

AP Chemistry Winter break packet

- 1) An unknown metal having a mass of 287.8 g was added to a graduated cylinder that contained 31.47 mL of water. After the addition of the metal, the water level rose to 56.85 mL. What is the density of the metal?
- 2) Explain the difference between precision and accuracy.
- 3) Explain three types of ways of separating substances by physical means. What physical properties are used to make the separation possible?
- 4) What element has an atomic number of 20 and two electron in its valence shell?
- 5) What is the probable compound formed from aluminum and oxygen has the formula?
- 6) Compare the reactivity of alkali metals, alkaline earth metals, halogens, and noble gases.
- 7) What color are the following substances: Iodine, chlorine, nickel (II) ions, copper (II) ions, zinc ions, cobalt (II) ions, bromine, sulfur, permanganate ion, triiodide complex ion.
- 8) Be able to solve for the number of protons, electrons, charge, and neutrons of neutral atom or an atom with a charge.
- 9) Be able to identify the most and least electronegative element and correctly define electronegativity
- 10) Be able to write the electron configuration for a neutral atom and an atom with a charge.
- 11) What are the Pauli exclusion principle and Hund's rule?
- 12) According to Hund's rule, how many unpaired electrons does the ground state of cobalt have?
- 13) Describe the size ionic radius of a cation and an anion compared to a neutral atom.
- 14) Write the complete electron configuration for As (arsenic) atom in the ground state. Indicate the number of unpaired electrons in the ground state atom, and explain your reasoning.

15) Explain why the first ionization energy of arsenic is greater than that of Sb (antimony).

16) A carbon-oxygen double bond in certain organic molecule absorbs radiation that has a frequency of $5.21 \times 10^{14} \text{ s}^{-1}$

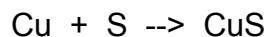
a) What is the wavelength of this radiation (in nm)?

b) What is the energy of this radiation per photon?

c) What is the energy (in kJ) per mole of photons?

17) After balancing the equation for the combustion of ethanol in the presence of oxygen and reducing all stoichiometric coefficients to their smallest possible whole number, what is the stoichiometric coefficient for O_2 ?

18) Consider the balanced equation:



Approximately what amount of sulfur in grams must be available for 28 grams of Cu to react to form the compound?

19) How many grams of N_2 occupy a volume of 12.8 liters at STP?

20) $2\text{NH}_3 \rightarrow 3\text{H}_2 + \text{N}_2$

Ammonia decomposes into hydrogen gas and nitrogen gas.

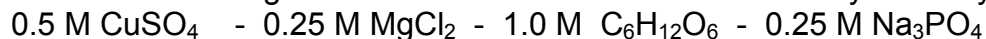
How many liters of H_2 at 25°C and 2.33 atm of pressure can be produced by the decomposition of 6.25 moles of NH_3 ?

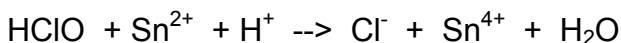
21) Complete combustion of a compound containing hydrogen and carbon produced 2.641 g of carbon dioxide and 1.442 grams of water as the only products. The molar mass of the hydrocarbon is 88.1 g/mol. What are the empirical and molecular formulas?

22) How much water must be evaporated from 500 ml of 1 M $\text{Ca}(\text{OH})_2$ to make it 5 M?

23) Compute the quantity in grams of sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) required to make a 1 M strength solution of 500 ml (a) 85.5 (b) 171 (c) 342 (d) 684 (e) 982

24) Which of the following solutions will conduct the most electricity and why?





25) Balance the above reaction. Which reactant acts as the reducing agent? How does the oxidation number of chlorine change in the reaction?

26) Aqueous solutions of potassium sulfide and nickel (II) chloride are mixed together. What is the net ionic equation?

27) Write the net ionic equation for the reaction below. Identify what got oxidized, reduced, the reducing agent, and the oxidizing agent in the following reaction.

zinc metal immersed in copper (II) chloride solution

28) Calculate the mass of product when 100.0 mL of 0.500 M CaCl_2 is added to 50.0 mL of 0.75 M sodium phosphate solution. What is the concentration of each ionic specie after the reaction is complete?

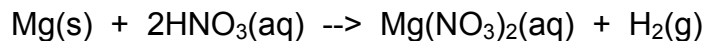
29) A sample of H_2 is collected over water. The pressure in the gas collection tube is 1.03 atm. The vapor pressure of the water is 0.06 atm. What pressure does the hydrogen gas exert?

30) What is the molar mass of the gas that effuses at half the rate of Ne?

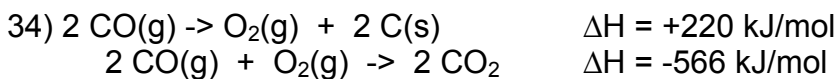
31) An ideal gas fills a balloon at a temperature of 27.0°C and 1.00 atm pressure. By what factor will the volume of the balloon change if the gas in the balloon is heated to 127.0°C ?

32) A gas sample with a mass of 12.5 grams occupies 600.0 mL and exerts a pressure of 825 mm of Hg at a temperature of 27.0°C . What is the molecular mass of the gas? The gas constant, R, is $0.08 \text{ (L}\cdot\text{atm)} / (\text{mol}\cdot\text{K})$

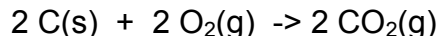
33) Small quantities of hydrogen gas can be prepared in the laboratory by the addition of aqueous nitric acid to magnesium.



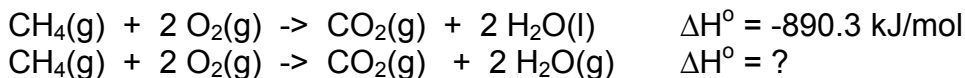
Typically, the hydrogen gas is bubbled through water for collection and becomes saturated with water vapor. Suppose 260.0 mL of hydrogen gas is collect at 30.0°C and has a total pressure of 764 torr by this process. What is the partial pressure of hydrogen gas in the sample? How many grams of magnesium must have reacted to produce the quantity of hydrogen gas? (The vapor pressure of water is 32 torr at 30.0°C)



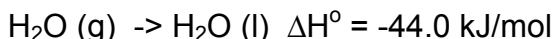
Use the information above to find the enthalpy change for the following reaction



35) The two processes for the combustion of methane in oxygen are outlined below.

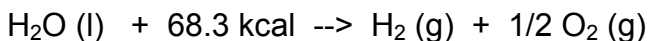


What is the value of enthalpy change, ΔH° , for the second reaction knowing that:



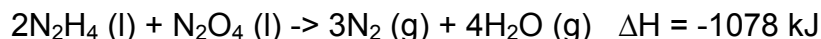
36) The specific heat of water is $1.00 \text{ cal/g } ^\circ\text{C}$. The temperature of a sample of water decreased from $48.0 \text{ } ^\circ\text{C}$ to $22.0 \text{ } ^\circ\text{C}$ as 152 calories of heat were lost. What is the mass of the sample of water?

37) An equation for the electrolysis of water is



How many liters of gaseous product are produced by the addition of 250.0 kcal of electrical energy to the reaction above?

38) Consider this reaction:



How much energy is released by this reaction during the formation 125 g of N_2

39) A 4.186 g piece of aluminum heated to $95.3 \text{ } ^\circ\text{C}$ is placed in a coffee cup calorimeter that initially contains 35.6g of water at $21.8 \text{ } ^\circ\text{C}$. If the final temperature is $24.7 \text{ } ^\circ\text{C}$, what is the specific heat capacity of the aluminum? (specific heat of water = $4.18 \text{ J/g } ^\circ\text{C}$)

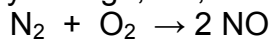
40) Write the lewis dot structure, molecular geometry and express the hybridization of the central atom in NO_2^- . Does the ion form a resonating structure?

41) What are four species isoelectronic with Ar?

42) The melting point of MgO is higher than that of NaF. Why?

43) What are the bond angles of the following species? BF_3 CF_4 NF_3 OF_2

44) Find the enthalpy change, ΔH , for the following reaction using the following information.



Bond Energies in kJ/mol $\text{N}=\text{N} = 418$; $\text{N}\equiv\text{N} = 941$; $\text{N}=\text{O} = 607$; $\text{O}=\text{O} = 495$

45) The following questions pertain to the H_2CO molecule.

- Draw a complete Lewis structure of H_2CO .
- What is the hybridization of the carbon atom?
- What is the organic functional group of this molecule

46) What will be the shape of a molecule when the central atom is surrounded by six atoms and the molecule does not contain lone pairs of electrons? What would be the shape if it were surrounded by 5 atoms and one lone pair of electrons?

47) How many sigma and pi bonds are there in the molecule $\text{H}_3\text{C}-\text{C}\equiv\text{C}-\text{CH}_3$

48) What is the type of hybridization used by chlorine in the ClF_4^- ion?

49) The reaction $\text{N}_2\text{H}_4 (\text{l}) \rightarrow \text{N}_2 + 2\text{H}_2$ $\Delta H^\circ = -50.6 \text{ kJ}$ is:

- Spontaneous at all temperatures
- non-spontaneous at all temperatures
- spontaneous only at low temperatures
- spontaneous only a high temperatures

50) A plot of rate constant versus $1/T$ for a reaction will allow you to calculate:

- rate law
- rate order
- activation energy
- intermediate

51) For the reaction: $(\text{CH}_3)_3\text{CBr}(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow (\text{CH}_3)_3\text{COH}(\text{aq}) + \text{Br}^-(\text{aq})$
it is found that halving the concentration of $(\text{CH}_3)_3\text{CBr}$ causes the reaction rate to be halved but halving the concentration of OH^- has no effect on the rate. What is the rate law for the reaction?

52) The boiling temperature of Ne is less than that of Kr. Explain?

53) Google the molecular structure of benzene and pyridine and explain why benzene is not soluble in water while pyridine is

54) Which has higher melting point methanol or methane? Explain why?

55) Which has a lower melting point neon or argon? Explain why?