SHOW ALL CALCULATIONS & USE PROPER SIGNIFICANT FIGURES AND UNITS

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

1. How many µL are there in 0.0051 mL of fluid? (2 points)
   A) 5.1x10⁻⁶ µL  B) 5.1x10⁻³ µL  C) 5.1 µL  D) 5.1x10⁻³ µL  E) 5.1x10⁻⁶ µL

2. Which of the following will form a compound with hydrogen that is most similar to the sulfur compound, H₂S? (2 points)
   A) ¹⁶O  B) ¹⁹F  C) ¹⁴N  D) ³⁵Br  E) ²¹Sc

3. How many grams is 3.62 mole of methane, CH₄? (2 points)
   A) 0.0173 g  B) 0.226 g  C) 3.62 g  D) 4.43 g  E) 58.1 g

4. How many grams of sodium hydroxide are needed to make 250.0 ml of 0.235M NaOH (MW = 39.997)? (2 points)
   A) 0.426 g  B) 0.681 g  C) 1.47 g  D) 2.35 g  E) 42.6 g

5. How much heat (in kJ) is needed to raise the temperature of a 500.0 mL cup of water to 85°C from 25°C (heat capacity of water is 4.184 J g⁻¹ K⁻¹ and density of water is 1.00 g/mL)? (2 points)
   A) 180 kJ  B) 130 kJ  C) 52 kJ  D) 7.2 kJ  E) 0.50 kJ

6. Use Hess’ Law to calculate the ΔH_rxn for the following reaction:
   \[ \text{NH}_₄\text{NO}_₃ (s) \rightarrow \text{N}_₂\text{O} (g) + \text{H}_₂\text{O} (g) \]
   Given the following heats of formation: N₂O (g) = +81.6 kJ/mol, H₂O (g) = –241.8 kJ/mol, NH₄NO₃ (s) = –365.6 kJ/mol. (10 points)

\[ \Delta H_{rxn} = \]
7. Name the following ionic compounds and indicate the solubility. (6 points each)

- \( \text{Cr}_2(\text{Cr}_2\text{O}_7)\text{}_3 \)  
- \( \text{NH}_4\text{NO}_2 \)  
- \( \text{Sr(OH)}_2 \)

8. Write the empirical formula for the following compounds and indicate the solubility. (6 points each)

- Lithium acetate  
- Lead (II) bromide  
- Periodic acid

9. Calculate the frequency of light emitted from a hydrogen atom when its electron falls from the \( n = 7 \) to the \( n = 3 \) state. (Potentially Useful Equations: \( E_n = -R_H/n^2 \), \( E = n\ h\ \nu \), \( c = \lambda\ \nu \), \( c = 3.0 \times 10^8 \text{ m/s} \), \( h = 6.626 \times 10^{-34} \text{ J s} \), \( R_H = 2.18 \times 10^{-18} \text{ J} \)) (6 points)

10. Sketch a rough picture showing the shape of \( n = 2, l = 1 \) and \( n = 3, l = 2 \) orbits. Give the name and orientation description (1s, 3p\(_x\), 4d\(_{z^2}\), etc.) as well be sure to indicate the \( x, y \) and \( z \) axes in these pictures as well as any nodal planes. (8 points)
11. The ΔH for the following reaction is +55.2 kJ mol\(^{-1}\). Calculate the amount of heat required to completely decompose 6.87 g of ammonium carbonate. (15 points)

\[
(NH_4)_2CO_3 (s) \rightarrow 2 NH_3 (g) + CO_2 (g) + H_2O (g)
\]

Minimum heat required =  

12. What elements have the following electron configurations: 1s\(^2\)2s\(^2\)2p\(^4\), [Ne]3s\(^3\)3p\(^5\), [Ar]4s\(^1\)3d\(^5\). (6 points)

13. Balance the following two equations and write out the final net ionic equations for each. (10 points)

\[
\begin{align*}
\text{____ (NH}_4\text{)}_2\text{SO}_4 (aq) + \text{___ AgNO}_3 (aq) & \rightarrow \text{________} + \text{________} \\
\text{____ SrCl}_2 (aq) + \text{___ Na}_2\text{SO}_3 (aq) & \rightarrow \text{________} + \text{________}
\end{align*}
\]

14. BONUS QUESTION: Describe an experiment which would show the wave character of an electron. (5 bonus points)