

INTRODUCTORY CHEMISTRY, CHEM 111
EXAM 1, SPRING 2006

NAME _____

DIRECTIONS: Circle the best answer for each question. There is only one correct answer to each question.

Avogadro's Number = 6.022×10^{23}

1 amu = 1.6606×10^{-24} g

- Copper has a density of 8.92 g/mL. A piece of copper is submerged in water in a graduated cylinder. The volume of water is observed to increase by 7.26 mL when the copper is placed in the cylinder. What is the mass of the copper?
a) 16.2 g b) 1.23 g c) 0.814 g d) 47.26 g e) 64.8 g
- Calculate the moles of PCl_3 in 25.0 g of PCl_3 .
a) 3.43×10^2 moles b) 5.49 moles c) 0.623 moles
d) 8.7×10^{-3} moles e) none of these
- How many moles of H_2O can be produced by the following chemical reaction when 0.250 moles of NH_3 react with an excess of oxygen? $4 \text{NH}_3(\text{g}) + 5 \text{O}_2(\text{g}) \rightarrow 4 \text{NO}(\text{g}) + 6 \text{H}_2\text{O}(\text{l})$
a) 0.250 moles H_2O b) 0.375 moles H_2O c) 0.167 moles H_2O
d) 1.50 moles e) none of these
- Lithium has 2 naturally occurring isotopes: ${}^6\text{Li} = 6.015$ amu and ${}^7\text{Li} = 7.016$. The % abundance of these isotopes must be approximately:
a) 50% ${}^6\text{Li}$ & 50% ${}^7\text{Li}$ b) 40% ${}^6\text{Li}$ & 60% ${}^7\text{Li}$ c) 75% ${}^6\text{Li}$ & 25% ${}^7\text{Li}$
d) 10% ${}^6\text{Li}$ & 90% ${}^7\text{Li}$ e) 90% ${}^6\text{Li}$ & 10% ${}^7\text{Li}$
- Which of the following will have the greatest mass?
a) 1000 K atoms b) 1000 Al atoms c) 1000 Be atoms d) 1000 Na atoms
e) 1000 S atoms
- How many electrons are found in the ion, ${}^{32}\text{S}^{2-}$?
a) 2 b) 30 c) 34 d) 18 e) none of these
- Write the symbol for the atom or ion that has 30 protons, 35 neutrons and 28 electrons.
a) ${}^{30}\text{P}^{2+}$ b) ${}^{65}\text{Zn}^{2+}$ c) ${}^{80}\text{Br}$ d) ${}^{80}\text{Br}^-$ e) none of these
- A hydrate is placed into a crucible. The mass of the hydrate, crucible and lid is 57.234 g. The empty crucible and lid have a mass of 50.942 g. The crucible and hydrate are heated until the crucible becomes red hot. After cooling the crucible, lid and remaining anhydrous material have a mass of 55.872 g. How many moles of water were driven off during the heating process?
a) 0.0757 moles b) 0.350 moles c) 0.274 moles d) 1.362 moles
e) 0.00498 moles
- How many neutrons are found in ${}^{51}\text{V}^{2+}$?
a) 23 b) 51 c) 25 d) 21 e) none of these
- Calculate the mass of Na_2SO_4 needed to prepare 0.500 L of a 0.150 M solution.
a) 0.0750 g b) 5.28×10^{-4} g c) 10.7 g d) 42.6 g
e) 473 g

11. Calculate the molar mass of $\text{Mg}(\text{NO}_3)_2$.
 a) 54.3 g/mol b) 86.3 g/mol c) 134.3 g/mol d) 148.3 g/mol
 e) 163.3 g/mol
12. Calculate the mass of 0.321 moles of LiOH .
 a) 7.69 g b) 1.34×10^{-2} g c) 74.6 g d) 23.95 g
 e) 15.6 g
13. How many atoms are there in 12.0 grams of Mg ?
 a) 0.494 atoms b) 2.87×10^{23} atoms c) 7.22×10^{24} atoms d) 5.19×10^{23} atoms
 e) 2.91×10^2 atoms
14. Balance the following chemical equation. What will be the coefficient in front of KCl when the equation is balanced? $\text{KClO}_3 \rightarrow \text{KCl} + \text{O}_2$
 a) 1 b) 2 c) 3 d) 4 e) none of these
15. Calculate the volume of 17.4 M acetic acid needed to prepare 1.00 L of 3.00 M acetic acid.
 a) 172 mL b) 5.80 mL c) 52.2 mL d) 346 mL
 e) 256 mL
16. Predict the formula of the electrically neutral compound containing the ions, Ca^{2+} and Br^- .
 a) CaBr b) CaBr_2 c) Ca_2Br d) Ca_2Br_3 e) none of these
17. Predict the formula of the electrically neutral compound containing the ions, Al^{3+} and CO_3^{2-} .
 a) AlCO_3 b) $\text{Al}_2(\text{CO}_3)_2$ c) $\text{Al}_3(\text{CO}_3)_2$ d) $\text{Al}(\text{CO}_3)_2$ e) none of these

Problems: Show all calculations in an orderly-step-by-step fashion. Maintain significant figures and include all units. For discussion questions use grammatically correct sentences.

1. Supply the requested name of formula.
- | | Name | Formula | | Name | Formula |
|----|-------|------------------|----|-------------|---------------------|
| a) | _____ | K | d) | thiosulfate | _____ |
| b) | boron | _____ | e) | _____ | Ar |
| c) | _____ | ClO_2^- | f) | _____ | CrO_4^{2-} |
2. A compound is found to be 23.2% Cl, 55.9% Rb and 20.9% O. Determine the empirical formula of this compound.

3. The thermite reaction, used to weld rails together in building railroads, is described by the following equation. $\text{Fe}_2\text{O}_3 + 2 \text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2 \text{Fe}$ You have 175 grams of aluminum and 300 grams of iron oxide, Fe_2O_3 .
- What is the limiting reagent?
 - What is the mass of iron metal produced if all of the limiting reagent is consumed?
 - What is the mass of iron oxide, Fe_2O_3 , remaining if all of the limiting reagent is consumed?
 - What is the mass of aluminum remaining after the reaction if all of the limiting reagent is consumed?
4. Describe the three fundamental particles that make up an atom. Describe the relationship between the mass and charge of each particle.
5. The atomic mass of sodium is 22.990 amu. Explain why there are no atoms of sodium that actually have this mass.

Key:

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|------|-------|-------|
| 1. e | 8. a | 15. a |
| 2. e | 9. e | 16. b |
| 3. b | 10. c | 17. e |
| 4. d | 11. d | |
| 5. a | 12. a | |
| 6. d | 13. b | |
| 7. b | 14. b | |

1. a) potassium b) B c) chlorite d) $S_2O_3^{2-}$
e) argon f) chromate
2. $ClRbO_2$
3. a) Fe_2O_3 b) 210 g c) 0 g d) 74 g
4. proton: 1 amu +1; electron: ≈ 0 amu, -1; neutron 1 amu; 0 charge
5. The atomic mass listed in the Periodic table is an average mass of the different isotopes of sodium.