?

d) Hannah thinks to herself, "Wow Lyndon must think he's soo smart" and seeing potassium ions everywhere, she challenges Lyndon to a question: Does potassium have the same valence shell electron configuration as Sc^{2+} ?

e) Kate has been watching this whole time and tries to take a picture of the whole scene, but her camera's flash is violet-colored. Lyndon is worried that the flash will remove electrons from his metal statue of Dr. Lavelle that has a work function of 348 kJ/mol. Should Lyndon be worried at all?

Final Note: While I tried my best to include as many concepts and types of questions that I could on this practice packet, there is no way I can cover everything. Most of the questions here are derived from past exams, and I tried to combine the trickiest parts of different questions together to expose you to as much as possible. Use the course outlines and make sure you know everything it says to know! When doing problems, make sure you know the concepts behind it first, don't just solve things like a robot.

Please also keep in mind, this a packet of practice problems. This is not at all indicative of the length or format of your actual midterm. This packet should take longer than the actual midterm. However, if I did a good job, you can expect to see questions that look and/or are solved similar to the ones here.

I will be going over this practice during my review session. This year, several new UA's will be joining to teach during the review session. In the past, my review sessions have been in lecture halls like CS50 but seats can run out. The actual date and location will be posted on chem community and on Dr. Lavelle's website soon. During my review session, we will always go over the concepts first, then work through the problem step by step, ask for questions, then discuss any tips and tricks for related questions you might see on the exam. I do not post full solutions, so the review session is the only place to see problems worked through and explained thoroughly. If you cannot attend, ask a friend for their notes.

Always pay close attention to units and do not panic if you have no idea how to answer a specific question. Write out what is known, what needs to be known, and what formulas may apply. Everyone has the potential for an A! Good luck:)

-Lyndon Bui