SHOW ALL CALCULATIONS & USE PROPER SIGNIFICANT FIGURES AND UNITS

Multiple Choice Questions: Circle the single best answer. No penalty for guessing.

1. How many significant figures do the following numbers have: 0.0003830 and 9320? (4 points)
   A) 4 for the first 3 for the second  
   B) 3 for the first 3 for the second  
   C) 4 for the first 4 for the second  
   D) 7 for the first 4 for the second  
   E) 8 for the first 3 for the second

2. IF₃ is which of the following molecular geometries. (4 points)
   A) tetrahedral  
   B) T-shaped  
   C) trigonal planar  
   D) octahedral  
   E) seesaw

3. What is the formal charge on carbon in CO? (4 points)
   A) –1  
   B) +1  
   C) 0  
   D) +2  
   E) +5

4. Calculate the formula weight of Na₂CO₃. (4 points)
   A) 51.00 g/mol  
   B) 105.989 g/mol  
   C) 73.989 g/mol  
   D) 221.970 g/mol  
   E) 82.998 g/mol

5. How many nodes does a 4dₓᵧ orbit have? (4 points)
   A) 2 radial and 1 angular  
   B) 0 radial and 1 angular  
   C) 1 radial and 1 angular  
   D) 3 radial and 2 angular  
   E) 1 radial and 2 angular

6. What volume of 0.3321 M NaOH is required to titrate 37.2 ml of 2.11 M HCl to a neutral endpoint? (4 points)
   A) 37.2 ml  
   B) 236.4 ml  
   C) 26.07 ml  
   D) 5.86 ml  
   E) 33.21 ml

7. What is the q of the surroundings if 1.00 mole of CH₄ is burned assuming no work is done on either the system or surrounding given the ΔH_{combustion} = –802 kJ mol⁻¹ for CH₄. (4 points)
   A) 802 kJ  
   B) –802 kJ  
   C) 0 kJ  
   D) 1602 kJ  
   E) cannot be determined
8. A given γ-ray photon has 2.21 µJ of energy. What is the energy if the frequency of this γ-ray were doubled? (4 points)
   A) 2.21 µJ   B) 4.42 µJ   C) 8.84 µJ   D) 1.11 µJ   E) cannot be determined

9. Which of the following atoms or ions has the 1s\(^2\) 2s\(^2\) 2p\(^6\) 3s\(^2\) 3p\(^6\) 4s\(^2\) 3d\(^5\) electron configuration? (4 points)
   A) He   B) Ca   C) Ru   D) Mn   E) Fe\(^{2+}\)

10. Draw the Lewis dot structure for SF\(_4\) and indicate oxidation numbers for each atom. (15 points)

11. Write the formula or name of the following ionic compounds and indicate the solubility. (16 points)
   ZnSO\(_4\)   Hg\(_2\)(ClO\(_4\))\(_2\)   potassium fluoride   manganese (II) sulfide

12. Given the following data enthalpies of reaction:
   \[
   \begin{align*}
   C (s) + \frac{1}{2} O_2 (g) &\rightarrow CO (g) \quad \Delta H = -110.5 \text{ kJ/mol} \\
   \frac{1}{2} N_2 (g) + \frac{3}{2} H_2 (g) &\rightarrow NH_3 (g) \quad \Delta H = -46.2 \text{ kJ/mol} \\
   C (s) + N_2 (g) + 2 H_2 (g) &\rightarrow NH_4CN (s) \quad \Delta H = 0.0 \text{ kJ/mol} \\
   \frac{1}{2} O_2 (g) + H_2 (g) &\rightarrow H_2O (g) \quad \Delta H = -241.8 \text{ kJ/mol}
   \end{align*}
   \]
   Calculate the ΔH for the reaction of CO with NH\(_3\). How much heat is released when 9.5 g of NH\(_3\) reacts with excess CO? (15 points)
   \[
   ___ \text{CO} (g) + ___ \text{NH}_3 (g) \rightarrow ___ \text{NH}_4\text{CN} (s) + ___ \text{H}_2\text{O} (g)
   \]
13. Explain the trend for the first ionization energy of the following atoms (Rb, Ca, Kr, Ar, F). Use electron configuration and effective charge arguments. (10 points)

14. Write the electron configuration for Be, Y, P$^{3+}$ and I$^{-}$ using noble gas configuration abbreviations if you want. Indicate if any of these have unpaired electrons. (12 points)

15. Which has a higher bond enthalpy, N=N (double bond) or N–N (single bond). Explain why. (6 points)

16. Balance the following two equations and write out a final net ionic equations. (12 points)

$$\text{____ K}_2\text{SO}_4 (aq) + \text{____ AgNO}_3 (aq) \rightarrow \text{_________} + \text{_________}$$

$$\text{____ NH}_4\text{SO}_3 (aq) + \text{____ NiCl}_2 (aq) \rightarrow \text{_________} + \text{_________}$$
17. The density of air at ordinary atmospheric pressure and 25°C is 1.19 g/L. What is the mass, in kilograms, of the air in a room that measures 8.2 x 13.5 x 2.75 m. (6 points)

18. How much heat is needed to raise the temperature of 250.0 mL of deionized water from 12.3 °C to 110.0 °C. Assume that the $\Delta H_{\text{vap}}$ for water is 2.253 kJ g$^{-1}$, the heat capacity of steam is 1.866 J g$^{-1}$ K$^{-1}$, and the heat capacity of liquid water is 4.184 J g$^{-1}$ K$^{-1}$. (12 points)

19. How many protons, electrons and neutrons does $^{197}$Au$^{2+}$ have? (5 points)

20. A mixture of N$_2$ (g) and H$_2$ (g) is caused to react in a closed container to form ammonia, NH$_3$ (g). The reaction ceases before either reactant has been totally consumed. At this stage, 2.0 mol of N$_2$, H$_2$ and NH$_3$ are present. How many moles of N$_2$ and H$_2$ were present originally? (10 points)

21. If the human eye receives a $1.45 \times 10^{-17}$ J signal from photons whose wavelength is 550 nm, how many photons have hit the eye ($h = 6.626 \times 10^{-34}$ J s, $c = 3.00 \times 10^8$ m s$^{-1}$)? (10 points)
22. Give the Lewis dot structure (including any resonance forms), formal charges, electron pair and molecular geometry for the molecule N₂O. (15 points)

23. Which of the following oxides are ionic and which are molecular: N₂O, Na₂O, CaO, CO, Cl₂O₇? Explain the reasons for your choices. (10 points)

24. Show the locations of electrons on a molecular orbital energy diagram and give the bond order for NO. (10 points)

25. BONUS: A mixture of pure AgCl and pure AgBr is found to contain 60.94% Ag by mass. What are the mass percentages of Cl and Br in the mixture? Hint: Solve a system of two equations (one relating moles of Ag, Cl and Br and the other relating masses) to give the final percentages. (10 points)