9/16/25 Exam
Mcq questions

1. Given 4 elements which has the smallest radius
2. Work on surroundings question
3. Question involving Delta H fusion
4. Shown a potential energy graph and asked to identify which letter represents activation energy
5. Limiting reagent problem
6. Calculating number of molecules using Avogadro's number
7. Phase diagram, identify where sublimation occurs
8. Identify where melting occurs in a heating curve
9. Heat of formation
10. Hess law
11. Bond enthalpy
12. When is tidal power not effective
13. Balancing half redox
14. Know difference between Bronsted Lowry, Lewis, and Arrhenius Acids/Bases
15. Determine which solutions would be used to create a buffer with a pH of 4.7
16. Know what happens at absolute zero
17. Half life problems, many conceptual problems such as asking purpose of radiocarbon dating, gamma radiation, and nuclear fusion
18. Lewis diagram of carbon monoxide
19. Which beaker has a faster dissolution and why. Ans: beaker with powder chunk
20. Purpose of proton gradient in ETC
21. Ideal gas law equation
22. Balancing reactions and determining coefficients
23. Know the definition of covalent bond

Short Answer questions

1. Check 6/27 FRQs

8/16/25 the calculator and periodic table are not part of the tutorial, you just have to start your exam without any mention of them at all and then figure out where they are after your time has begun
Essay questions: 1. Given the melting points of RbI, NaOh, and MgO. Using your knowledge of intermolecular forces, explain why the melting points of these compounds go in that order.

ANS via chatgpt: NaOH has the lowest melting point because its OH^- anion is polyatomic and forms hydrogen bonding, which is weaker than strong ionic lattices. RbI has a higher melting point since it is held together by ionic bonding between Rb^+ and I^-. MgO has the highest melting point because the Mg^{2+} and O^{2-} ions create very strong ionic bonds due to their higher charges and smaller sizes.

2. Shown an exothermic reaction graph with its quantities and the equation: explain why this is an exothermic graph and what effect the catalyst has on the reaction and what, specifically, the catalyst does.
3. Given a calorimeter. Add 0.40 g of NaOH to a 100mL of .10M HCl. Had a graph of the temperature over time. Give the reaction. Explain why the temperature goes sharply up and then starts to go down. Calculate the overall enthalpy given the c and density of water.
Given a heat curve, asked where the potential energy was increasing
Given the phase diagram of water and asked where the density increases
Calculate % ratio between gases under two different pressures

Gas laws, hardly any VSEPR, maybe one nuclear question (what happens during fission/fusion is energy released with increase of mass or decrease of mass??)
One moles to atoms conversion
Given four different medications derived from natural sources, one was a pit viper and others were plants. Asked to draw conclusion from table multiple choice re: a) economy of rainforest countries b) importance of not destroying rainforests c) something incorrect and d) synthetic meds can be derived from natural materials
High # of calculations, just ran out of time trying to do all the math. In 9/16 test
Had the question about methane as a greenhouse gas and I don't understand why the answer is "gas at ambient temp" and not "absorbs UV rays" (got that one wrong, I guess) In 9/16 test

7/17/25 H2S VSEPR shape
Two liquid tubes heated, why is one higher than the other (answer is due to temp increasing kinetic energy of molecules)
__mL of a compound. find the number of moles of a 0.25 M HCL solution.
Overall Hess' law shows up of two equations
What first causes ATP to be made in photosynthesis? Confused between leaves receiving thermal energy and radiation absorbed by chlorophyll
Explain the electron configuration of the periodic table and the trends of electronegativity. Which of the experiments is the first experiment to determine the nucleus? Rutherford gold foil
Given kb values which ionizes the best
8/16/25 Given two balanced half redox equations, what do you need to put coefficient in one to make it equal

8/16/25, 7/3/25, 8/23 - if looking for a buffer around 4.7 pH, which of a list of compounds would you choose - given H+ concentration of 4 options
9/2 (short answer)--Be able to draw glycine and the polymerization of glycine + drawing of how peptide bonds are formed with 2 glycine molecules
Ka= Products/reactants [product][product]/[reactant][reactant] 8/16/25-the answers were all exponents with have to then multiply and square them. Couldn't get it to work on the calculator (ex 2.8x10-4)2 x (1.17x10-3)4
Lewis Dot Structures recognize correct lewis dot structure given 4 samples 8/23 9/2 CO2
Shape of a molecule - bent, linear, etc… 9/2
What will happen(molecules) when the temperature is absolute zero!!
8/23 9/2 Know the difference of Arrhenius vs Bronsted-Lowrey descriptions of pH
8/16/25, 8/23 another phase diagram - identify the place where sublimation is occurring
Radioactive Decay: protons/atomic # Recognize when decay produces an Alpha particle, beta particle, gamma ray, Know about Gamma rays 8/23 9/2

- Fusion in the sun question asks what causes fusion to occur in the sun - multiple choice answers - plasma convection currents, neutrinos in the core, extreme heat in the core (ANS) or magnetic forces?8/23 7/18 8/16

Why:

- The Sun's core reaches about **15 million °C** with extremely high pressure.
- This heat gives hydrogen nuclei (protons) enough **kinetic energy** to overcome their natural electrostatic repulsion (**Coulomb barrier**) and collide forcefully enough for

nuclear fusion to occur.

- The main fusion process in the Sun is the **proton–proton chain**, turning hydrogen into helium and releasing energy.

- What is the purpose of the electrons carried by NAD and FAD2 in the mitochondria. (They are dropped off at the Electron Transport Chain, purpose is to charge ADP + P to make ATP)
  - ANS: **In short:** NADH and $FADH_2$ are like "charged batteries" that carry high-energy electrons to the ETC. Their electrons' energy gets converted into a proton gradient, and that gradient powers **ATP synthesis**.

Shown an amino acid (recognizable by it's amino group - NH3) what kind of biomolecule will it make - answer is proteins (or polypeptides) 9/16

8/23 9/2 9/16 Neutralization reaction - recognize given 4 reactions, which one is a neutralization reaction

8/23 9/2 why is liquid NO2 higher Boiling Point than liquid N2? They have exact same bonds. But NO2 is polar, N2 is not. Dipole-dipole interactions cause more attractions between CO2 molecules therefore boiling point is delayed/higher.

7/18 8/16 What is the correct molecular compound for butane? Multiple Choice question C4H10

7/18 Explain how elements are arranged on the periodic table in relation to electron configuration patterns.

8/23 9/2 Why is Methane an important greenhouse gas? Gas at ambient temps, central C molecule, absorbs UV rays

Polypeptides and the molecular geometry of glycine 9/2 short answer question

9/2 7/18 Thermal heat of Granite, Oak, Ceramic

(Short answer) Explain how Oak and Ceramic are the same temperature but why one is able to absorb heat faster than another. Given: chart of specific heat capacities

7/18

6/27

FRQ: 9/16 test

1) given multiple Molarity concentrations…asked to identify the relative pH (ex .1M of strong acid) and give an explanation why.
2) VSEPR (had to draw Lewis structure of… Nh3, CH4, H2O and CO2) and say what shape and if it is polar or non polar and explain
3) Needed to explain one reaction or process in which we get energy from the sun, discuss why silicon crystal structure is good for solar energy, and one pro that solar energy has when thinking of environmental impact

Most of these other comments helped with the exam too, it seems like they reuse many MC questions.

06/17 Common points of interest found on Chemistry CSET

- Molecular Geometry and hybridization
- Polar vs. nonpolar bonds
- Molarity of acids and bases: differences and similarities
- Calculations / conversions
- Enthalpy: Graphs, etc.

- Exothermic vs endothermic: reactions, graphs, equations
- Nuclear fission vs Nuclear Fusion: Differences and Similarities, advantages and disadvantages, results of production and usage, radioactivity
- La Chatelier's Principle
- Pressure vs. Temperature
- Gas Laws with calculations
- Balancing Chemical Equations
- Equilibrium: Equations and reactions
- Molecular state during dissolving
- Enthalpy reactions
- Hydration vs. Oxidation reactions: Differences and similarities, usages
- Acids vs. bases

8/23 Comments from a participant who just took the CSET test really really really recently
9/2/2023

Grading for the CSET Chemistry subtest is as follows. Total score possible is 300. Passing is 220. There are 50 Multiple Choice Questions worth 80% of the total score. There are 3 Constructed Response Questions worth 20% of the total score. Test time is 2 hours.

Implications: Based on the % weight each MC question is worth 4.8 points and each Constructed Response question is worth 20 points. So you should allot 1.9 min per MC question and 8 min per Constructed Response question. Of course some questions are easy, giving you more time for the more difficult ones.

9/2 7/18 (short answer)--Be able to draw glycine and the polymerization of glycine + drawing of how peptide bonds are formed with 2 glycine molecules
Hydrogenation of ____ (can't remember of what)
8/23 in Quantum model of atom, what does electron look like?

Calculator -scientific Notation
Enthalpy calculations - chart given, but multiple questions Several of these in 8/23 9/2 7/18 8/16/25
Molar Concentration (amount of X grams into various mL of solutions also in 8/23 9/2
8/23 9/2 Calculate equilibrium constants
8/23 9/2 Know if an equation will move to the right or the left if you increase volume, increase pressure and if you add product
8/23 9/2 Know the difference of Arrhenius vs Bronsted-Lowrey descriptions of pH
pH calculations, what is the concentration of of H+ in X solution (in 8/23 -simple conversions from H+ concentration to pH)
8/23 - if looking for a buffer around 4.7 pH, which of a list of compounds would you choose - given H+ concentration of 4 options
What is the pH of Example: $3.0*10^{-7}$
Solutes vs. solutes - saw this Q also in 8/23
Phase diagrams: what is happening at each phase - 8/23 identify where on the heating and cooling curve melting is occurring

8/23 7/18 another phase diagram - identify the place where sublimation is occurring
Most questions were about nuclear, pH, and enthalpy (lots of various enthalpy and entropy knowledge)
VSEPR - needed for one question 8/23 - two questions about molecule 3D structure- CO2 and SO2?
7/18 Very little about Gas laws, but needed to know about 1 mol/22.4 L
8/23 H2O orbital hybridization
Beta particles: B+, B-
Ka= Products/reactants [product][product]/[reactant][reactant]
Lewis Dot Structures recognize correct lewis dot structure given 4 samples 8/23 9/2 CO2
Shape of a molecule - bent, linear, etc… 9/2 7/18
Radioactive Decay: protons/atomic # Recognize when decay produces an Alpha particle, beta particle, gamma ray, Know about Gamma rays 8/23 9/2 7/18
Molarity calculations: how many grams of Y are needed to make .5 M of X?
7/18 How would you separate a solution from water, close densities, differing masses, and something else…
Which would work best? electrolysis, filtration, centrifuge...
7/18 PPM calculations
7/18 Where on the graph is activation energy displayed.

Written Response These 3 questions are the same as I had in 8/23

1. Add Potassium Nitrate to water, explain what happens and how you could speed it up?, Define solute and solution
2. Molecular formula: draw an organic chemical and explain how the process of the molecules hydrate Draw Ethane, Ethanol and Ethanoic Acid. Describe hydration of the above molecules and any catalysts or other reactants. Same question with oxidation of molecules and catalysts or reactants.
3. Combustion Bonding: why is the energy to break the bonds greater in the reactants than the formation for the products Given a list of bond energies determine the overall change in energy in the system. Why is breaking bonds always endothermic and making bonds is always exothermic?

Humans exhale carbon dioxide when they breathe. If the concentration of carbon dioxide in the air that people breathe gets too high, it can be fatal. Therefore, in space shuttles, submarines, and other sealed environments, it is common to use "air scrubbers" to remove carbon dioxide from the air. The air scrubbers on the space shuttle remove carbon dioxide by using lithium hydroxide (LiOH). The reaction in the air scrubbers is shown below:

$CO_2 + 2LiOH \rightarrow Li_2CO_3 + H_2O$

Each astronaut produces 8.8×10^2 g CO_2 per day that must be removed from the air on the shuttle. If a typical shuttle mission is 9 days, and the shuttle can carry 3.50×10^4 g LiOH, what is the maximum number of people the shuttle can safely carry for one mission?

Consider the following chemical reaction of bromothymol blue indicator. It appears yellow in undissociated form and blue in its dissociated aqueous solution.

$$\underset{\text{yellow}}{HC_2H_3O_2(aq)} \Leftrightarrow H^+(aq) + \underset{\text{blue}}{C_2H_3O_2^-(aq)}$$

What will be the color of the solution if a large amount of H_2CO_3 is added?

Calculating the amounts of Reactants and product in reactions involving a limiting reactant:

A. How many grams of solid aluminum sulfide can be prepared by the reaction of 10.0g aluminum and 1 5.0g sulfur?How much of the non-limiting reactant is in excess?

Collecting gas over water, given vapor pressure, total pressure, asking the pressure of the gas
8/23 9/2 had this question - Calculate gas pressure of H gas collected over H2O. Given vapor pressure.
Which of the experiments is the first experiment to determine atom structure
What will happen(molecules) when the temperature is absolute zero!! Yes glad I read this question as it was on the test 8/23 9/2
Ratio of effusion-Graham's law calculation
Explain the process of dissolution of an ionic compound at molecular level, and explain two ways to speed up the process
How to produce organic compounds from crude oil? - distillation?
Given moles of different compounds, each Ka or Kb, asking which one has the highest H+ or pH
Gibbs free energy, change in enthalpy, change in entropy, low/high T determine whether spontaneous
Given bond energy and chemical equation, determine exothermic or endothermic, explain how catalyst will influence the reaction
Balance redox equation - asking how many charges are changed or something similar
Below - this was an essay question on 8/23 - see earlier description
Draw molecule structure, ethene, ethanol, acetic acid. Write the Chemical reaction: ethene -hydration->ethanol, ethanol -??-> acetic acid. Write the condition of the reaction.
Glycerol -> lipids
Fusion in the sun question asks what causes fusion to occur in the sun - multiple choice answers - plasma convection currents, neutrinos in the core, extreme heat in the core or magnetic forces?8/23
8/23 9/2 9/16Nuclear energy why better than fossil fuels (choices - easier to control, easy to dispose of waste products, denser Energy form…)
8/23 9/2 Organic chem questions
What is the purpose of the electrons carried by NAD and FAD2 in the mitochondria. (They are dropped off at the Electron Transport Chain, purpose is to charge ADP + P to make ATP)
Shown an amino acid (recognizable by it's amino group - NH3) what kind of biomolecule will it make - answer is proteins (or polypeptides)
8/23 9/2 Neutralization reaction - recognize given 4 reactions, which one is a neutralization reaction
8/16/ 25 8/23 Butene formula
8/16/25 8/23 Balance a redox equation (need to balance the electrons)
8/23 9/2 9/16 why is liquid CO2 higher Boiling Point than liquid N2? They have exact same bonds. But CO2 is polar, N2 is not. Dipole-dipole interactions cause more attractions between CO2 molecules therefore boiling point is delayed/higher.

8/23 9/2 Why is Methane an important greenhouse gas? Gas at ambient temps.
8/23 9/2 What is the drawback for using Tidal energy - inclement weather was one option, but I think the answer was that there are few locations along shorelines where the tidal exchange is significant enough to create energy

8/23 9/2 recognize on a graph of an exothermic reaction, the part of the graph representing the energy of activation
8/23 shown a table of medications, what plant they came from and what disease or condition they treat - choose which multiple choice answer is illustrated by the information given (possible answers were - some countries benefit financially from discoveries of medicinal plants, we should save the rainforest because MANY diseases are cured by medicinal plants, Synthetic medications are based on naturally occurring… (can't remember the 4th option, but 3 of them were not really addressed by the data given.)

Draw the hydration of ethene. Then the esterification with acetic acid. See above essay question.

Polypeptides and the molecular geometry of glycine 9/2 short answer question
9/2 Thermal heat of
-Granite
-Oak
-Ceramic
(Short answer) Explain how Oak and Ceramic are the same temperature but why one is able to absorb heat faster than another. Given: chart of specific heat capacities

Lots of pH and acid base stuff
Lots of organic
Density
2 redox questions
Nothing on balancing or stoich
9/2 3 or 4 half life questions The half life questions on 8/23 were all whole numbers. Didn't have to calculate partial half lives. 1. Was how much substance remaining after 10 multiples of half lives. 2. How many years have passed with the amount remaining?
9/2 Periodic trends - 8/23 size of nucleus compare Na and P in row 2

FRQ: one about water's hydrogen bonds vs its covalent bonds. Know density and water's states of matter.
VSEPR know how to draw shapes from name; polarity
Nuclear chem: know how to write all reactions.

Practice on the TI-30XS virtual calculator
1) https://www.ctcexams.nesinc.com/PageView.aspx?f=HTML_FRAG/GENRB_CBTTutorials.html
2) Click on Interactive CBT Tutorial
3) Click "Next —>" (lower right)
4) Click "Navigator" (lower right)
5) Scroll down and click "On-screen Scientific Calculator"
6) Click "Calculator" (upper left)

Sample of entering in Avagodro's number in scientific notation on the TI-30XS virtual calculator:

1) Press the '(' key
2) Enter 6.022 using the keyboard on the computer where you are taking the test.
3) Press the 'x10^{N}' key

4) Enter -23
5) Press the '>' (i.e. right arrow) key
6) Press the ')' key

Changing mode to degrees on the TI-30XS virtual calculator:

1) Press the "mode" key
2) Use the up, down, right, and left arrow keys to select "DEG"
3) Press the "enter" key
4) Press the "2nd" key and then "quit" key

Changing mode to scientific notation on the on the TI-30XS virtual calculator:

1) Press the "mode" key
2) Use the up, down, right, and left arrow keys to select "SCI"
3) Press the "enter" key
4) Press the "2nd" key and then "quit" key

Square root of 60:

1) Press the "2nd" key and then square root key
2) Enter "60"
3) Press the "enter" key
4) Press the "< >" key (above the "enter" key)

Per a document on the internet at ctcexams.nesinc.com (searching for Score Reports) which was revised 10/22…

🧪 Chemistry CSET Study Guide

I. Test Overview

- Total Score: 300 points
- Passing Score: 220
- Question Breakdown:
  - 50 Multiple Choice Questions (MCQs) — 80% (4.8 points each)
  - 3 Constructed Response (CR) Questions — 20% (20 points each)
- Test Duration: 2 hours
- Recommended Time Management:
  - ~1.9 minutes per MCQ
  - ~8 minutes per CR question

II. Key Chemistry Topics

A. Atomic Structure & Periodic Table

- Quantum model of the atom

- Periodic trends (atomic radius, electronegativity)

- Electron configuration

- Scientists: Dalton, Thomson, Millikan, Rutherford, Bohr, Einstein

B. Chemical Bonding & Molecular Structure

- Lewis Dot Structures: Practice with CO_2, H_2O, NH_3, CH_4

- VSEPR Theory: Determine shapes and polarity (linear, bent, tetrahedral, etc.)

- Hybridization: Know orbital types (e.g., sp^3 for CH_4)

- Polarity: Polar vs. nonpolar molecules and bonds

C. Thermochemistry & Energetics

- Enthalpy (ΔH): Identify exothermic vs. endothermic

- Entropy (ΔS) & Gibbs Free Energy (ΔG): Predict spontaneity

- Bond Energy: Use bond enthalpies to calculate net reaction energy

- Specific Heat: Compare substances like oak vs. ceramic

D. Acids, Bases & pH

- Arrhenius vs. Brønsted-Lowry definitions

- pH & $[H^+]$ Calculations: Use $-\log[H^+]$

- Buffer Systems: Identify correct buffer around target pH

- Ka/Kb & Equilibrium Constants

- Neutralization Reactions: Recognize complete acid-base neutralization

E. Solutions & Molarity

- Molarity: Calculations involving mass, volume, mols

- Solubility: Ionic compound dissolution at the molecular level

- Dilution & concentration changes

- Colligative properties overview

F. Chemical Reactions

- Types: Synthesis, decomposition, combustion, redox

- Balancing: Especially redox reactions

- Limiting Reactants: Mass-mass stoichiometry

- Catalysts: Effect on activation energy and reaction rate

G. Gas Laws

- Ideal Gas Law (PV=nRT)

- Collecting gases over water (subtract vapor pressure)

- Graham's Law of Effusion

- Avogadro's Law: 1 mol gas = 22.4 L at STP

H. Equilibrium & Reaction Direction

- Le Chatelier's Principle: Effects of volume, pressure, concentration

- Writing equilibrium expressions

- Predicting reaction shifts

I. Nuclear Chemistry

- Decay Types: Alpha, beta (β^+/β^-), gamma

- Fission vs. Fusion: Differences, advantages, energy yield

- Half-Life Calculations: Mass remaining or time elapsed

- Nuclear Reaction Balancing

III. Organic & Biochemistry

- Recognize and draw: Ethene, Ethanol, Acetic Acid
- Functional groups: Alkene, Alcohol, Carboxylic acid
- Glycine and peptide bond formation
- Combustion of hydrocarbons
- Hydration, Oxidation, Esterification, Polymerization
- NADH and $FADH_2$ role in ETC (Electron Transport Chain)
- Proteins from amino acids
- Glycerol in lipid formation

IV. Real-World Chemistry Applications

- Solar Energy: Silicon's crystal structure advantages; carbon-neutral energy
- CO_2 Scrubbers: $CO_2 + 2LiOH \rightarrow Li_2CO_3 + H_2O$ (used in space)
- Organic Compound Production: From crude oil via distillation
- Environmental Chemistry: Methane as greenhouse gas; Tidal energy limitations

V. Experimental Design & Lab Skills

- Separation Techniques: Filtration, distillation, centrifugation, electrolysis
- Phase Diagrams: Identify phase changes (melting, boiling, sublimation)
- Heating Curves: Interpret temperature vs. time graphs
- Density & Specific Heat: Explain why different materials heat differently

VI. Sample FRQs (Free Response Questions)

1. Bond Energy & Reaction Thermodynamics
 - Explain why breaking bonds is endothermic; forming bonds is exothermic
 - Calculate net energy using bond enthalpies

2. Organic Reactions
 - Draw and describe hydration and oxidation of ethene → ethanol → acetic acid
 - Identify reactants, products, catalysts
3. Solubility & Solutions
 - Explain what happens when a salt like KNO_3 dissolves in water
 - Suggest methods to speed up dissolution (e.g., stirring, heating)
4. Water's Properties
 - Compare hydrogen bonds vs. covalent bonds in H_2O
 - Discuss implications for water's density, boiling point, and phase states