**Extra Practice
1st Semester-ish**

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| 1. What number of moles of O2 is needed to produce 22.0 grams of P4O6 from P? (Molar Mass P4O6 =220 ) Write your answer in the box on the answer sheet.  |
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| 2. The simplest formula for an oxide of phosphorus that is 43.7 percent phosphorus by weight is… |
| (A) P2O5 (B) PO (C) PO2 (D) P2O3 (E) P2O |



For questions 3 and 4 refer to the mass spectrograph above.

 3. How many isotopes does this element have?

 (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

 4. What is the element?

 (A) Be (B) B (C) Ne (D) Na

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| 5. When a 1.50-gram sample of limestone (CaCO3) was dissolved in acid, 0.50 gram of CO2 was generated. If the rock contained no carbonate other than CaCO3, what was the percent of CaCO3 by mass in the limestone? Write your answer in the box on the answer sheet.  |
| 6. If you were given two 20.0 gram samples, each a mixture of LiF and KF, but in different proportions, which of the following pieces of information could be used to determine which mixture has the higher proportion of KF?(A) The volume of each mixture (C)The mass of F in each sample(B) The number of isotopes of K and Li (D) The reaction of each mixture with water |
| 7. \_\_ CH3CH2COOH(l) + \_\_ O2(g) 🡪 \_\_ CO2(g) + \_\_ H2O(l) |
| How many moles of O2 are required to oxidize 1 mole of CH3CH2COOH according to the reaction represented above? |
| (A) 2 moles (B) 5/2 moles (C) 3 moles (D) 7/2 moles (E) 9/2 moles |
| 8. A student does an experiment to determine gravimetrically the percentage of water in a hydrate. The student gets a result that is significantly lower than the accepted value. Which of the following is the most likely explanation? |
| (A) Strong initial heating caused some of the hydrate sample to spatter out of the crucible. |
| (B) The dehydrated sample absorbed moisture after heating. |
| (C) The amount of the hydrate sample used was too small. |
| (D) The crucible was not heated to constant mass before use. |
| (E) Excess heating caused the dehydrated sample to decompose.  |

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| 9. Two solutions are combined: 50.0 ml of 0.500 M KHCO3 and 25.0 ml of 2.50 molar K2CO3 What is the resulting concentration of K+? Write your answer in the box on the answer sheet.  |
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| **Compound** | **Lattice Energy (kJ/mol)** |
| NaF | 930 |
| MgF2 | 2978 |

10. The energy required to dissociate an ionic solid into gaseous ions (lattice energy) for the compounds NaF and MgF2 is shown in the table above. On the basis of Coulomb’s law, which of the following best helps to explain the large difference between the lattice energies of NaF and MgF2 ?(A) The charge of the Mg cation is greater than that of the Na cation. (B) The electronegativity of Mg is greater than that of Na.(C) The mass of the Mg cation is greater than that of the Na cation.(D) The solubility of MgF2 is less than that of NaF. The figure presents a particle diagram. The diagram consists of 40 unshaded circles, each with a positive sign drawn inside, labeled “Ion Cores.” These unshaded circles are arranged in 4 rows of 10, and none of the circles are touching. The area surrounding the unshaded circles is shaded, and negative signs are drawn in the shaded area. This shaded area is labeled “Sea of Electrons.”11. What substance could be modelled by the diagram above?(A) NaCl (B) CH4 (C) Fe (D) SiO2 The figure presents the graph of a line with the origin labeled O. The horizontal axis is labeled Volume, in milliliters, and the numbers 5 through 50, in increments of 5 are indicated. The vertical axis is labeled Temperature, in degrees Celsius, and the numbers 20 through 140, in increments of 20, are indicated. The line has data points along it. There are vertical gridlines at approximately 8 milliliters, 21.5 milliliters, 27.5 milliliters, and 42 milliliters. Between each vertical gridline the range is labeled. The labels are as follows: A, B, C, and D. The data of the line is as follows. Note that all values are approximate. The line begins in range A at 1 milliliter, 15 degrees Celsius and moves steeply upward and to the right. It reaches the point 8 milliliters, 99 degrees Celsius and moves horizontally to the right through range B. It reaches the point 23 milliliters, 99 degrees Celsius, in range C, and then moves upward and to the right. It reaches the point 27.5 milliliters, 125 degrees Celsius, and moves horizontally and to the right through range D. The line ends at 44 milliliters, 125 degrees Celsius.12. A student performed a fractional distillation of a mixture of two straight-chain hydrocarbons, C7H16 and C8H18. Using clean, dry flasks, the student collected the distillate. Over what volume range should the student collect the distillate of the compound with the weaker intermolecular forces?(A) A (B) B (C) C (D) DThe figure presents a box with several electrons represented by circles with a negative sign on the inside of each. Outside the upper left-hand side of the box of electrons there are two wavy arrows pointing at an angle towards the box. Inside the center of the box of electrons, there is one arrow pointing from an electron at an angle out of the box. Outside the upper right-hand side of the box of electrons there are two more electrons each with an arrow pointing from the electron at an angle away from the box.13. The diagram above represents the photoelectric effect for a metal. When the metal surface is exposed to light with increasing frequency and energy of photons, electrons first begin to be ejected from the metal when the energy of the photons is 3.3×10−19J. What is the bonding energy of a *core* electron in the metal?(A) 3.3 x 10-19 J (B) less than 3.3 x 10-19 J (C) more than 3.3 x 10-19 J (D) more information is needed 14. A 1.0 L sample of an aqueous solution contains 0.15 mol of LiCl and 0.25 mol of MgCl2. What is the minimum number of moles of AgNO3 that must be added to the solution in order to precipitate all of the Cl− as AgCl(s) ? (Assume that AgCl is insoluble.) Write your answer in the box on the answer sheet.  |
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| 15. When 100 mL of 1.0 M Na3PO4 is mixed with 100 mL of 1.0 M AgNO3, a yellow precipitate forms and [Ag+] becomes negligibly small. Which of the following is a correct listing of the ions remaining in solution in order of increasing concentration?  |
| (A) [PO43−] < [NO3−] < [Na+] (B) [PO43−] < [Na+] < [NO3−] (C) [NO3−] < [PO43−] < [Na+] |
| (D) [Na+] < [NO3−] < [PO43−] (E) [Na+] < [PO43−] < [NO3−] |

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| 16. The **weak** acid HF is titrated with KOH. The net ionic equation is: |
| (A) HF + K+ + OH− 🡪 KF + H2O |
| (B) HF + KOH 🡪 K+ + F− + H2O |
| (C) H+ + OH− 🡪 H2O |
| (D) HF + H2O 🡪 F− + H3O+ |
| (E) HF + OH− 🡪 F− + H2O  |

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| 17. Commercial vinegar was titrated with NaOH solution to determine the content of acetic acid, HC2H3O2. For 50.0 milliliters of the vinegar, 45.0 milliliters of 0.900-molar NaOH solution was required. What was the concentration of acetic acid in the vinegar if no other acid was present? Write your answer on the answer sheet.  |
| **SKIP THIS QUESTION** |

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| The figure presents a graph in the first quadrant of a coordinate plane. The horizontal axis is labeled “Molar Concentration of C o with a positive 2 charge, aqueous,” and the numbers 0 through 0.100, in increments of 0.020, are indicated. The vertical axis is labeled “Absorbance,” and the numbers 0.10 through 0.60, in increments of 0.10, are indicated. The line of best fit is drawn. The line begins where the axes meet. It moves steadily upward and to the right passing through the points 0.020 Molar and 0.11 absorbance, 0.040 Molar and 0.22 absorbance, 0.060 Molar and 0.33 absorbance, 0.080 Molar and 0.44 absorbance, and 0.100 Molar and 55 absorbance. There are 5 data points along the line. The data points at 0 Molar, 0.020 Molar, 0.065 Molar, and 0.100 Molar are on the line. The data point at 0.050 Molar is just below the line. |

18. A student made a standard curve using a spectrophotometer and solutions of cobalt II chloride. Which of the following could have caused the error in the point the student plotted at the 0.50M Co2+?

(A) The student rinsed the cuvette with distilled water, and some was left in the cuvette when the student put the standard solution in it.
(B) The student did not rinse the cuvette between standards and there were a few drops of the 0.100M solution in the cuvette when the student put the 0.050M solution in it.
(C) The student left fingerprints on the cuvette when placing it into the spectrophotometer.
(D) The student made a mistake when calibrating the instrument before measuring the solutions.

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| 19. A student dissolved a known mass of a solid weak acid in water and titrated it with NaOH to determine its molar mass. He obtained a result that was higher than the accepted value. Which of the following could explain why? |
| I. He did not rinse all acid from the weighing paper into the titration vessel |
| II. He added more water than was needed to dissolve the acid |
| III. He added some base beyond the equivalence point |
| (A) I only (B) III only (C) I and II only (D) II and III only (E) I, II, and IIIHCl + H2O 🡪 H3O+ + Cl‑20. For the dissolution of HCl in water, shown above, which of the following pairs includes both of the Bronsted-Lowry bases?(A) HCl and Cl‑  (B) HCl and H3O+ (C) H2O and H3O+ (D) H2O and Cl- |

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| Mass of empty crucible | 12.0 g |
| Mass of crucible and sample before heating | 14.4 g |
| Mass of crucible and sample after heating | 16.0 g |

21. A student places a sample of a pure metal in a crucible and heats it strongly in air. Data from the experiment are given in the table above. The final mass was determined after the sample was cooled to room temperature. Which of the following statements related to the experiment is correct?

(A) The mass of the sample decreased, so physical changes occurred as the metal first melted and then boiled out of the crucible.
(B) The mass of the sample increased, so a chemical change occurred when bonds formed between the metal and another substance.
(C) There was nothing for the metal to react with, so only a physical change could have occurred.
(D) The sample was only heated, so neither a physical nor a chemical change occurred.

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| The figure presents two diagrams, labeled “Diagram 1” and “Diagram 2.” Both diagrams contain six randomly arranged circles. In diagram 1, there are 3 larger circles labeled C l with a negative one charge and 3 smaller circles labeled N a with a positive one charge. In diagram 2, there are 3 larger circles labeled N O 3 with a negative one charge and 3 smaller circles labeled A g with a positive one charge.22. The diagrams above represent solutes present in two different dilute aqueous solutions before they were mixed. Water molecules are not shown. When the solutions were combined, a precipitation reaction took place. Which of the diagrams below is the best particle representation of the mixture after the precipitation reaction occurred?There are 3 circles labeled N a with a positive one charge and 3 circles labeled N O 3 with a negative one charge. At the bottom of the box, there are 6 circles touching each other. 3 of the 6 circles are labeled A g with a positive one charge and 3 are labeled C l with a negative one charge, with the two types of circles alternating.There are 6 pairs of circles. The two circles in each pair touch each other. In 3 pairs, one of the circles is labeled A g with a positive one charge and the other circle is labeled C l with a negative one charge. In the other 3 pairs, one of the circles is labeled N a with a positive one charge and one of the circles is labeled N O 3 with a negative one charge. (A) (B) There are 3 pairs of circles. The two circles in each pair touch each other. In each pair, one of the circles is labeled N a with a positive one charge and one of the circles is labeled N O 3 with a negative one charge. At the bottom of the box, there are 6 circles touching each other. 3 of the 6 circles are labeled A g with a positive one charge and 3 are labeled C l with a negative one charge, with the two types of circles alternating.There are 3 circles labeled N a with a positive one charge and 3 circles labeled N O 3 with a negative one charge. There are 3 pairs of circles with the circles touching each other. In each pair, one of the circles is labeled A g with a positive one charge and the other circle is labeled C l with a negative one charge.(C) (D) 23. 5 Fe2+ + MnO4− + 8 H+ ⇄ 5 Fe3+ + Mn2+ + 4 H2O |
| A 50.0-ml sample of Fe2+ was titrated with 0.100 M MnO4- and 15.50 ml was required to reach the end point. What is the concentration of Fe2+ in the solution? Write your answer in the box on the answer sheet**SKIP THIS QUESTION** |
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| 24. 6 I− + 2 MnO4− + 4 H2O(l) 🡪 3 I2(s) + 2 MnO2(s) + OH−**SKIP THIS QUESTION** |
| Which of the following statements regarding the reaction represented by the equation above is correct? |
| (A) Iodide ion is oxidized by hydroxide ion. |
| (B) MnO4− is oxidized by iodide ion. |
| (C) The oxidation number of manganese changes from +7 to +2. |
| (D) The oxidation number of manganese remains the same. |
| (E) The oxidation number of iodine changes from −1 to 0. |

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|  Questions 25-28 refer to atoms for which the occupied atomic orbitals are shown below:  |
| http://chem.neopages.com/quiz/apchem/mc1999a.gif |
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| 25. Represents an atom that is chemically unreactive  |
| 26. Represents an atom in an excited state  |
| 27. Represents an atom that has four valence electrons.  |
| 28. Represents an atom of a transition metal.  |

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| **Ionization Energies for element X (kJ mol−1)** |  |   |
| First | Second | Third | Fourth | Five |  |   |
| 580 | 1815 | 2740 | 11600 | 14800 |  |   |
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| 29. The ionization energies for element X are listed in the table above. On the basis of the data, element X is most likely to be…  |
| (A) Na (B) Mg (C) AI (D) Si (E) P |

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| 30. Which of the following represents a pair of isotopes? |
|    |  | Atomic Number | Mass Number |
| (A)  | I. | 6 | 14 |
| II. | 7 | 14 |
| (B)  | I. | 6 | 7 |
| II. | 14 | 14 |
| (C)  | I. | 6 | 14 |
| II. | 14 | 28 |
| (D)  | I. | 7 | 13 |
| II. | 7 | 14 |
| (E)  | I. | 8 | 16 |
| II. | 16 | 20 |

31. Choose the group in which the three species have the same number of electrons (they are isoelectronic).
(A) O2¯, K+, Ca2+
(B) Sc, Ti, V2+
(C) O2¯, N3¯, Na+
(D) Li+, Na+, K+
(E) Cs, Ba2+, La3+

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| 32. Which of the following properties generally decreases across the periodic table from sodium to chlorine?(A) First ionization energy(B) Atomic mass(C) Electronegativity(D) Maximum value of oxidation number(E) Atomic radius |
| 33. Which of the following statements is a result of the fact that the outermost electrons in neon do not experience the same nuclear charge as the outermost electrons in Na?(A) Na has a greater density at standard conditions than Ne.(B) Na has a lower first ionization energy than Ne.(C) Na has a higher melting point than Ne.(D) Na has a higher neutron-to-proton ratio than Ne.(E) Na has fewer naturally occurring isotopes than Ne. |

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34. The complete photoelectron spectra of neutral atoms of two unknown elements, X and Y, are shown above. Which of the following can be inferred from the data?

(A) Element X has a greater electronegativity than element Y does.

(B) Element X has a greater ionization energy than element Y does.

(C) Element Y has a greater nuclear charge than element X does.

(D) The isotopes of element Y are approximately equal in abundance, but those of element X are not.

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| 35. Pi bonding occurs in each of the following species EXCEPT…(A) CO2 (B) C2H4 (C) CN− (D) C6H6 (E) CH4 |
| 36. Which of the following has a zero dipole moment? |
| (A) SF6 (B) PCl3 (C) H2O( D) NO2 (E) H2CO37. For which of the following molecules are resonance structures necessary to describe the bonding satisfactorily? |
| 1. CO2 (B) NO2 (C) CCl4 (D) H2O (E) PH3
 |
|  **Use these answers for questions 38-41.** |
| (A) hydrogen bonding (B) hybridization (C) ionic bonding |
| (D) resonance (E) van der Waals forces (London dispersion forces) |
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| 38. Is used to explain why iodine molecules are held together in the solid state |
| 39. Is used to explain why the boiling point of HF is greater than the boiling point of HBr |
| 40. Is used to explain the fact that the four bonds in CH4 are equivalent41. Is used to explain the fact that the carbon-to-carbon bonds in benzene, C6H6, are identical |
| 42. CH4, CO2, NH3, PCl5, SF6 Which of the following does not describe any of the molecules above? |
| (A) Linear (B) Octahedral (C) See-saw (D) Tetrahedral (E) Trigonal pyramidal |
| 43. CH3CH2CH2OH boils at a higher temperature than CH3OCH2CH3, although the compounds are isomers. The difference in boiling points is due to differences in |
| (A) molecular mass (B) density (C) specific heat (D) hydrogen bonding (E) heat of combustion |
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| 44. X = CH3-CH2-CH2-CH2-CH3 Y = CH3-CH2-CH2-CH2-OH Z = HO-CH2-CH2-CH2-OH |
| Based on concepts of polarity and hydrogen bonding, which of the following sequences correctly lists the compounds above in the order of their decreasing solubility in water? |
| (A) Z >Y > X (B) Y > Z >X (C) Y > X >Z (D) X > Z > Y (E) X > Y > Z |
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| 45. Molecules of propene, CH3CHCH2, have carbon atoms with which types of hybridization?  |
| I. sp II. sp2  III. sp3 |
| (A) I only (B) III only (C) I and II only (D) II and III only (E) I, II, and III |
| 46. When a sample of oxygen gas in a closed container of constant volume is heated until its absolute temperature is doubled, which of the following is also doubled? |
| (A) The density of the gas (B) The pressure of the gas (C) The average velocity of the gas molecules |
| (D) The number of molecules per cm3 (E) The potential energy of the molecules |
| 47. At high pressure, propane gas has an actual volume that is greater than the volume predicted by the ideal gas law. This is because the molecules have non-negligible |
| (A) volume (B) mass (C) velocity (D) attractions  |
| 48. A gaseous mixture containing 7.0 moles of nitrogen, 2.5 moles of oxygen, and 0.50 mole of helium exerts a total pressure of 0.90 atmospheres. What is the partial pressure of the nitrogen? |
| (A) 0.13 atm (B) 0.27 atm (C) 0.63 atm (D) 0.90 atm (E) 6.3 atm |

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| 49. Which of the following actions would be likely to change the boiling point of a sample of a pure liquid in an open container? |
| I. Placing it in a smaller container |
| II. Increasing the number of moles of the liquid in the container |
| III. Moving the container and liquid to a higher altitude |
| (A) I only (B) II only (C) III only (D) II and III only (E) I, II, and III |

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|  **Questions 50-53 refer to the following descriptions of bonding in different types of solids.**  |
| (A) Lattice of positive and negative ions held together by electrostatic forces |
| (B) Closely packed lattice with delocalized electrons throughout |
| (C) Strong single covalent bonds with strong intermolecular forces |
| (D) Strong multiple covalent bonds with weak intermolecular forces |
| (E) Macromolecules held together with strong polar bonds  |
| 50. Rubidium fluoride, RbF (s)  |
| 51. Silver, Ag(s) |
| 52. Carbon dioxide, CO2(s)  |
| 53. Water, H2O(s)  |

Questions 54-55 relate to the graph shown on the right. The graph shows the temperature of a pure substance as it is heated at a constant rate in an open vessel at 1.0 atm pressure. The substance changes from the solid to the liquid to the gas phase.

 54. The substance is at its normal freezing point at time…
(A) t1 (B) t2 (C) t3 (D) t4 (E) t5
55. What happens to the substance between to the substance between t4 t4and t5?
(A) The molecules are leaving the liquid phase.
(B) The solid and liquid phases coexist in the equilibrium.
(C) The vapor pressure of the substance is decreasing.
(D) The average intermolecular distance is decreasing.
(E) The temperature of the substance is increasing.

56. The best explanation for the fact that diamond is extremely hard is that diamond crystals… **SKIP THIS QUESTION**
(A) are made up of atoms that are intrinsically hard because of their electronic structures
(B) consist of positive and negative ions that are strongly attracted to each other
(C) are giant molecules in which each atom forms strong covalent bonds with all of its neighboring atoms
(D) are formed under extreme conditions of temperature and pressure
(E) contain orbitals or bands of delocalized electrons that belong not to single atoms but to each crystal as a whole

57. Which of the following describes the changes in forces of attraction that occur as H2O changes phase from a liquid to a vapor? **SKIP THIS QUESTION**
(A) H-O bonds break as H-H and O-O bonds form.
(B) Hydrogen bonds between H2O molecules are broken.
(C) Covalent bonds between H2O molecules are broken.
(D) Ionic bonds between H+ ions and OH− ions are broken.
(E) Covalent bonds between H+ ions and H2O molecules become more effective.

58. Of the following pure substances, which has the highest melting point? **SKIP THIS QUESTION**

(A) S8 (B) I2 (C) SiO2 (D) SO2 (E) C6H6