

(Solubility table, activity series of metals, and all relevant constants would be given)

- The following are properties of the element zirconium; classify them as physical or chemical properties. **[3]**
 - reacts with hot HCl(g) _____
 - melting point = 1852°C _____
 - reacts with silicon at high temperature _____
- Classify the following changes as physical or chemical. **[3]**
 - tearing up a piece of paper _____
 - burning sugar _____
 - dissolving sugar in water _____
- How many significant figures? **[4]**
 - 0.004196 _____
 - 2.00×10^{-3} _____
 - 4068 _____
 - 90.09 _____
- Express the following in scientific notation to have three significant figures. **[2]**
 - 8,720,000
 - 0.006285
- The lowest recorded temperature in the world was recorded as -89.2°C at the Soviet Antarctic Station on July 23, 1983. What is this temperature in °F? **[2]**
 - The highest recorded temperature in the world was recorded as 136.4°F at Azizia, Libya, in the Sahara desert on September 13, 1922. What is this temperature in °C? **[2]**

6. Perform the following conversions.

a) 25.9 km to mm **[2]**

b) 13.6 g/mL to kg/m³ **[2]**

c) 3655 square feet to square meters (12.0 inches = 1ft, 1 inch = 2.54 cm) **[3]**

7. How many grams of gold will have the same volume as 100.0 g of copper? Densities (g/cm³) of copper and gold are 8.96 and 19.32, respectively. **[2]**

8. Much of iron is obtained from the mineral magnetite, which has a density of 5.2 g/cm³ and contains 72.4 % iron by mass. How many cubic meters of magnetite are needed to supply 1000 kg of iron? **[3]**

9. a) It takes 1368 J to raise the temperature of 45.6 g of lead by 13.3°C. What is the specific heat of lead? **[2]**

b) How much energy is needed to raise the temperature of 850 g block of aluminum from 22.8°C to 94.6°C? Specific heat of aluminum is 0.900 J/g °C. **[2]**

10. a) An ion contains 50 protons, 68 neutrons, and 48 electrons. Give its isotopic or nuclide symbol. **[1.5]**

b) How many protons, neutrons, and electrons are in $^{59}\text{Co}^{3+}$? **[1.5]**

c) Identify each of the following elements: **[6]**

i) A noble gas with 54 protons _____

ii) A member of the oxygen family. The anion with 2- charge contains 36 electrons. _____

iii) A member of the alkaline earth family. The 2+ ion has 18 electrons. _____

iv) How many elements are there in period # 4? _____

v) Write the formula of a diatomic elementary substance that is a liquid at 25°C. _____

vi) Give the symbol of the most active alkali metal. _____

11. Calculate the atomic mass to four significant digits for antimony, given the following: [3]

Isotope	Atomic Mass(amu)	% Abundance
Sb-121	120.9038	57.25
Sb-123	122.9041	42.75

12. Write the formula for each of the following: [6]

a) Copper(I) carbonate _____

b) Iron(II) nitrite _____

c) Diphosphorous pentoxide _____

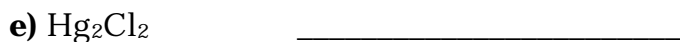
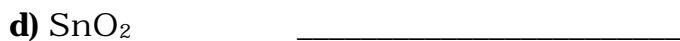
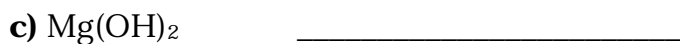
d) Hydrosulfuric acid _____

e) Cobalt (II) chloride hexahydrate _____

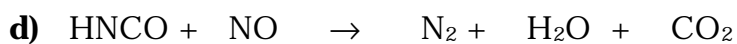
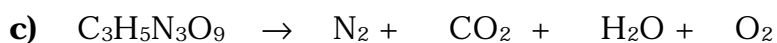
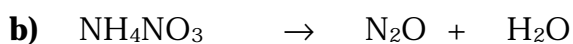
f) Ammonium sulfate _____

13. Write the correct name for each of the following: [6]

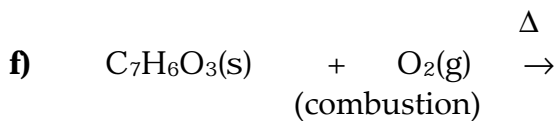
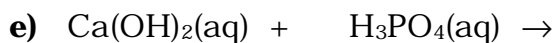
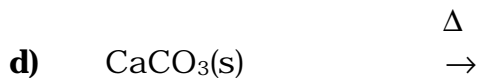
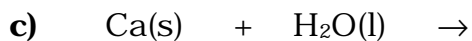
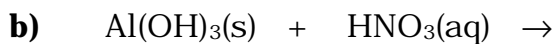
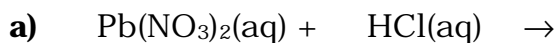
a) AgNO_3 _____



14. Balance the following equations: **[4]**



15. Complete and balance the following reactions. Give the proper states of substances. In each case there is a reaction. **[12]**



16. Aspartame is an artificial sweetener which is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed as Nutra-Sweet. The molecular formula of aspartame is $C_{14}H_{18}N_2O_5$.

a) Calculate the molar mass of aspartame. **[2]** _____

b) How many moles of molecules are in 10.0 g of aspartame? **[2]**

c) How many molecules are in 5.00 g of aspartame? **[1]**

d) How many atoms of nitrogen are in 10.0 g of aspartame? **[2]**

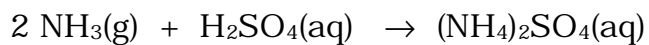
e) What is the mass of one molecule of aspartame? [2]

17. Monosodium glutamate (MSG), a food-flavor enhancer, has been blamed for “Chinese restaurant syndrome,” the symptoms of which are headaches and chest pains. MSG has the following composition by mass: 35.51 % C, 4.77 % H, 37.85 % O, 8.29 % N, and 13.60 % Na.

a) Calculate the simplest (empirical) formula of MSG. [5]

b) What is its molecular formula if its molar mass is 169? [2]

18. The fertilizer ammonium sulfate is prepared by the following reaction.



The yield of the reaction is 87.0 %. How many grams of NH_3 are needed to produce 445 grams of ammonium sulfate? **[3]**

19. Consider the reaction



If 0.86 mole of MnO_2 and 48.2 g of HCl react,

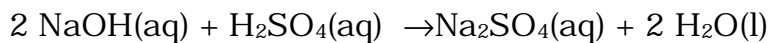
a) Which is the limiting reagent? **[4]**

b) How many grams of chlorine will be produced? **[2]**

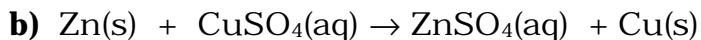
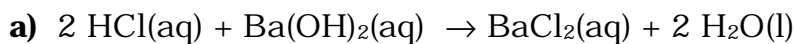
c) How many grams of which reactant are left unused? **[3]**

- 20.** Calculate the mass of NaOH required to prepare a 500.0 mL solution of concentration 2.80 M. **[2]**
- 21.** How many moles of Cl^- are present in 60.0 mL of 0.100 M MgCl_2 solution? **[2]**
- 22.** Calculate the volume in mL of a solution required to provide 0.85 g of acetic acid, CH_3COOH , from a 0.30 M solution of the acid. **[2]**
- 23.** A 46.2 mL of 0.568 M KOH solution is mixed with an 80.5 mL of 1.396 M KOH solution. The resulting solution is mixed with 228 mL of water. Calculate the molarity of KOH in the final solution. **[3]**
- 24.** An aqueous solution containing 12.0% NaOH by mass has a density of 1.131 g/mL. Calculate the molarity of NaOH in the solution. **[3]**

- 25.** How many mL of a 0.610 M NaOH solution are needed to completely neutralize 20.0 mL of a 0.245 M H₂SO₄? **[3]**



- 26.** Write the net-ionic equations for the following reactions. **[4]**



- 27.** How much heat is given off when 1.00 kg of CH₃OH is burned according to the reaction? **[2]**

