Touro College

Chemistry Department

Final Examination Fall 2013

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

R= 8.31 J/mol K = 0.0821 L atm/mol K = 62.4 L torr/mol K PV = nRT

 h = 6.63x10–34 J•s Standard Pressure = 1 atm = 760 torr = 101.3 kP

 E = hν = hc c = 3.0000x108 m/ s

 λ

 The rate of effusion of a gas varies inversely with the square root of the molar mass of the gas

Some thermodynamic data.

|  |  |
| --- | --- |
| Substance | ΔH*f̊ (kJ/mol)* |
| CO2(g) | –393.5 |
| CO(g) | –110.5 |
| C2H6(g) | – 84.68 |
| HBr(g) | –36.43 |
| HCl(g) | –92.30 |
| H2O (*l*) | –285.8 |
| HI(g) | +25.9 |
|  |  |
|  |  |

Specific heat of water = 4.18 joule/g K

 **Touro College**

**Department of Chemistry**

**Final Examination, Jan 2013.**

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Answers to all questions must be written on these sheets.

\_\_\_\_\_\_1. Which one of the following exhibits dipole-dipole attraction between molecules?

A) PH3 B) CCl4 C) Br2 D) CO2 E) C10H22

\_\_\_\_\_\_2) Of the following, \_\_\_\_\_\_\_\_\_\_ has the highest boiling point.

A) N2 B) Br2 C) H2 D) Cl2 E) O2

\_\_\_\_\_\_3) What is the predominant intermolecular force in CBr4?

 A) London-dispersion forces B) ion-dipole attraction C) ionic bonding

 D) dipole-dipole attraction E) hydrogen-bonding

\_\_\_\_\_\_4) In general, the vapor pressure of a substance increases as \_\_\_\_\_\_\_\_\_\_ increases.

 A) surface tension B) molecular weight C) hydrogen bonding D) viscosity

 E) temperature

\_\_\_\_\_\_5) Some things take longer to cook at high altitudes than at low altitudes because

A) water boils at a lower temperature at high altitude than at low altitude

B) water boils at a higher temperature at high altitude than at low altitude

C) heat isn't conducted as well in low density air

D) natural gas flames don't burn as hot at high altitudes

E) there is a higher moisture content in the air at high altitude

Give the correct formula for each of the following compounds:

6. Aluminum nitrate \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 7. barium acetate\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8. Nickel (II) oxide \_\_\_\_\_\_\_\_\_\_\_\_\_ 9. Dinitrogen trioxide\_\_\_\_\_\_\_\_\_\_\_\_\_

Give correct names for the following compounds. (1 pt each)

10. Mg(NO2)2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 11. SF6 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

12. Fe2(SO4)3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 13. (NH4)2Cr2O7 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



14) Based on the figure above, the boiling point of diethyl ether under an external pressure of 1.32 atm is \_\_\_\_\_\_\_\_\_\_°C.

 A) 10 B) 20 C) 30 D) 40 E) 0

15. The blue line in the hydrogen spectrum has a wave length of 487 nanometers.

 a) What is the wave length of the line in meters?\_\_\_\_\_\_\_\_\_\_ ( 1 pt.)

 b) What is the frequency of the line? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (1.5 pt)

16. Write a balanced equation for the following reaction:

(2 pts)

 Aluminum + sulfuric acid → aluminum sulfate + hydrogen

17. Find the empirical formula of a hydrocarbon which is 75% carbon by mass.\_\_\_\_\_\_\_\_\_\_\_

18. Find the % oxygen by mass in the compound with the formula Ba(OH)2 . \_\_\_\_\_\_\_\_\_\_\_\_\_

19. Find the number of moles of carbon dioxide in 8.80 grams of carbon dioxide.\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_20. Which measurement has exactly three significant figures?

 A) 0.005 mL B) 642.0 g C) 0.0870 g/mL D) 4061 nm

\_\_\_\_\_\_\_\_\_\_21. In the reaction CaCO3 + 2 HCl → CaCl2 + CO2 + H2O, How many

 grams of CaCO3 are required to react completely with 50.0 mL of 4.00 molar

 HCl? ( MM of CaCO3 is 100 )

\_\_\_\_\_\_\_\_\_\_22. How many grams of H2O (MM = 18) are produced by the complete combustion of 39 grams of C6H6? (molar mass = 78)

 A) 54 grams B) 27 grams C)108 grams D) 36 grams

\_\_\_\_\_\_\_\_\_\_\_23. What is the molarity of a solution containing 8.0 grams of NaOH in a volume

 of 400 mL ? A) 0.50 M B) 0.050 M C) 1.00 M D) 4.0 M

\_\_\_\_\_\_\_\_\_\_\_24. If 200. mL of 0.600 molar HCl is diluted with water to a new concentration of 0.150 molar, what is the total volume of the new solution?

 A) 600. mL B) 800. mL C) 1200. mL D) 50.0 mL

\_\_\_\_\_\_\_\_\_\_\_\_\_25. Oxygen can be prepared using the reaction

 2 KClO3 → 2 KCl + 3 O2

 The molar mass of KClO3 is 123 g. If 2.00 grams of KClO3 are decomposed in this reaction, and 0.600 grams of O2 are produced, what is the % yield of oxygen?

\_\_\_\_\_26. A 66.0g sample of solid CO2( MM=44) vaporizes completely to fill an empty plastic bag to a final volume of 22.4 L at 0̊ C. What is the final pressure in the sealed bag?

 A) 380 mm Hg B) 507 mm Hg C) 760 mm Hg D) 1140 mm Hg E) 1520 mm Hg

\_\_\_\_\_27. What is the ratio of the rate of effusion of H2 to the rate of effusion of O2 if both are at 800K? A) 32:1 B) 16 :1 C) 8:1 D) 4:1 E) 1:1

\_\_\_\_\_\_\_\_28. The expression **** = is **smallest** for A) blue light B) infra red radiation

 C) ultra violet radiation D) X-rays

\_\_\_\_\_\_ 29. How many electrons are there in the **entire** third principal energy level of a Co atom in the ground state? A) 13 B) 14 C) 15 D) 6

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_30. Write the electron configuration of an Sn atom. (show sublevels)

\_\_\_\_\_31. On the phase diagram above, between which points does sublimation occur?

 A) d and e B) e and f C) d and g D) a and b E) none of these

\_\_\_\_\_\_32. The normal boiling point of the substance is represented by point

 A)a B)b C) c D) d e) e

\_\_\_\_\_\_\_33 To convert the substance, beginning from point g, to the liquid state, one would have to A) increase both the temperature and pressure

 B) increase the temperature, while decreasing the pressure

 C) decrease the temperature, while increasing the pressure

 D) decrease both the temperature and pressure

 E) increase the temperature; no change in pressure is required.

 \_\_\_\_\_\_ 34. A steel tank contains carbon dioxide at 27̊C and a pressure of 12.0 atm

 Determine the temperature necessary to increase the pressure of the gas to 24.0 atm.

 A) 54̊ C B) 13.5̊ C C) 600 K D) 150 K

\_\_\_\_\_\_35. A gas with a volume of 4.00 liters at a pressure of 100. kilopascals and a temperature of 300 K is expanded to a new volume of 16.0 liters. The temperature increases to 400 K. What is the new pressure of the gas?

 A) 33.3 kP B) 66.7 kP C) 18.75 kP D) 533 kP

 Write the symbol for the element that fits the description.

\_\_\_\_\_\_36. Has the largest ionization energy in period 4

\_\_\_\_\_\_37. Forms +4 ions that contain 18 electrons.

\_\_\_\_\_\_38. An element in period 3 that has 3 unpaired electrons.

39-40. Consider the combustion reaction of benzene,

 2 C6H6(g) + 15 O2(g) →12 CO2(g) + 6 H2O(g) ΔHo = –6270 kJ

\_\_\_\_\_39. From this reaction it can be concluded that the complete combustion of one mole

 of benzene would A) absorb 3135 kJ B) absorb 6270 kJ C) release 3135 kJ

 D) release 6270 kJ

\_\_\_\_\_40. If the reaction above is written to form 6 H2O(ℓ) instead of the 6 H2O(g), the ΔH̊ becomes –6534 kJ. From this information, it can be calculated that the heat of vaporization for water, H2O(ℓ) → H2O(g), is A) 44 kJ/mol B) –44 kJ/mol

 C) 264 kJ/mol D) –264 kJ/mol

\_\_\_\_\_41. ΔH for the reaction 2 HI(g) → H2(g) + I2(s) is

 A) +25.9 kJ B) + 51.8 kJ C) – 25.9 kJ D) –51.8 kJ

\_\_\_\_\_42. Which of the following substances has a ΔH*f̊* of 0 ?

 A) Br2(g) B) Cl2(ℓ) C) Hg(ℓ) D) N (g)

\_\_\_\_\_\_\_\_\_43. A 20.0 gram sample of metal, initially at 100̊ C is added to a sample of cold

 water. The metal transfers 450. joules of heat to the water. If the final temperature of the

 metal is 25.0̊ C, what is the specific heat of the metal, in j/g̊ ?

\_\_\_\_\_\_\_\_\_\_44. Which element contains a half filled p sublevel?

 A) P B) B C) C D) Ne

\_\_\_\_\_\_45. Which of the following characteristics would most likely be associated with a

 liquid of high viscosity? A) low boiling point B) low vapor pressure

 C) weak attractions D) rapid evaporation

\_\_\_\_\_\_\_\_\_\_\_\_\_\_46. What is the electron configuration of an Fe2+ ion?

 A) [Ar]3d44s2 B) [Ar] 3d6 C) [Ar] 3d84s2 D) [Ar]3d64s24p2

\_\_\_\_\_\_\_\_\_\_\_\_\_47. In a hydrogen atom, the highest energy photon is emitted when an electron

 drops from A) the second shell to the first B) the fourth shell to the second

 C) the third shell to the second D) the sixth shell to the third.

Match the molecule or ion with its geometry.

Geometries: A) tetrahedral B) trigonal pyramid C) bent, bond angle close to 109̊

 D) linear E) trigonal planar.

\_\_\_\_\_48. CH2Cl2

\_\_\_\_\_49. SO32–

\_\_\_\_\_50. ClO4–

\_\_\_\_\_51. CO32–

\_\_\_\_\_52. C2H2

\_\_\_\_\_53. OF2

\_\_\_\_\_54. CO2

\_\_\_\_\_55 I3–

Match the molecule or ion with its molecular geometry.

A) See-saw B) octahedral C) trigonal bipyramid D) T shape E) trigonal pyramid

F) square based pyramid.

\_\_\_\_\_56. ICl5

\_\_\_\_\_57. PF5

\_\_\_\_\_58. BrF3

\_\_\_\_\_59. SF4

\_\_\_\_\_60. SiF62--

\_\_\_\_\_61. PCl3

Choose the molecule or ion from the list below that fits the description.

A) H2CO B) CO32– C) CO D) NO2 E) CH4

\_\_\_\_\_\_62. Contains only single bonds

\_\_\_\_\_\_63. Contains a triple bond

\_\_\_\_\_\_64. A molecule with a dipole moment of zero

\_\_\_\_\_\_65. A paramagetic molecule, a free radical

\_\_\_\_\_\_66. Resonance delocalizes a bond over three equivalent positions.

\_\_\_\_\_\_67. sp3 hybridization.

\_\_\_\_\_\_68. How many orbitals are there in a 4 d sublevel?

\_\_\_\_\_\_\_69. The Heisenberg uncertainly principle deals with the uncertainty in the determination

 of which characteristics of an electron? A) charge and mass B) charge and velocity

 C) position and velocity D) location and mass.

Drawings: I. A. Draw a Lewis structure of the NO2– ion.

 B. Indicate the shape of the ion.

 C. Find the formal charge of the nitrogen in your drawing. ( 4 pts)

 D. Indicate the type of hybridization on the nitrogen atom.

 II. Draw a Lewis structure of PO33–  . Indicate the shape of the ion,

 and find the formal charge of the phosphorous. ( 4 pts)

 Indicate the type of hybridization on the phosphorous atom.

 III. Hydrogen is formed when Aluminum reacts with HCl:

 2 Al + 6 HCl → 2 AlCl3 + 3 H2 (g)

In excess Al, how many milliliters of 2.00 molar HCl are required to produce 250. mL of H2 gas at 298 K and a pressure of 0.950 atm? (SHOW WORK, step by step!!) ( 4 points)

 Extra Credits :

 I. Define the melting point of a solid in terms of vapor pressure. ( 1 pt)

 II. Explain in terms of intermolecular attractions, why butane, C4H10 , is a better choice for a typical gas lighter than either propane, C3H8 or pentane, C5H12