FINAL EXAM

CHM 1045 FALL 2012

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

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| 1. | A 13.53-g sample of solid sodium bicarbonate (the active ingredient in baking soda) completely decomposes into solid sodium hydroxide and carbon dioxide gas when heated. After the sodium hydroxide cools, it has a mass of 6.44 g. According to the law of conservation of mass, what mass of carbon dioxide must have been formed? | |
| A) | 6.44 g |
| B) | 7.09 g |
| C) | 19.97 g |
| D) | 87.16 g |
| E) | 3.54 g |

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| 2. | Which of the following sets of units is not in the order of increasing size? | |
| A) | g < mg < cg |
| B) | L < dL < L |
| C) | cPa < dPa < kPa |
| D) | pm < mm < nm |
| E) | ns < ms < s |

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| 3. | The melting point of a particular solid is 3035 K. This corresponds to | |
| A) | 3308°C. |
| B) | 2701°C. |
| C) | 1566°F. |
| D) | 4940°F. |
| E) | 5004°F. |

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| 4. | A thin sheet of rhodium metal that is 2.54 cm by 6.54 cm has a mass of 55.7 g and a thickness of 2.45 mm. What is the density of rhodium? |

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| 5. | A car averages 28.5 miles per gallon of gasoline. How many liters of gasoline will be needed for a trip of 619 km? Some conversion factors that may be helpful are the following:  1 qt = 0.946 L  1 mile = 1.609 km  4 qt = 1 gal (exactly)  1 ft = 12 in (exactly) | |
| A) | 7.50  103 L |
| B) | 1.32  102 L |
| C) | 4.15  104 L |
| D) | 2.90  103 L |
| E) | 5.11  101 L |

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| 6. | Dalton’s atomic theory consisted of all the following postulates **EXCEPT** | |
| A) | Atoms of different elements have different properties. |
| B) | Elements are composed of indivisible particles called atoms. |
| C) | With gases, the volumes consumed and produced are in ratios of small whole numbers. |
| D) | Atoms combine in fixed ratios of whole numbers. |
| E) | In chemical changes, atoms are not destroyed, created, or changed. |

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| 7. | Naturally occurring element X exists in three isotopic forms: X-28 (27.976 amu, 92.21% abundance), X-29 (28.976 amu, 4.70% abundance), and X-30 (29.974 amu, 3.09% abundance). Calculate the atomic weight of X. | |
| A) | 28.1 amu |
| B) | 35.3 amu |
| C) | 29.1 amu |
| D) | 86.9 amu |
| E) | 25.8 amu |

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| 8. | The formulas of the sulfate ion, the nitrite ion, and the acetate ion are represented, respectively, as |

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| 9. | Name and write the correct formula for the following compounds: | |
| A) | sodium sulfite |
| B) | calcium fluoride |
| C) | K2MnO4 |
| D) | Fe2O3 |

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| 10. | Balance the following equations: | |
| A) | NH4NO3 → H2O + N2 + O2 |
| B) | CH3CHO + O2 → CO2  + H2O |
| C) | Sn + HNO3 → SnO2  + NO2 + H2O |
| D) | Na2CO3 + H2SO4 → Na2SO4  + H2O + CO2 |

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| 11. | How many atoms of carbon are there in 0.56 mol of procaine, C13H20N2O2, a “pain killer” used by dentists? | |
| A) | 7.3  1023 |
| B) | 6.7  1023 |
| C) | 4.4  1024 |
| D) | 4.7  1024 |
| E) | 5.0  1024 |

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| 12. | What is the percentage by mass of carbon in DDT, C14H9Cl5? | |
| A) | 29.8% |
| B) | 39.4% |
| C) | 53.8% |
| D) | 47.4% |
| E) | 74.5% |

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| 13. | A molecular compound contains 92.3% carbon and 7.7% hydrogen by mass. If 0.504 mol of the compound weighs 26.21 g, what is its molecular formula? | |
| A) | CH |
| B) | C4H4 |
| C) | C3H8 |
| D) | C8H8 |
| E) | C6H12 |

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| 14. | In order to dilute 88.2 mL of 0.896 *M* HCl to 0.100 *M*, the volume of water that must be added is | |
| A) | 7.90 × 102 mL. |
| B) | 78.4 mL. |
| C) | 9.84 mL. |
| D) | 7.02 × 102 mL. |
| E) | 1.02 × 10–3 mL. |

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| 15. | SO2 reacts with H2S as follows:  2H2S + SO2  3S + 2H2O  When 7.50 g of H2S reacts with 12.75 g of SO2, which statement applies? | |
| A) | 6.38 g of sulfur is formed. |
| B) | 10.6 g of sulfur is formed. |
| C) | 0.0216 mol of H2S remains. |
| D) | 1.13 g of H2S remains. |
| E) | SO2 is the limiting reagent. |

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| 16. | A 5.95-g sample of AgNO3 is reacted with BaCl2 according to the equation    to give 3.26 g of AgCl. What is the percent yield of AgCl? | |
| A) | 32.5 % |
| B) | 54.8 % |
| C) | 43.3 % |
| D) | 64.9 % |
| E) | 100. % |

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| 17. | List the 6 common strong acids and 6 common strong bases: | |
|  | STRONG ACIDS STRONG BASES |
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| 18. | Which of the following is best described as an acid–base reaction? | |
| A) | 2KClO3(*aq*)  2KCl(*s*) + 3O2(*g*) |
| B) | Cu(*s*) + H2S(*g*)  CuS(*s*) + H2(*g*) |
| C) | 2H2(*g*) + O2(*g*)  2H2O(*l*) |
| D) | HNO3(*aq*) + NH3(*aq*)  NH4+(*aq*) + NO3–(*aq*) |
| E) | P4(*s*) + 3OH–(*aq*) + 3H3O(*l*)  PH3(*g*) + 3H2PO2–(*aq*) |

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| 19. | Balance the following oxidation-reduction reaction between iron(II) sulfate and potassium permanganate in a sulfuric acid solution?  Fe2+(*aq*) + MnO4–(*aq*) → Fe3+(*aq*) + Mn2+(*aq*) |

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| 20. | The reaction of HCl with NaOH is represented by the equation  HCl(*aq*) + NaOH(*aq*) → NaCl(*aq*) + H2O(*l*)  What volume of 0.499 *M* HCl is required to titrate 49.9 mL of 0.110 *M* NaOH? | |
| A) | 49.9 mL |
| B) | 226 mL |
| C) | 2.74 mL |
| D) | 11.0 mL |
| E) | 2.00 mL |

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| 21. | Which of the following is a correct statement of Charles’s law, ? | |
| A) | The pressure of a gas sample varies inversely with the volume. |
| B) | The volume of a gas sample varies directly with the absolute temperature. |
| C) | The volume of a gas varies proportionally with the pressure. |
| D) | All gas samples of the same volume at STP contain the same number of molecules. |
| E) | All gas samples of the same volume at STP contain the same number of atoms. |

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| 22. | A 27.0-L sample of nitrogen at 5.30 atm and 27°C is simultaneously expanded to 54.8 L and heated to 36°C. What is the new pressure of the gas? | |
| A) | 3.48 atm |
| B) | 209 atm |
| C) | 2.69 atm |
| D) | 271 atm |
| E) | 2.54 atm |

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| 23. | The volume of 1 mol of nitrogen | |
| A) | is increased by decreasing the temperature. |
| B) | has the value of 22.4 L at 0°C and 1.00 atm. |
| C) | is decreased by decreasing the pressure of the gas. |
| D) | is lower than that of ammonia at high pressures. |
| E) | is decreased by increasing its kinetic energy. |

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| 24. | A 1.00-L sample of a gas at STP has a mass of 2.05 g. The molar mass of the gas is | |
| A) | 45.9 g/mol. |
| B) | 22.4 g/mol. |
| C) | 9.15 g/mol. |
| D) | 109 g/mol. |
| E) | 67.2 g/mol. |

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| 25. | Using the van der Waals equation, determine the pressure of 454.0 g of SO2(*g*) in a 5.50-L vessel at 787 K. For SO2(g), *a* = 6.865 L2 • atm/mol2 and *b* = 0.05679 L/mol. (*R* = 0.0821 L • atm/(K • mol)) | |
| A) | 10.7 atm |
| B) | 10.5 atm |
| C) | 78.4 atm |
| D) | 101 atm |
| E) | 83.3 atm |

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| 26. | Given:  Fe2O3(*s*) + 3CO(*g*)  2Fe(*s*) + 3CO2(*g*); *H* = –26.8 kJ  FeO(*s*) + CO(*g*)  Fe(*s*) + CO2(*g*); *H* = –16.5 kJ  determine *H* for the following thermochemical equation.  Fe2O3(*s*) + CO(*g*)  2FeO(*s*) + CO2(*g*) | |
| A) | –43.3 kJ |
| B) | –10.3 kJ |
| C) | 6.2 kJ |
| D) | 10.3 kJ |
| E) | 22.7 kJ |

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| 27. | What is *H*° of the following reaction?  CO2(*g*) + 2CH4(*g*)  C3H8(*g*) + O2(*g*)   |  |  | | --- | --- | | Substance | *H*°*f* (kJ/mol) | | CO2(*g*) | –393.5 | | CH4(*g*) | –74.9 | | C3H8(*g*) | –104.7 | | |
| A) | 438.6 kJ |
| B) | 348.4 kJ |
| C) | –348.4 kJ |
| D) | –648.0 kJ |
| E) | –573.1 kJ |

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| 28. | Exactly 197.6 J will raise the temperature of 10.0 g of a metal from 25.0°C to 60.0°C. What is the specific heat capacity of the metal? | |
| A) | 1.77 J/(g · °C) |
| B) | 0.565 J/(g · °C) |
| C) | 15.6 J/(g · °C) |
| D) | 47.3 J/(g · °C) |
| E) | none of these |

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| 29. | In your own words, briefly describe the following terms: | |
| A) | Kinetic Energy |
| B) | Potential Energy |
| C) | work |
| D) | Exothermic Process |
| E) | Endothermic Process |

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| 30. | At constant pressure, the sign of *q* for the process CO2(*g*)  CO2(*s*) is expected to be | |
| A) | positive, and the process is endothermic. |
| B) | negative, and the process is endothermic. |
| C) | positive, and the process is exothermic. |
| D) | negative, and the process is exothermic. |
| E) | impossible to predict. |

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| 31. | Fill in the following chart: | | |
| ORBITALS | | MAXIMUM # OF ELECTRONS | SHAPE |
|  | | 2 |  |
| p | |  |  |
|  | |  | 4 leaf clover |
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32. There are 4 quantum numbers. Describe each of them and how to find the permissibility.

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| n | | |  |
| l | | |  |
| m*l* | | |  |
| m*s* | | |  |
| 33. | What is the wavelength of light emitted when the electron in a hydrogen atom undergoes a transition from level *n* = 5 to level *n* = 2? (*c* = 3.00  m/s, *h* = 6.63 10-34 J s), *RH* = 2.179 × 10-18 J) | |

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| 34. | Which type of electromagnetic radiation has the longest wavelength? | |
| A) | gamma rays |
| B) | x rays |
| C) | blue light |
| D) | red light |
| E) | microwaves |

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| 35. | The ground-state electron configuration of a Ni2+ ion is 1s22s22p63s23p63d8. Therefore, Ni2+ is | |
| A) | diamagnetic. |
| B) | paramagnetic with one unpaired electron. |
| C) | paramagnetic with four unpaired electrons. |
| D) | paramagnetic with two unpaired electrons. |
| E) | paramagnetic with five unpaired electrons. |

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| 36. | Explain one important experiment/discovery/theory that each of the following scientists contributed: | |
| A) | Einstein |
| B) | Rutherford |
| C) | Heisenberg |
| D) | Millikan |
| E) | Bohr |

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| 37. | Explain each of the following rules then draw an example: | |
| A) | Pauli exclusion principle |
| B) | Aufbau principle |
| C) | Hund's rule |

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| 38. | Which of the following ground-state electron configurations corresponds to an atom that has the most negative value of the electron affinity? | |
| A) | 1s22s22p63s1 |
| B) | 1s22s22p63s23p5 |
| C) | 1s22s22p63s23p2 |
| D) | 1s22s22p63s23p63d54s2 |
| E) | 1s22s22p6 |

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| 39. | Which set of ions are isoelectronic in their ground-state electron configurations? | |
| A) | Na+, K+, Rb+, Cs+ |
| B) | Mg2+, Ca2+, Sr2+, Ba2+ |
| C) | N, O, F, Ne |
| D) | F–, Cl–, Br–, I– |
| E) | N3–, O2–, Mg2+, Al3+ |

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| 40. | Which of the following properties, in general, increases from left to right across a period in the periodic table? | |
| A) | atomic radius |
| B) | ionization energy |
| C) | metallic character |
| D) | ionic charge |
| E) | density |

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| 41. | How many valence electrons does a carbonate ion have? | |
| A) | 22 |
| B) | 24 |
| C) | 28 |
| D) | 30 |
| E) | 32 |

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| 42. | Which molecule or ion has a trigonal pyramidal molecular geometry? | |
| A) | CO32– |
| B) | SO3 |
| C) | BF3 |
| D) | CH4 |
| E) | NH3 |

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| 43. | Which molecule is polar? | |
| A) | CF4 |
| B) | SO2 |
| C) | CS2 |
| D) | C2H4 |
| E) | C6H6 |

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| 44. | What is the hybridization of the nitrogen atom in the nitrate ion? | |
| A) | s |
| B) | sp |
| C) | sp2 |
| D) | sp3 |
| E) | sp3d |

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| 45. | The configuration (2s)2(2s\*)2(2py)2(2px)2 is the molecular orbital description for the ground state of | |
| A) | Li2+. |
| B) | Be2. |
| C) | B2. |
| D) | B22–. |
| E) | C2. |



E = -RH  - -RH

n2higher level n2lower level

