ANSWERS

Chemistry Term 1 Study Guide - Fall 2017

Topics:

- Scientific method
- Scientific notation
- Significant figures
- Unit conversions and dimensional analysis
- Elements
- Compounds
- Heterogeneous mixtures
- Homogeneous mixtures
- Distillation
- Filtration
- Density
- Physical and chemical changes
- Physical and chemical properties
- Old dead white guys
- Protons, neutrons, electrons
- Atomic number, mass number
- Isotopes
- Ions and charges
- Nuclear chemistry equations
- Alpha, beta, gamma, positron emission
- Electron capture
- Half-life problems
- Electron configurations
- Noble gas shortcut
- Electron rules: Aufbau, Pauli, Hund
- Valence electrons
- Periodic table groups
- Atomic radius trends
- Ionization energy trends
- Electronegativity trends
- Anions and cations
- Law of conservation of mass

Questions:

1. What is the difference between precision and accuracy? Give examples of each.
2. Your beaker has a mass of 120.6 g. Determine the mass in kg. .1206 kg
3. Convert 75 miles/hour into meters/s. (1 mile = 1.61 km) 34 m/s
4. The density of tungsten is 19.25 g/mL. If you have a piece of tungsten that has a mass of 4.45×10^{-2} kg, what is the volume of the sample in mL? 2.31 mL
5. Convert your answer in #4 to m^3. 2.31×10^{-6} m^3
6. You want to determine if a piece of metal is tungsten. The mass is 56.84 g. You place metal in a graduated cylinder that contains 45.5 mL of water. The volume rises to 49.1 mL. Is the metal tungsten? NO
7. Give 2 examples each for elements, compounds, heterogeneous mixtures, and homogeneous mixtures.
8. How would you separate a mixture of rocks, sand, sugar, oil, and water?
9. What is a physical change? Give 2 examples.
10. What is a chemical change? Give 2 examples.
11. What is a physical property? Give 2 examples.
12. What is a chemical property? Give 2 examples.
13. What is the law of conservation of mass? Explain an example.
14. Magnesium reacts with nitrogen to create magnesium nitride. What mass of nitrogen is required to produce 100.90 g of magnesium nitride if you start with 72.90 g of magnesium? 28.00g

15. Consider each state of matter (solid, liquid, and gas).
    a. Does each state have a definite or indefinite volume?
    b. Does each state have a definite or indefinite shape?
    c. Describe what the particles (atoms or molecules) are doing in each state.
16. Write the full electron configuration for iodine.
17. Write the shortcut electron configuration for erbium.
18. Complete the following chart:

Symbol	Protons	Neutrons	Electrons	Charge	Atomic #	Mass #
$^{78}_{34}Se^{-2}$	34	44	36	-2	34	78
$^{138}_{56}Ba^{+2}$	56	82	54	+2	56	138
$^{192}_{77}Ir$	77	115	77	0	77	192

19. There are five naturally occurring isotopes of the element zinc. The relative abundance and mass of each are as follows:

Zinc-64 = 48.89%, 63.929 amu
Zinc-66 = 27.81%, 65.926 amu
Zinc-67 = 4.11%, 66.927 amu
Zinc-68 = 18.57%, 67.925 amu
Zinc-70 = 0.62%, 69.925 amu

Calculate the average atomic mass of zinc. 65.37 amu

20. Define isotope and ion.
21. Write the equations for the alpha decay of ^{256}Lr and ^{211}Fr.
22. Write the equations for the beta decay of ^{90}Sr and ^{52}Fe.
23. Write the equations for the positron emission of ^{50}Mn and ^{8}B.
24. Write the equations for the electron capture of ^{239}Cm and ^{73}As.
25. Thallium-201 has a half-life of 73.0 hours. If 4.0 g of thallium-201 decays over a period of 146 hours, how many grams of thallium-201 will remain? 1.0 g
26. After 24.0 days, 2.00 mg of an original 128.0 mg sample remain. What is the half-life of the sample? 4.00 days
27. Os-182 has a half-life of 21.5 hours. If 1.25 g remain after 64.5 hours, what was the mass of the original sample? 10.0g
28. What happens to atomic radius as you go across a period on the periodic table? Explain.
29. What happens to atomic radius as you go down a column on the periodic table? Explain.
30. What is ionization energy? Describe the trends. How is ionization energy related to atomic size?
31. What is electronegativity? Describe the trends. How is electronegativity related to atomic size?
32. Put the following elements in order of increasing atomic size: Niobium, barium arsenic, nitrogen, radium, neon
33. Now put the elements in order of increasing ionization energy.

Chem Midterm Review

(1) precision - closeness of measurements to each other, 3.00g, 3.01g, 2.99g
- also refers to exactness of measurement, 3.00g instead of 3g

accuracy - closeness to true answer, getting a mass of 199.99g when it should be 200.00g

(2) $\frac{120.6\text{g}}{} \cdot \frac{1\text{kg}}{1000\text{g}} = \boxed{.1206\text{ kg}}$

(3) $\frac{75\text{ mi}}{\text{hr}} \cdot \frac{1.61\text{ km}}{1\text{ mi}} \cdot \frac{1000\text{m}}{1\text{ km}} \cdot \frac{1\text{ hr}}{60\text{ min}} \cdot \frac{1\text{ min}}{60\text{s}} = \boxed{34\ \frac{\text{m}}{\text{s}}}$

(4) $\frac{4.45\times10^{-2}\text{ kg}}{} \cdot \frac{1000\text{g}}{1\text{kg}} = 44.5\text{ g}$

$d = \frac{m}{V}$

$V \cdot d = m$

$V = \frac{m}{d} = \frac{44.5\text{g}}{19.25\text{g/mL}} = \boxed{2.31\text{ mL}}$

(5) $\frac{2.31\text{ mL}}{} \cdot \frac{1\text{ cm}^3}{1\text{ mL}} \cdot \left(\frac{1\text{m}}{100\text{cm}}\right)^3 = \boxed{2.31\times10^{-6}\text{ m}^3}$

(6) 49.1 mL - 45.5 mL = 3.6 mL

$d = \frac{m}{V} = \frac{56.84\text{g}}{3.6\text{mL}} = \boxed{16\text{ g/mL}\quad \text{NO}}$

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(7) elements - Cu, Ag, H, etc
compounds - CO_2, H_2O, NaCl
hetero mix - salad, pizza, sand + water
homo mix - Kool Aid, salt water, soda, tap water

(8) Separate rocks, sand, sugar, oil, water:
- pick out rocks
- use filtration to separate sand from rest
- pour off oil (doesn't mix w/ water + sugar)
- use evaporation or distillation to separate H_2O from sugar

(9) Physical change - changes the appearance of something but not its composition
- ex: cutting + crumpling paper
dissolving salt + sugar

(10) chemical change - changes the chemical composition
- ex: iron rusting, acid reacting,

(11) Physical property - can be observed or measured w/out changing substance
- ex: color, weight, density, measured length, etc

(12) Chemical property - ability to undergo chemical change
- ex: abitility to react w/ oxygen, flammability, etc

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(13) law of conservation of mass - mass can neither be created nor destroyed
- ex: if you dissolve 25 g of salt in 100 g H_2O, then you have 125 g of salt water

(14) Mg + N → magnesium nitride
72.90 g + [28.00 g] = 100.90 g

(15) solid - definite volume - V doesn't change
- definite shape - shape doesn't change
- Atoms are moving a little, can't move very far, stuck in place

liquid - definite volume - V doesn't change
- indefinite shape - shape changes depending on what container it's in
- Atoms are moving more, flowing past each other

gas - indefinite volume - expand / contract to fill whatever container it's in
- indefinite shape - takes shape of container
- Atoms are moving freely, colliding w/ each other + walls of container

(16) I: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^5$

(17) Er: [Xe] $6s^2 5d^1 4f^{11}$

(18) see chart

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(19) $.4889 \cdot 63.929$ amu $= 31.25$
$.0411 \cdot 66.27$ amu $= 2.75$
$.0062 \cdot 69.925$ amu $= .43$
$.2781 \cdot 65.926$ amu $= 18.33$
$.1857 \cdot 67.925$ amu $= +\ 12.61$
65.37 amu

(20) Isotope - same element but different # neutrons and different mass # + mass
Ion - atom w/ a charge (different # electrons)

(21) $^{256}_{103}Lr \rightarrow {}^{4}_{2}He + {}^{252}_{101}Md$
$^{211}_{87}Fr \rightarrow {}^{4}_{2}He + {}^{207}_{85}At$

(22) $^{90}_{38}Sr \rightarrow {}^{0}_{-1}e + {}^{90}_{39}Y$
$^{52}_{26}Fe \rightarrow {}^{0}_{-1}e + {}^{52}_{27}Co$

(23) $^{50}_{25}Mn \rightarrow {}^{0}_{+1}e + {}^{50}_{24}Cr$
$^{8}_{5}B \rightarrow {}^{0}_{+1}e + {}^{8}_{4}Be$

(24) $^{239}_{96}Cm + {}^{0}_{-1}e \rightarrow {}^{239}_{95}Am$
$^{73}_{33}As + {}^{0}_{-1}e \rightarrow {}^{73}_{32}Ge$

(25) 73.0 hr
4.0 g
146 hr

$\frac{146\text{ hr}}{73.0\text{ hr}} = 2$ $\frac{4.0\text{ g}}{2^2} = $ **1.0 g**

(26) 24.0 days
2.00 mg
128.0 mg

$\frac{128.0\text{ mg}}{2.00\text{ mg}} = 2^x$

$64 = 2^x \quad x = 6$

$\frac{24.0\text{ days}}{6} = $ **4.00 days**

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OR

$\frac{128.0\text{ mg}}{2} \overset{1}{=} \frac{64.00\text{ mg}}{2} \overset{2}{=} \frac{32.00\text{ mg}}{2} \overset{3}{=} \frac{16.00\text{ mg}}{2} \overset{4}{=} \frac{8.00\text{ mg}}{2} \overset{5}{=} \frac{4.00\text{ mg}}{2} \overset{6}{=} 2.00\text{ mg}$

(27) 21.5 hr
1.25 g remain
64.5 hrs

$\frac{64.5\text{ hr}}{21.5\text{ hr}} = 3$ $1.25\text{g} \cdot 2^3 = \boxed{10.0\text{g}}$

(28) Atomic radius decreases as you go across a period. The # of protons in the nucleus increases (increasing the nuclear charge), pulling e^- in closer.

(29) Atomic radius increases as you go down a column because you're adding electron energy levels.

(30) Ionization energy is the energy required to remove an e^-

- Across a period, IE increases. Smaller atoms mean less distance between e^- and nucleus, more attraction, and harder (more energy) to remove an electron
- Down a column, IE decreases. Bigger atoms mean more distance between e^- and nucleus, less attraction, and easier (less energy) to remove e^-

(31) Electronegativity - ability of atom to hog e^- in a compound

- Across a period - EN increases. Smaller atoms mean more attraction between nucleus + e^-
- Down a column - EN decreases. Bigger atoms mean less attraction between nucleus + e^-

(32) smallest: Ne, N, As, Nb, Ba, Ra largest

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(33) Smallest IE: Ra, Ba, Nb, As, N, Ne highest IE

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☆ Term 1 study guide corrections ☆

(3) $\frac{75 \text{ yrs}}{} \cdot \frac{365 \text{ days}}{1 \text{ yr}} \cdot \frac{24 \text{ hr}}{1 \text{ day}} \cdot \frac{60 \text{ min}}{1 \text{ hr}} \cdot \frac{60 \text{ s}}{1 \text{ min}} = \boxed{2.4 \cdot 10^9 \text{ s}}$

(4) $d = 19.25 \frac{g}{mL}$
$m = 4.45 \cdot 10^2 g$
$V = ?$

$d = \frac{m}{V}$

$V = \frac{m}{d} = \frac{4.45 \times 10^2 g}{19.25 g/mL}$

$= \boxed{23.1 \text{ mL}}$

(6) $m = 56.84 g$
$V = 49.1 \text{ mL} - 45.5 \text{ mL} = 3.6 \text{ mL}$

$d = \frac{m}{V} = \frac{56.84 g}{3.6 mL} = 16 g/mL$

Do you think 16 g/mL is close to 19.25 g/mL?
Be sure to explain your reasoning

(5) $\frac{23.1 \text{ mL}}{} \cdot \frac{1 L}{1000 \text{ mL}} \cdot \frac{1 kL}{1000 L} = \boxed{2.31 \cdot 10^{-5} \text{ kL}}$

(19) 48.89% of the isotopes have a mass of 63.929 amu, which is the highest abundance of all the isotopes. The average atomic mass will be close to this mass. It will be a little higher because the other isotopes, while less abundant, have a heavier mass and will increase the average atomic mass a little bit