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**KNOW THY REFERENCE TABLES!**

Knowing your reference tables well is a big help on the NYS Chemistry Regents exam since about half of the questions can be answered using the tables. This compilation of Reference Table related questions from the June 2010-January 2011 NYS Chemistry Regents exams will help you to recognize questions requiring the use of reference tables, as well as giving you practice using the reference tables to answer Regents style questions. Multiple choice questions are organized together, followed by constructed response questions.

**Multiple choice (Part A and B1)**

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|  | **Question** | **Ref Table** | **Ans** |
| 1 | What is the total number of neutrons in an atom of O-18?  (1) 18 (2) 16 (3) 10 (4) 8 |  |  |
| 2 | Which element is malleable and a good conductor of electricity at STP?  (1) argon (2) carbon (3) iodine (4) silver |  |  |
| 3 | Which element has chemical properties that are most similar to the  chemical properties of sodium?  (1) beryllium (2) calcium (3) lithium (4) magnesium |  |  |
| 4 | If an element, *X*, can form an oxide that has the formula *X*2O3, then element *X* would most likely be located on the Periodic Table in the  same group as  (1) Ba (2) Cd (3) In (4) Na |  |  |
| 5 | What is the total mass of KNO3 that must be dissolved in 50. grams of H2O at 60.°C to make a saturated solution?  (1) 32 g (2) 53g (3) 64 g (4) 106g |  |  |
| 6 | Which statement describes the general trends in electronegativity and metallic properties as the elements in Period 2 are considered in order of increasing atomic number?  (1) Both electronegativity and metallic properties decrease.  (2) Both electronegativity and metallic properties increase.  (3) Electronegativity decreases and metallic properties increase.  (4) Electronegativity increases and metallic properties decrease. |  |  |
| 7 | Given the reaction at 101.3 kilopascals and 298 K:  hydrogen gas + iodine gas → hydrogen iodide gas  This reaction is classified as  (1) endothermic, because heat is absorbed  (2) endothermic, because heat is released  (3) exothermic, because heat is absorbed  (4) exothermic, because heat is released |  |  |
| 8 | What is the total number of valence electrons in a calcium atom in the ground state?  (1) 8 (2) 2 (3) 18 (4) 20 |  |  |
| 9. | An atom of which element has the largest atomic radius?  (1) Fe (2) Mg (3) Si (4) Zn |  |  |
| 10. | A balanced equation representing a chemical reaction can be written using  (1) chemical formulas and mass numbers  (2) chemical formulas and coefficients  (3) first ionization energies and mass numbers |  |  |
| 11. | The percent composition by mass of nitrogen in NH4OH (gram-formula mass = 35 grams/mole) is equal to |  |  |
| 12. | Which Group 15 element exists as diatomic molecules at STP?  (1) phosphorus (2) nitrogen (3) bismuth (4) arsenic |  |  |
| 13. | Which substance can *not* be broken down by a chemical change?  (1) methane (2) propanal (3) tungsten (4) water |  |  |
| 14. | Which unit can be used to express the concentration of a solution?  (1) L/s (2) J/g (3) ppm (4) kPa |  |  |
| 15. | Which compound is insoluble in water?  (1) KOH (2) NH4Cl (3) Na3PO4 (4) PbSO4 |  |  |
| 16. | The isotopes K-37 and K-42 have the same  (1) decay mode  (2) bright-line spectrum  (3) mass number for their atoms  (4) total number of neutrons in their atoms |  |  |
| 17. | Which compound is an Arrhenius acid?  (1) CaO (2) HCl (3) K2O (4) NH3 |  |  |
| 18. | Based on the results of testing colorless solutions with indicators, which solution is most acidic?  (1) a solution in which bromthymol blue is blue  (2) a solution in which bromcresol green is blue  (3) a solution in which phenolphthalein is pink  (4) a solution in which methyl orange is red |  |  |
| 19. | Which nuclide is listed with its half-life and decay mode? |  |  |
| 20. | The table below shows the number of subatomic particles in atom *X* and in atom *Z*.    Atom *X* and atom *Z* are isotopes of the element  (1) aluminum (2) carbon (3) magnesium (4) nitrogen |  |  |
| 21. | The bond between which two atoms is most polar?  (1) Br and Cl (2) Br and F (3) I and Cl (4) I and F |  |  |
| 22. | In the formula *X*2(SO4)3, the *X* represents a metal. This metal could be located on the Periodic Table in  (1) Group 1 (2) Group 2 (3) Group 13 (4) Group 14 |  |  |
| 23. | At STP, which element is solid, brittle, and a poor conductor of electricity?  (1) Al (2) K (3) Ne (4) S |  |  |
| 24. | Which element forms an ionic compound when it reacts with lithium?  (1) K (2) Fe (3) Kr (4) Br |  |  |
| 25. | Which compound has both ionic and covalent bonds?  (1) CO2 (2) CH3OH (3) NaI (4) Na2CO3 |  |  |
| 26. | A cylinder with a movable piston contains a sample of gas having a volume of 6.0 liters at 293 K and 1.0 atmosphere. What is the volume of the sample after the gas is heated to 303 K, while the pressure is held at 1.0 atmosphere?  (1) 9.0 L (2) 6.2L (3) 5.8 L (4) 4.0L |  |  |
| 27. | What is the minimum amount of heat required to completely melt 20.0 grams of ice at its melting point?  (1) 20.0 J (2) 83.6 J (3) 6680 J (4) 45200J |  |  |
| 28. | Which formula represents an unsaturated hydrocarbon?  (1) C5H12 (2) C6H14 (3) C7H16 (4) C8H14 |  |  |
| 29. | The reaction between an organic acid and an alcohol produces  (1) an aldehyde (2) a ketone (3) an ether (4) an ester |  |  |
| 30. | Which balanced equation represents a redox reaction?  (1) AgNO3(aq)+ NaCl(aq) →AgCl(s) + NaNO3(aq)  (2) H2CO3(aq) →H2O(*ℓ*) + CO2(g)  (3) NaOH(aq) + HCl(aq) →NaCl(aq) + H2O(*ℓ*)  (4) Mg(s) + 2HCl(aq) →MgCl2(aq) + H2(g) |  |  |
| 31. | The mass of a proton is approximately equal to the mass of  (1) an alpha particle (2) an electron (3) a neutron (4) a positron |  |  |
| 32. | Which Group 14 element is classified as a metal?  (1) carbon (2) Ga (3) silicon (4) tin |  |  |
| 33. | An atom of which element has the greatest attraction for electrons in a chemical bond?  (1) As (2) Ga (3) Ge (4) Se |  |  |
| 34. | Which type of bond is found between atoms of solid cobalt?  (1) nonpolar covalent (2) polar covalent (3) metallic (4) ionic |  |  |
| 35. | The molarity of an aqueous solution of NaCl is defined as the  (1) grams of NaCl per liter of water  (2) grams of NaCl per liter of solution  (3) moles of NaCl per liter of water  (4) moles of NaCl per liter of solution |  |  |
| 36. | A carbon-carbon triple bond is found in a molecule of  (1) butane (2) butanone (3) butane (4) butyne |  |  |
| 37. | Which compound when dissolved in water is an Arrhenius acid?  (1) CH3OH (2) HCl (3) NaCl (4) NaOH |  |  |
| 38. | Which nuclear emission has no charge and no mass?  (1) alpha particle (2) beta particle (3) gamma ray (4) positron |  |  |
| 39. | Which radioisotope is matched with its decay mode |  |  |
| 40. | Which Lewis electron-dot diagram represents an atom in the ground state for a Group 13 element? |  |  |
| 41. | Which element forms a compound with chlorine with the general formula *M*Cl?  (1) Rb (2) Ra (3) Re (4) Rn |  |  |
| 42. | Which characteristics both generally *decrease* when the elements in Period 3 on the Periodic Table are considered in order from left to right?  (1) nonmetallic properties and atomic radius  (2) nonmetallic properties and ionization energy  (3) metallic properties and atomic radius  (4) metallic properties and ionization energy |  |  |
| 43. | An atom of argon in the ground state tends *not* to bond with an atom of a different element because the argon atom has  (1) more protons than neutrons  (2) more neutrons than protons  (3) a total of two valence electrons  (4) a total of eight valence electrons |  |  |
| 44. | Which compound has the *lowest* vapor pressure at 50°C?  (1) ethanoic acid (2) ethanol (3) propanone (4) water |  |  |
| 45. | Given the potential energy diagram and equation representing the reaction between substances *A* and *D*:    According to Table *I*, substance *G* could be  (1) HI(g) (2) H2O (g) (3) CO2(g) (4) C2H6(g) |  |  |
| 46. | A sample of gas confined in a cylinder with a movable piston is kept at constant pressure. The volume of the gas doubles when the temperature of the gas is changed from  (1) 400. K to 200. K (3) 400.°C to 200.°C  (2) 200. K to 400. K (4) 200.°C to 400.°C |  |  |
| 47. | According to Table *F*, which compound is soluble in water?  (1) barium phosphate (3) silver iodide  (2) calcium sulfate (4) sodium perchlorate |  |  |
| 48. | Which formula represents an unsaturated hydrocarbon? |  |  |
| 49. | Which metal is more active than H2?  (1) Ag (2) Au (3) Cu (4) Pb |  |  |
| 50. | Which compound is produced when HCl(aq) is neutralized by Ca(OH)2(aq)?  (1) CaCl2 (2) CaH2 (3) HClO (4) HClO2 |  |  |

**Part B-2 Questions**

Space for answers is left below the questions for this section.

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|  | **Question** | **Table** |
| 1 | In an experiment, 2.54 grams of copper completely reacts with sulfur, producing 3.18 grams of copper(I) sulfide. Write the chemical formula of the compound produced. |  |
| 2 | **Physical Properties of CF4 and NH3**  **at Standard Pressure**     1. State evidence that indicates NH3 has stronger intermolecular forces than CF4. 2. Draw a Lewis electron-dot diagram for CF4. |  |
| 3 | A 2.0-liter aqueous solution contains a total of 3.0 moles of dissolved NH4Cl at 25°C and standard pressure.   1. Determine the molarity of the solution. 2. Identify the *two* ions present in the solute. |  |
| 4 | The diagram and balanced ionic equation below represent a voltaic cell with copper and silver electrodes and the reaction that occurs when the cell is operating.    Describe the direction of electron flow in the external circuit in this operating cell. |  |
| 5 | A 20.0-milliliter sample of HCl(aq) is completely neutralized by 32.0 milliliters of 0.50 M KOH(aq).  Calculate the molarity of the HCl(aq). Your response must include *both* a numerical setup and the calculated result. |  |
| 6. | Write an electron configuration for a silicon atom in an excited state. |  |
| 7. | **Densities of Group 14 Elements**     1. Identify *one* element from this table for *each* type of element: metal, metalloid, and nonmetal. 2. Calculate the volume of a tin block that has a mass of 95.04 grams at STP. Your response must include *both* a numerical setup and the calculated result. |  |
| 8. | Base your answers on the elements in Group 2 on the Periodic Table.   1. State the general trend in first ionization energy for the elements in Group 2 as these elements are considered in order from top to bottom in the group. 2. State, in terms of the number of electron shells, why the radius of a strontium atom in the ground state is larger than the radius of a magnesium atom in the ground state. 3. Explain, in terms of atomic structure, why the elements in Group 2 have similar chemical properties. |  |
| 9. | In the gold foil experiment, a thin sheet of gold was bombarded with alpha particles. Almost all the alpha particles passed straight through the foil. Only a few alpha particles were deflected from their original paths.State *one* conclusion about atomic structure based on the observation that almost all alpha particles passed straight through the foil. |  |
| 10. | 1. Convert the boiling point of hydrogen chloride at standard pressure to kelvins. 2. Explain, in terms of molecular polarity, why hydrogen chloride is more soluble than methane in water at 20.°C and standard pressure. 3. Explain, in terms of intermolecular forces, why ammonia has a higher boiling point than the other compounds in the table. |  |
| 11. | What is the total number of electron pairs shared between the carbon atom and one of the oxygen atoms in a carbon dioxide molecule? |  |
| 12. | Explain, in terms of subatomic particles, why the radius of a chloride ion is larger than the radius of a chlorine atom. |  |
| 13. | Explain, in terms of valence electrons, why the bonding in magnesium oxide, MgO, is similar to the bonding in barium chloride, BaCl2. |  |
| 14. | An atom in an excited state has an electron configuration of 2-7-2.   1. Explain, in terms of subatomic particles, why this excited atom is electrically neutral. 2. Write the electron configuration of this atom in the ground state. |  |
| 15. | Glycine, NH2CH2COOH, is an organic compound found in proteins. Acetamide, CH3CONH2, is an organic compound that is an excellent solvent. Both glycine and acetamide consist of the same four elements, but the compounds have different functional groups.   1. Calculate the gram-formula mass of glycine. Your response must include *both* a numerical setup and the calculated result. 2. Identify *one* functional group in a glycine molecule. 3. Draw a structural formula for acetamide. |  |
| 16. | Heat is added to a 200.-gram sample of H2O(s) to melt the sample at 0°C. Then the resulting H2O(*ℓ*) is heated to a final temperature of 65°C.   1. Determine the total amount of heat required to completely melt the sample. 2. Show a numerical setup for calculating the total amount of heat required to raise the temperature of the H2O(*ℓ*) from 0°C to its final temperature. 3. Compare the amount of heat required to vaporize a 200.-gram sample of H2O(*ℓ*) at its boiling point to the amount of heat required to melt a 200.-gram sample of H2O(s) at its melting point. |  |
| 17. | When a uranium-235 nucleus absorbs a slow-moving neutron, different nuclear reactions may occur. One of these possible reactions is represented by the complete, balanced equation below.    For this reaction, the sum of the masses of the products is slightly less than the sum of the masses of the reactants. Another possible reaction of U-235 is represented by the incomplete, balanced equation below.     1. Write a notation for the missing product in equation 2. 2. Determine the half-life of krypton-92 if only 6.0 milligrams of an original 96.0-milligram sample remains unchanged after 7.36 seconds. |  |

**Part C Questions:**

Space for answers is left below the questions for this section.

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|  | **Question and answer space** | **Ref Table Used** |
| 1. | In the early 1800s, John Dalton proposed an atomic theory that was based on experimental observations made by several scientists. Three concepts of Dalton’s atomic theory are stated below.  Statement *A*: Atoms are indivisible and cannot be destroyed or broken down into smaller parts.  Statement *B*: Atoms of one element cannot be changed into atoms of another element.  Statement *C*: All atoms of one element have the same mass.   1. Explain, in terms of particles, why statement *A* is no longer accepted. 2. Explain, in terms of particles in the atoms of an element, why statement *C* is *false*. |  |
| 2. | Litharge, PbO, is an ore that can be roasted (heated) in the presence of carbon monoxide, CO, to produce elemental lead. The reaction that takes place during this roasting process is represented by the balanced equation below.  PbO(s) + CO(g) →Pb(*ℓ*) + CO2(g)   1. Write the balanced equation for the reduction half-reaction that occurs during this roasting process. 2. Determine the oxidation number of carbon in carbon monoxide. 3. Calculate the percent composition by mass of oxygen in litharge (gram-formula mass = 223.2 grams per mole). Your response must include *both* a numerical setup and the calculated result. |  |
| 3. | In one industrial organic reaction, C3H6 reacts with water in the presence of a catalyst. This reaction is represented by the balanced equation below.    Write the IUPAC name for the organic reactant. |  |
| 4. | A student, wearing chemical safety goggles and a lab apron, is to perform a laboratory test to determine the pH value of two different solutions. The student is given one bottle containing a solution with a pH of 2.0 and another bottle containing a solution with a pH of 5.0. The student is also given six dropping bottles, each containing a different indicator listed in Reference Table *M*.   1. Identify an indicator in Reference Table *M* that would differentiate the two solutions. 2. Compare the hydronium ion concentration of the solution having a pH of 2.0 to the hydronium ion concentration of the other solution given to the student. |  |
| 5. | Gasoline is a mixture composed primarily of hydrocarbons such as isooctane, which is also known as 2,2,4-trimethylpentane.  Gasoline is assigned a number called an octane rating. Gasoline with an octane rating of 87 performs the same as a mixture that consists of 87% isooctane and 13% heptane.  An alternative fuel, E-85, can be used in some automobiles. This fuel is a mixture of 85g ethanol and 15g gasoline.   1. Draw a structural formula for a molecule of 2,2,4-trimethylpentane. 2. Identify the functional group in a molecule of ethanol in the alternative fuel E-85. |  |
| 6. | Hydrogen peroxide, H2O2, is a water-soluble compound. The concentration of an aqueous hydrogen peroxide solution that is 3% by mass H2O2 is used as an antiseptic. When the solution is poured on a small cut in the skin, H2O2 reacts according to the balanced equation below.     1. Calculate the total mass of H2O2 in 20.0 grams of an aqueous H2O2 solution that is used as an antiseptic. Your response must include *both* a numerical setup and the calculated result. 2. Determine the gram-formula mass of H2O2. |  |
| 7. | The catalytic converter in an automobile changes harmful gases produced during fuel combustion to less harmful exhaust gases. In the catalytic converter, nitrogen dioxide reacts with carbon monoxide to produce nitrogen and carbon dioxide. In addition, some carbon monoxide reacts with oxygen, producing carbon dioxide in the converter. These reactions are represented by the balanced equations below.  Reaction 1: 2NO2(g) + 4CO(g) → 2N2(g) + 4CO2(g) + 1198.4 kJ  Reaction 2: 2CO(g) + O2(g) →2CO2(g) + 566.0 kJ  Determine the oxidation number of carbon in *each* carbon compound in reaction 2. Your response must include *both* the sign and value of *each* oxidation number. |  |
| 8. | In one trial of an investigation, 50.0 milliliters of HCl(aq) of an unknown concentration is titrated with 0.10 M NaOH(aq). During the titration, the total volume of NaOH(aq) added and the corresponding pH value of the reaction mixture are measured and recorded in the table below.    In another trial, 40.0 milliliters of HCl(aq) is completely neutralized by 20.0 milliliters of this 0.10 M NaOH(aq). Calculate the molarity of the titrated acid in this trial. Your response must include *both* a numerical setup and the calculated result. |  |
| 9. | The radioisotope uranium-238 occurs naturally in Earth’s crust. The disintegration of this radioisotope is the first in a series of spontaneous decays.  The sixth decay in this series produces the radioisotope radon-222. The decay of radon-222 produces the radioisotope polonium-218 that has a half life of 3.04 minutes. Eventually, the stable isotope lead-206 is produced by the alpha decay of an unstable nuclide.   1. Explain, in terms of electron configuration, why atoms of the radioisotope produced by the sixth decay in the U-238 disintegration series do not readily react to form compounds. 2. Complete the nuclear equation *below* for the decay of the unstable nuclide that produces Pb-206, by writing a notation for the missing nuclide.      1. Determine the original mass of a sample of Po-218, if 0.50 milligram of the sample remains unchanged after 12.16 minutes. |  |
| 10. | In a laboratory, a student makes a solution by completely dissolving 80.0 grams of KNO3(s) in 100.0 grams of hot water. The resulting solution has a temperature of 60.°C. The room temperature in the laboratory is 22°C. Classify, in terms of saturation, the type of solution made by the student. |  |
| 11. | The Solvay process is a multistep industrial process used to produce washing soda, Na2CO3(s). In the last step of the Solvay process, NaHCO3(s) is heated to 300°C, producing washing soda, water, and carbon dioxide. This reaction is represented by the balanced equation below.  2NaHCO3(s) + heat →Na2CO3(s) + H2O(g) + CO2(g)  Write the IUPAC name for washing soda. |  |
| 12 | In liquid water, an equilibrium exists between H2O(*ℓ*) molecules, H(aq) ions, and OH−(aq) ions. A person experiencing acid indigestion after drinking tomato juice can ingest milk of magnesia to reduce the acidity of the stomach contents. Tomato juice has a pH value of 4. Milk of magnesia, a mixture of magnesium hydroxide and water, has a pH value of 10.   1. Identify the negative ion found in milk of magnesia. 2. What is the color of thymol blue indicator when placed in a sample of milk of magnesia? |  |
| 13 | Two sources of copper are cuprite, which has the IUPAC name copper(I) oxide, and malachite, which has the formula Cu2CO3(OH)2. Copper is used in home wiring and electric motors because it has good electrical conductivity. Other uses of copper not related to its electrical conductivity include coins, plumbing, roofing, and cooking pans. Aluminum is also used for cooking pans. At room temperature, the electrical conductivity of a copper wire is 1.6 times greater than an aluminum wire with the same length and cross-sectional area. At room temperature, the heat conductivity of copper is 1.8 times greater than the heat conductivity of aluminum. At STP, the density of copper is 3.3 times greater than the density of aluminum.   1. Write the chemical formula of cuprite. 2. Determine the oxidation number of oxygen in the carbonate ion found in malachite. 3. Identify *one* physical property of aluminum that could make it a better choice than copper for a cooking pan. |  |