


Midterm Exam Review: Honors Chemistry

All problems must be worked out by hand on paper and work shown.

Use dimensional analysis for any unit conversions.

Topics:

Unit 1: Measurement and Data Analysis

- Understand how to take accurate and precise measurements with different instruments
- Understand the metric system for units and conversions between units and scientific notation
- Understand the concept of uncertainty, including percent error, significant figures, precision/accuracy
- Understand how to read a graph, determine slope, and meaning/significance of slope
- Understand how to use dimensional analysis to convert between units
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Unit 2: Matter and Energy

- Understand how matter is classified (lots of vocab here – i.e. chem./phys changes, homo vs. heterogeneous mixtures, pure substances, elements, compounds)
- Identify mixtures/pure substances from particle diagrams
- Density – know concepts as well as math problem solving
- Temperature – know concepts as well as math problem solving
- Understand how energy is transferred – concepts as well as math problem solving (endo vs. exothermic processes, specific heat capacity, calorimetry)
- $Q = m C_p (T_{\text{final}} - T_{\text{initial}})$

Unit 3: The Structure of the Atom

- Know contributions of early scientists to atomic theory
- Understand the difference between atoms, isotopes, and ions
- Know how to use the periodic table to determine # of protons, neutrons, electrons, predict charge, and electron configuration
- Understand the difference between mass # and atomic mass
- Understand how to calculate average atomic mass
- Understand nuclear reactions, nuclear particles, half-life calculations and graphs

Unit 4: The Periodic Table

- Name and identify the groups (families) on the periodic table
- Define atomic radius, ionic radius, metallic character, shielding effect, ionization energy, and electronegativity
- Identify patterns in periodic trends when moving left to right across a period
- Identify patterns in periodic trends when moving up or down a group

Unit 5: Chemical Bonding and Nomenclature

- Understand how to name and write formulas for ionic compounds and covalent compounds
- Understand the effects of periodic trends on bonding patterns (what determines whether a bond will be polar, nonpolar, or ionic)
- Know how to draw Lewis Structures for atoms, molecules, and ions
- Understand the difference/similarities between ionic, covalent, and metallic bonding

Periodic Table of the Elements
For Assessments Based on the 2010 Chemistry Standards of Learning

Periodic Table of the Elements																									
Group																		Atomic mass = 28.0855							
1																		Symbol = Si							
2																		Atomic number = 14							
																		Name = Silicon							
																		6.9590 He Helium							
1		2		Transition Elements										13	14	15	16	17	18						
3		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20							
H 1 Hydrogen		Li 6.941 Lithium	Be 9.012 Beryllium									B 10.811 Boron	C 12.011 Carbon	N 14.007 Nitrogen	O 15.999 Oxygen	F 18.998 Fluorine	Ne 20.180 Neon	Na 22.990 Sodium	Mg 24.305 Magnesium						
4		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20						
Na 22.990 Sodium		Mg 24.305 Magnesium	Al 26.982 Aluminum	Si 28.086 Silicon	P 30.974 Phosphorus	S 32.06 Sulfur	Cl 35.45 Chlorine	Ar 39.948 Argon	K 39.098 Potassium	Ca 40.078 Calcium	Sc 44.956 Scandium	Ti 47.88 Titanium	V 50.942 Vanadium	Cr 51.996 Chromium	Mn 54.938 Manganese	Fe 55.845 Iron	Co 58.933 Cobalt	Ni 58.69 Nickel	Cu 63.546 Copper						
5		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20						
K 39.098 Potassium		Ca 40.078 Calcium	Sc 44.956 Scandium	Ti 47.88 Titanium	V 50.942 Vanadium	Cr 51.996 Chromium	Mn 54.938 Manganese	Fe 55.845 Iron	Co 58.933 Cobalt	Ni 58.69 Nickel	Cu 63.546 Copper	Zn 65.38 Zinc	Ga 69.723 Gallium	Ge 72.64 Germanium	As 74.922 Arsenic	Se 78.96 Selenium	Br 79.904 Bromine	Kr 83.80 Krypton	Rb 85.468 Rubidium						
6		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20						
Rb 85.468 Rubidium		Sr 87.62 Strontium	Y 88.906 Yttrium	Zr 91.224 Zirconium	Nb 92.906 Niobium	Mo 95.94 Molybdenum	Tc 98 Technetium	Ru 101.07 Ruthenium	Rh 102.91 Rhodium	Pd 106.91 Palladium	Ag 107.87 Silver	Cd 112.41 Cadmium	In 114.82 Indium	Sn 118.71 Tin	Sb 121.76 Antimony	Te 127.6 Tellurium	I 126.91 Iodine	Xe 131.29 Xenon	Cs 132.91 Cesium						
7		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20						
Cs 132.91 Cesium		Ba 137.33 Barium	La 138.905 Lanthanum	Hf 178.49 Hafnium	Ta 180.948 Tantalum	W 183.84 Tungsten	Re 186.21 Rhenium	Os 190.23 Osmium	Ir 192.22 Iridium	Pt 195.08 Platinum	Au 196.967 Gold	Hg 200.59 Mercury	Tl 204.38 Thallium	Pb 207.2 Lead	Bi 208.98 Bismuth	Po 209 Polonium	At 210 Astatine	Rn 222 Radon	Fr 223 Francium						
8		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20						
Fr 223 Francium		Ra 226 Radium	Ac 227 Actinium	Rf 261 Rutherfordium	Db 262 Dubnium	Sg 266 Seaborgium	Bh 264 Bohrium	Hs 277 Hassium	Mt 268 Meitnerium	110															
																		Most elements in green boxes are those of the most stable of common isotopes.							
																		Metals				Nonmetals			
Lanthanoid Series																									
		Ce 58 Cerium	Pr 59 Praseodymium	Nd 60 Neodymium	Pm 61 Promethium	Sm 62 Samarium	Eu 63 Europium	Gd 64 Gadolinium	Tb 65 Terbium	Dy 66 Dysprosium	Ho 67 Holmium	Er 68 Erbium	Tm 69 Thulium	Yb 70 Ytterbium	Lu 71 Lutetium										
Actinoid Series																									
		Th 90 Thorium	Pa 91 Protactinium	U 92 Uranium	Np 93 Neptunium	Pu 94 Plutonium	Am 95 Americium	Cm 96 Curium	Bk 97 Berkelium	Cf 98 Californium	Es 99 Einsteinium	Fm 100 Fermium	Md 101 Mendelevium	No 102 Nobelium	Lr 103 Lawrencium										

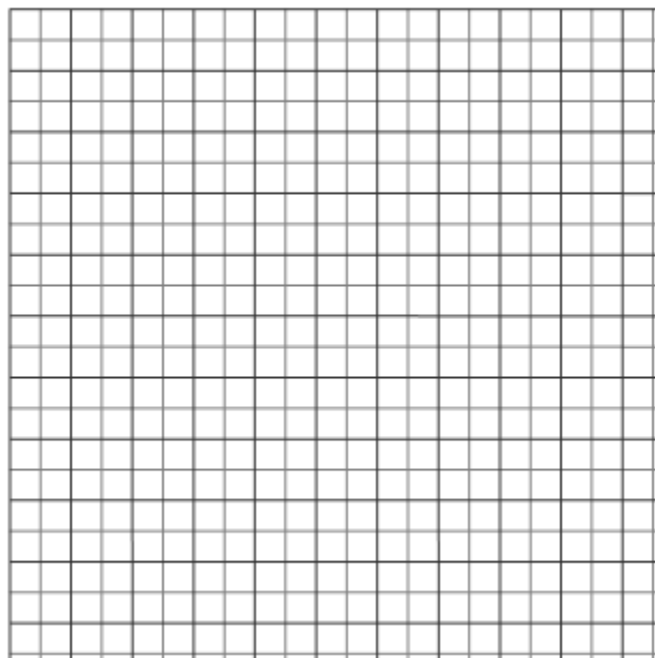
Revised May 2011

Review Questions:

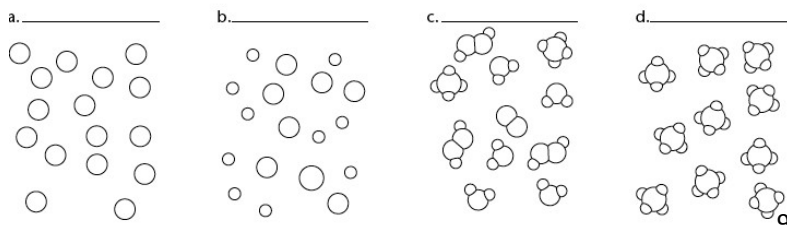
- Which characteristics of a solid, a liquid, and a gas are exhibited by each of the following substances? How would you classify each substance? Justify your answer.
 - A bowl of pudding
 - A bucketful of sand

2. A student performed analysis of a sample for its calcium content and got the following results: 14.92 %, 14.91%, 14.88%, and 14.91%. The actual amount of calcium in the sample is 15.70%. What conclusion can you draw about the accuracy and precision of these results?
3. Calculate the percent error for the experiment performed in #2.

4. Pressure and volume data from an experiment are recorded to the right.
- | Pressure
p(kPa) | Volume
(cm ³) |
|---------------------|------------------------------|
| 200 | 31 |
| 180 | 34 |
| 140 | 44 |
| 100 | 62 |
| 85 | 73 |
| 70 | 88 |
| 60 | 103 |
- (a) Create a line graph of this data. (Plot the points, do not connect the dots)
- (b) Draw a best fit line for the data points.
- (c) Calculate the slope of the line.



5. A children's pain relief elixir contains 80. mg acetaminophen per 0.50 teaspoon. The dosage recommended for a child who weighs between 24 and 35 lb is 1.5 teaspoons. What is the range of acetaminophen dosages, expressed in mg acetaminophen/kg body weight, for children who weigh between 24 and 35 lb?



6. Label each figure as a pure substance or a mixture.
7. Is an element or a compound represented in figure d above? Explain your answer.

8. A copper wire (density 8.96 g/cm³) has a diameter of 0.25 mm. If a sample of the copper wire has a mass of 22 g, how long is the wire?

9. A 25.00 g sample of a solid is placed in a graduated cylinder and then the cylinder is filled to the 50.0 mL mark with benzene. The mass of benzene and solid together is 58.80 g. Assuming that the solid is insoluble in benzene and that the density of benzene is 0.880 g/cm³, calculate the density of the solid.

10. A 110. g sample of copper (specific heat capacity 0.20 J/g°C) is heated to 82.4°C and then placed in a container of water at 23.3°C. The final temperature of the water and copper is 24.9°C. What is the mass of the water in the container, assuming that all the heat lost by the copper is gained by the water?

11. Dalton assumed that all atoms of the same element were identical in all their properties. Explain why this assumption is not valid.

12. Write the atomic symbol (A_ZX) for each of the atoms described below. a.

$Z = 5, A = 12$

- b. The isotope with 7 protons and 8 neutrons in its nucleus
c. Atomic number = 17, number of neutrons = 18

d. $Z = 92$, number of neutrons = 143

e. Number of protons = 6, mass number = 14

f. The isotope of phosphorus with 16 neutrons in its nucleus

13. Write the reaction for each nuclear decay process:

a. ${}^{140}\text{La}$ undergoes beta decay

b. ${}^{135}\text{Cs}$ releases an alpha particle

c. C-14 undergoes positron emission

14. Radioactive isotope X has a half-life of 2 days. How much of isotope X will remain after 2 weeks if you begin with 35 g of X?

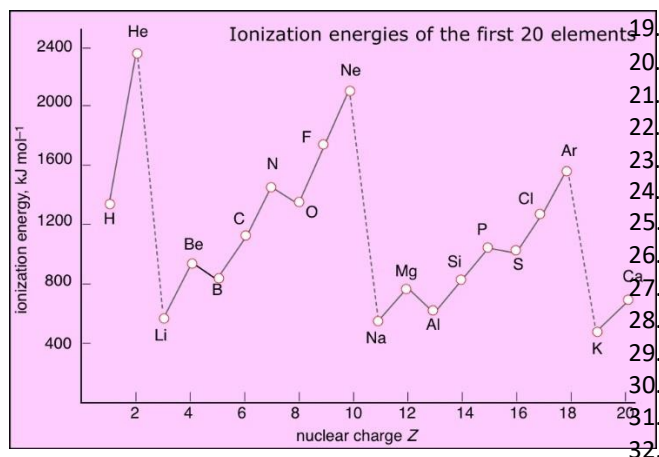
15. Do the proton and the neutron have exactly the same mass? How do the masses of the proton and neutron compare to the mass of the electron? Which particles make the greatest contribution to the chemical properties of an atom?

16. What is the noble gas electron configuration for a neutral atom of iron? The sulfide ion? Classify each as paramagnetic or diamagnetic.

17. List the following atoms in terms of increasing atomic radius, decreasing ionization energy, and increasing electronegativity:

Al, Si, P, S, Cl

18. Explain how atomic radius can affect electronegativity, ionization energy, shielding, and electron affinity.



19. Explain each observation using the graph to the left:

- (a) He, Ne, and Ar have the highest ionization energies
(b) oxygen has a lower ionization energy than nitrogen
(c) lithium, sodium, and potassium have the lowest ionization energies
(d) aluminum has a lower ionization energy than magnesium

20. Why do we call $\text{Ba}(\text{NO}_3)_2$ barium nitrate, but we call $\text{Fe}(\text{NO}_3)_2$ iron (II) nitrate?

21. Name each of the following compounds.

a. NaCl

b. Rb_2O

c. CaS

d. ZnBr_2

g. Cr_2O_3

h. Al_2O_3

i. CCl_4

j. N_2F_4

m. $\text{Ca}_3(\text{PO}_4)_2$

n. $\text{Al}_2(\text{SO}_4)_3$

o. $\text{Pb}(\text{NO}_3)_2$

p. PCl_3

22. Write the formula of the following compounds:

a. cesium bromide

b. barium sulfate

c. ammonium chloride

d. chlorine monoxide

e. silicon tetrachloride

f. beryllium oxide

g. magnesium fluoride

h. sulfur difluoride

i. phosphoric acid

j. sodium hydrogencarbonate

k. ammonium acetate

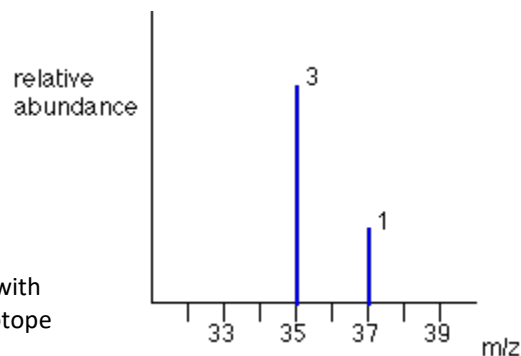
l. ferric phosphate

23. Calculate the energy of a wave with a wavelength of 550 nm.

24. Chlorine exists mainly as two isotopes ^{35}Cl and ^{37}Cl .

Which is more abundant? How can you use the periodic table OR a graph like the one to the right to determine this?

25. An element consists of 1.40% of an isotope with mass 203.973 amu, 24.10% of an isotope with mass 205.9745 amu, 22.10% of an isotope with mass 206.9759 amu, and 52.40% of an isotope with mass 207.9766 amu. Calculate the average atomic mass and identify the element.



26. The element Europium exists in nature as two stable isotopes: ^{151}Eu has a mass of 150.9196 amu, and ^{153}Eu has a mass of 152.9209 amu. The average atomic mass of Europium is 151.96 amu. Calculate the percent abundance of the two isotopes.

27. Compare and contrast the nuclear and electronic stability of an atom.

28. Draw Lewis Dot Structures:

a) Oxygen atom

b) Water molecule

c) Nitrogen atom

d) Ammonia molecule

e) Hydrochloric acid

f) Sodium chloride

29. What does it mean for a molecule to have polar bonds, but be nonpolar overall?

30. Differentiate between ionic, polar covalent and nonpolar covalent bonding.