TAMS Tournament Chemistry Test

1. **Questions 50 Minutes, Calculator allowed**
2. What is the name of the chemical compound with the condensed structural formula CH3CHCHCHCBr2?
   1. 1, 1 dibromo-1,3 pentane
   2. 1, 1 dibromo-1,3 pentene
   3. 5, 5 dibromo-1,3 dipentene
   4. 3,3 dibromo-2,4 pentene
   5. 5, 5 dibromo-2,4 pentadiene
3. When three moles of cyclohexane are combusted with an excess of oxygen, how many moles of water are produced?
   1. 18 moles
   2. 9 moles
   3. 3 moles
   4. 6 moles
   5. 15 moles
4. Iridium-192 is a radioisotope used in medicine in the treatment of breast cancer. The rate constant for the decay is 9.5x10-3 hr-1. If a patient is injected with a sample containing 85 mg of 192Ir, how many days will it take for the amount of 192Ir to decrease to 10 mg?
   1. 22.27
   2. 9.38
   3. 9.5
   4. 21.4
   5. 24
5. If aqueous solutions of K3PO4(aq) and Ca(NO3)2(aq) are mixed together, solid Ca3(PO4)2(s) [M=310.3] precipitates from solution. If 600 mL of 0.4M K3PO4(aq) and 600 mL of 0.4M Ca(NO3)2(aq) are mixed together, what will be the concentration of the excess reactant after the Ca3(PO4)2 has precipitated?
   1. 0.4M
   2. 0.08M
   3. 0.067M
   4. 0.12M
   5. 0.008M
6. What is the heat of formation for the reaction 2 C(s) + H2(g) → C2H2 (g), given the following heat of formations?

C2H2(g) + (5/2) O2(g) → 2 CO2(g) + H2O(l) ΔH= -1299.6 kJ

C(s) + O2(g) → CO2(g) ΔH= -393.5 kJ

H2(g) + (1/2) O2(g) → H2O(l) ΔH= -285.8 kJ

* 1. 226.8 kJ
  2. -226.8 kJ
  3. -1978.9 kJ
  4. -620.3 kJ
  5. 620.3

1. Which substance is stored in contact with water to prevent it from reacting with air?
   1. Bromine
   2. Lithium
   3. Mercury
   4. Phosphorus
   5. None of the above
2. What gas is produced when dilute HNO3 is added to silver metal?
   1. NO
   2. H2
   3. NH3
   4. N2
   5. NH4
3. A 1.50 g sample of an ore containing silver was dissolved, and all of the Ag+ was converted to 0.124 g of Ag2S. What was the percentage of silver in the ore?
   1. 6.41%
   2. 7.20%
   3. 8.27%
   4. 10.8%
   5. 12.9%
4. Methyl-t-butyl ether, C5H12O, is added to gasoline to promote cleaner burning. How many moles of oxygen gas, O2, are required to burn 1.0 mol of this compound completely to form carbon dioxide and water?
   1. 4.5 mol
   2. 6.0 mol
   3. 7.5 mol
   4. 8.0 mol
   5. 9.0 mol
5. Chlorine can be prepared by reacting HCl with MnO2. The reaction is represented by this equation.

MnO2(s) + 4HCl(aq) → Cl2(g) + MnCl2(aq) + 2H2O(l)

Assuming the reaction goes to completion what mass of concentrated HCl solution (36.0% HCl by mass) is needed to produce 2.50 g of Cl2?

* 1. 5.15g
  2. 14.3g
  3. 19.4g
  4. 26.4g
  5. 59.0g

1. What is the Na+ ion concentration in the solution formed by mixing 20. mL of 0.10 M Na2SO4 solution with 50. mL of 0.30 M Na3PO4 solution?
   1. 0.15 M
   2. 0.24 M
   3. 0.48 M
   4. 0.70 M
   5. 0.85 M
2. What is the total pressure in a 2.00 L container that holds 1.00 g He, 14.0 g CO, and 10.0 g of NO at 27.0 °C?
   1. 21.6 atm
   2. 13.2 atm
   3. 1.24 atm
   4. 0.310 atm
   5. 0.031 atm
3. What type of solid is generally characterized by having low melting point and low electrical conductivity?
   1. Ionic
   2. Metallic
   3. Molecular
   4. Network covalent
   5. Pokémon
4. How many nearest neighbors surround each particle in a face-centered cubic lattice?
   1. 4
   2. 6
   3. 8
   4. 12
   5. 10
5. Consider this equation and the associated value for ∆Ho.

2H2(g) + 2Cl2(g) → 4HCl(g) ∆Ho = 92.3 kJ

Which statement about this information is incorrect?

* 1. If the equation is reversed, the ∆Ho value equals +92.3 kJ.
  2. The four HCl bonds are stronger than the four bonds in H2 and Cl2.
  3. The ∆Ho value will be –92.3 kJ if the HCl is produced as a liquid.
  4. 23.1 kJ of heat will be evolved when 1 mol of HCl(g) is produced.
  5. Change in enthalpy is 92.3 kJ.

1. For which process will ∆Ho and ∆Go be expected to be most similar?
   1. 2Al(s) + Fe2O3(s) → 2Fe(s) + Al2O3(s)
   2. 2Na(s) + 2H2O(l) → 2NaOH(aq) + H2(g)
   3. 2NO2(g) → N2O4(g)
   4. 2H2(g) + O2(g) → 2H2O(g)
   5. O(g)🡪O(s)
2. For a particular reaction, ∆Ho = –38.3 kJ and ∆So = –113 J·K–1. This reaction is
   1. spontaneous at all temperatures.
   2. nonspontaneous at all temperatures.
   3. spontaneous at temperatures below 66 °C.
   4. spontaneous at temperatures above 66 °C.
   5. spontaneous
3. What is ∆Go for this reaction?

1/2N2(g) + 3/2H2(g) = NH3(g) Kp = 4.42 × 104 at 25 °C.

* 1. –26.5 kJ·mol–1
  2. –11.5 kJ·mol–1
  3. –2.2 kJ·mol–1
  4. –0.97 kJ·mol–1
  5. –0.98 kJ·mol–1

1. If the half-life of a reaction increases as the initial concentration of substance increases, the order of the reaction is
   1. 0
   2. 1
   3. 2
   4. 3
   5. 4
2. The radioisotope N-13, which has a half-life of 10 minutes, is used to image organs in the body. If an injected sample has an activity of 40 microcuries (40 µCi), what is its activity after 25 minutes in the body?
   1. 0.75 µCi
   2. 3.5 µCi
   3. 7.1 µCi
   4. 12 µCi
   5. 13 µCi
3. Which anion forms the smallest number of insoluble salts?
   1. Cl-
   2. NO3-
   3. CO32-
   4. SO42-
   5. F-
4. Which piece of apparatus can measure a volume of 25.0 mL most precisely?
   1. 25 mL beaker
   2. 25 mL conical flask
   3. 25 mL graduated cylinder
   4. 25 mL pipet
   5. 25 mL Erlenmeyer flask
5. Five pellets of a metal have a total mass of 1.25 g and a total volume of 0.278 mL. What is the density of the metal in g·mL-1?
   1. 0.348
   2. 0.900
   3. 4.50
   4. 22.5
   5. 2250
6. What is the color of the flame test for sodium?
   1. Green
   2. Red
   3. Violet
   4. Yellow
   5. Orange
7. When is it acceptable to eat in a chemistry laboratory?
   1. Anytime when a person is not doing an experiment.
   2. Whenever there are no hazardous chemicals out.
   3. If it is necessary to do so in order to keep another appointment.
   4. If the experiment requires you to do so.
   5. Never.
8. Selenium (Se) is similar to sulfur in its properties and francium (Fr) is an alkali metal. What is the formula for francium selenite?
   1. FrSeO2
   2. Fr2SeO4
   3. Fr2SeO3
   4. Fr2Se2O3
   5. Fr2Se
9. How many ozone molecules are in 3.20 g of O3?
   1. 4.0 × 1022
   2. 6.0 × 1022
   3. 1.2 × 1023
   4. 6.0 × 1023
   5. 4.0 × 1023
10. Acetylene, C2H2, reacts with oxygen according to the unbalanced equation:

C2H2(g) + O2(g)🡪 CO2(g) + H2O(g)

What is the O2/C2H2 ratio when this equation is correctly balanced?

* 1. 2/1
  2. 3/1
  3. 4/1
  4. 5/1
  5. 5/2

1. Silicon carbide, SiC, is produced by heating SiO2 and C to high temperatures according to the equation:

SiO2(s) + 3C(s) 🡪 SiC(s) + 2CO(g)

How many grams of SiC could be formed by reacting 2.00 g of SiO2 and 2.00 g of C?

* 1. 1.33
  2. 2.26
  3. 3.59
  4. 4.00
  5. 4.01

1. Which solute produces the highest boiling point in a 0.15m aqueous solution?
   1. CaCl2
   2. NaBr
   3. CuSO4
   4. CH3OH
   5. KCl
2. A gas has a volume of 6.0 L at a pressure of 0.80 atm. What is the volume if the pressure is changed to 0.20 atm at constant temperature?
   1. 1.5 L
   2. 3.0 L
   3. 12 L
   4. 24 L
   5. 48 L
3. What pressure (in atm) will be exerted by a 1.00 g sample of methane, CH4, in a 4.25 L flask at 115˚C?
   1. 0.139
   2. 0.330
   3. 0.467
   4. 7.50
   5. 8.50
4. What are the strongest intermolecular force between neighboring carbon tetrachloride, CCl4, molecules?
   1. dipole-dipole forces
   2. dispersion forces
   3. hydrogen bonds
   4. covalent bonds
   5. ionic bonds
5. A homogeneous liquid reaction mixture is often heated to increase the rate of reaction. This is best explained by the fact that raising the temperature
   1. increases the heat of reaction
   2. decreases the energy of activation
   3. increases the vapor pressure of the liquid
   4. decreases the vapor pressure of the liquid
   5. increases the average kinetic energy of the reactants
6. For the reaction,

2A + B 🡪 C

Which relationship is correct?

* 1. ∆[A] = ∆[C]
  2. -∆[A] = ∆[C]
  3. -2∆[A] = ∆[C]
  4. -∆[A] = 2∆[C]
  5. -2∆[A] = 2∆[C]

1. Which is constant for different reactant concentrations in a first-order reaction?
   1. The time required for the concentration of reactants to drop below 0.001 M
   2. The time required for one-half of reactants to disappear
   3. The rate of disappearance of reactants in
   4. Mol\*L-1\*time-1
   5. None of the above
2. A 0.10 M solution of which salt is the most acidic?
   1. NH4C2H3O2
   2. NaCN
   3. KNO3
   4. AlCl3
   5. NaCl
3. MnO4- + NO2- + H+🡪 Mn2+ + NO3- + H2O

When this equation is balanced correctly with the smallest integer coefficients, what is the coefficient for H+?

* 1. 1
  2. 6
  3. 8
  4. 16
  5. 24

1. In which case does chromium undergo reduction?
   1. CrO3🡪CrOF3
   2. Cr3+🡪Cr(OH)4-
   3. 2CrO42-🡪Cr2O72-
   4. Cr3+🡪CrO42-
   5. Cr(s)🡪Cr(g)
2. In a hydrogen atom, which transition produces a photon with the highest energy?
   1. n = 3 🡪 n = 1
   2. n = 5 🡪 n = 3
   3. n = 12 🡪 n = 10
   4. n = 12 🡪 n = 11
   5. n = 22 🡪 n = 20
3. How many orbitals in a ground state oxygen atom are completely filled?
   1. 1
   2. 2
   3. 3
   4. 4
   5. 5
4. Which atom has the smallest first ionization energy?
   1. Na
   2. K
   3. Mg
   4. Ca
   5. F
5. The electron configuration of a cobalt atom is

1s22s22p63s23p63d74s2.

How many unpaired electrons are present in a gaseous Co3+ ion in its ground state?

* 1. 8
  2. 6
  3. 4
  4. 2
  5. 0

1. When the atoms; P (Z = 15), S (Z = 16) and As (Z = 33), are arranged in order of increasing radius, what is the correct order?
   1. P, S, As
   2. As, S, P
   3. S, P, As
   4. P, As, S
   5. As, P, S
2. The oxide of which element is the most ionic?
   1. Al
   2. B
   3. C
   4. Si
   5. Cl
3. Which species below has the same general shape as NH3?
   1. SO32-
   2. CO32-
   3. NO3-
   4. SO3
   5. H2O
4. Which formula can be used to represent an alkynes?
   1. CnH2n-2
   2. CnH2n
   3. CnH2n+2
   4. CnH2n+4
   5. CnH2n+6
5. How many different structural isomers exist for dichloropropane, C3H6Cl2?
   1. 4
   2. 5
   3. 6
   4. 0
   5. Some other number
6. Which functional group is present in CH3COOH?
   1. Aldehyde
   2. Carboxylic acid
   3. Achohol
   4. Hydroperoxide
   5. None of the above
7. How many sigma bonds does a molecule of ethene have?
   1. 1
   2. 4
   3. 5
   4. 7
   5. 8