1. In 1928, 3.3 g of a new element was isolated from 660 kg of the ore molybdenite. The percent by mass of this element in the ore was:
   a. 5 %
   b. 6.6 %
   c. 3.3 %
   d. $5.0 \times 10^{-4}$ %
   e. 2.2 %

2. A quantitative observation
   a. contains a number and a unit.
   b. does not contain a number.
   c. always makes a comparison.
   d. must be obtained through experimentation.
   e. none of these

3. Which of the following is the least probable concerning five measurements taken in the lab?
   a. The measurements are accurate and precise.
   b. The measurements are accurate but not precise.
   c. The measurements are precise but not accurate.
   d. The measurements are neither accurate nor precise.
   e. All of these are equally probable.

4. A scientist obtains the number 0.045006700 on a calculator. If this number actually has four (4) significant figures, how should it be written?
   a. 0.4567
   b. 0.4501
   c. 0.045
   d. 0.04500
   e. $0.04501$

5. A piece of indium with a mass of 16.61 g is submerged in 46.3 cm$^3$ of water in a graduated cylinder. The water level increases to 48.6 cm$^3$. The correct value for the density of indium from these data is:
   a. 7.222 g/cm$^3$
   b. 7.2 g/cm$^3$
   c. 0.14 g/cm$^3$
   d. 0.138 g/cm$^3$
   e. more than 0.1 g/cm$^3$ away from any of these values.

6. Using the rules of significant figures, calculate the following: 4.0021 – 1.013
   a. 2.989
   b. 3
   c. 2.9891
   d. 2.99
   e. 3.0
7. Convert 4324 mL to qts. (1 L = 1.06 qt)
   a. 4583 qts
   b. 4.079 qts
   c. 4.079e-3 qts
   d. 4079 qts
   e. **4.583 qts**

8. A monolayer containing 3.15e-6 g of oleic acid has an area of 20.0 cm². The density of oleic acid is 0.895 g/mL. What is the thickness of the monolayer (the length of an oleic acid molecule)?
   a. 7.04e-5 cm
   b. 5.68e6 cm
   c. 1.41e-7 cm
   d. **1.76e-7 cm**
   e. 1.41e-7 cm

9. The density of gasoline is 0.7025 g/mL at 20°C. When gasoline is added to water:
   a. **it will float on top.**
   b. it will sink to the bottom.
   c. it will mix so you can’t see it.
   d. the mixture will improve the running of the motor.
   e. none of these things will happen.

10. A freighter carrying a cargo of uranium hexafluoride sank in the English Channel late August 1984. The cargo of uranium hexafluoride weighed 2.251e8 kg and was contained in 30 drums, each having a volume of 1.62x10⁶ L. What is the density (g/mL) of uranium hexafluoride?
    a. 1.39 g/mL
    b. **4.63 g/mL**
    c. 2.25 g/mL
    d. 0.216 g/mL
    e. 46.3 g/mL

11. Which of the following pairs of compounds can be used to illustrate the law of multiple proportions?
    a. NH₄ and NH₄Cl
    b. ZnO₂ and ZnCl₂
    c. H₂O and HCl
    d. **NO and NO₂**
    e. CH₄ and CO₂

12. \(^{40}\)Ca\(^{2+}\) has
    a. **20 protons, 20 neutrons, and 18 electrons.**
    b. 22 protons, 20 neutrons, and 20 electrons.
    c. 20 protons, 22 neutrons, and 18 electrons.
    d. 22 protons, 18 neutrons, and 18 electrons.
    e. 20 protons, 20 neutrons, and 22 electrons.
13. Which of the following name(s) is(are) correct?
   1) sulfide $S^{2-}$
   2) ammonium chloride NH$_4$Cl
   3) acetic acid HC$_2$H$_3$O$_2$
   4) barium oxide BaO

   a. **all**
   b. none
   c. 1, 2
   d. 3, 4
   e. 1, 3, 4

14. Which of the following statements is (are) true?
   a. $^{18}$O and $^{19}$F have the same number of neutrons.
   b. $^{13}$C and $^{14}$N are isotopes of each other because their mass numbers are the same.
   c. $^{18}$O$^{2-}$ has the same number of electrons as $^{20}$Ne.
   d. a and b
   e. **a and c**

15. The formula for calcium bisulfate is
   a. Ca(SO$_4$)$_2$
   b. CaS$_2$
   c. **Ca(HSO$_4$)$_2$**
   d. Ca$_2$HSO$_4$
   e. CaS

16. All of the following are in aqueous solution. Which is incorrectly named?
   a. H$_2$SO$_4$, sulfuric acid
   b. H$_3$PO$_4$, phosphoric acid
   c. H$_3$PO$_4$, phosphoric acid
   d. **HCN, cyanic acid**
   e. HCl, hydrochloric acid

17. Write the names of the following compounds:
   a) FeSO$_4$ __iron(II) sulfate__
   b) NaC$_2$H$_3$O$_2$ __sodium acetate__
   c) KNO$_2$ __potassium nitrite__
   d) Ca(OH)$_2$ __calcium hydroxide__
   e) NiCO$_3$ __nickel(II) carbonate__

18. You are given a compound with the formula MCl$_2$, in which M is a metal. You are told that
    the metal ion has 26 electrons. What is the identity of the metal?
   a. Co
   b. Al
   c. Fe
   d. Cr
   e. **Ni**
19. The atomic mass of rhenium is 186.2. Given that 37.1% of natural rhenium is rhenium-185, what is the other stable isotope?

   a. \( \frac{183}{75} \text{Re} \)
   
   b. \( \frac{187}{75} \text{Re} \)
   
   c. \( \frac{189}{75} \text{Re} \)
   
   d. \( \frac{181}{75} \text{Re} \)
   
   e. \( \frac{190}{75} \text{Re} \)

20. Naturally occurring copper exists in two isotopic forms: Copper-63 and Copper-65. The atomic mass of copper is 63.55 amu. What is the approximate natural abundance of Copper-63?

   a. 63%
   
   b. 90%
   
   c. 70%
   
   d. 50%
   
   e. 30%

21. For which compound does 0.256 mole weigh 12.8 g?

   a. \( \text{C}_2\text{H}_4\text{O} \)
   
   b. \( \text{CO}_2 \)
   
   c. \( \text{CH}_3\text{Cl} \)
   
   d. \( \text{C}_2\text{H}_6 \)
   
   e. none of these

22. A given sample of xenon fluoride contains molecules of a single type \( \text{XeF}_n \), where \( n \) is some whole number. Given that \( 9.03 \times 10^{20} \) molecules of \( \text{XeF}_n \) weigh .311 g, calculate \( n \).

   a. 1
   
   b. 2
   
   c. 4
   
   d. none of these

23. How many atoms of hydrogen are present in 5.5 g of water?

   a. 1.8e23
   
   b. 1.6e24
   
   c. 6.6e24
   
   d. 3.7e23
   
   e. 0.61
24. What is the molar mass of cryolite (Na₃AlF₆)?
   a. 209.9
   b. 185.3
   c. **210.0**
   d. 104.2
   e. 68.97

25. What is the coefficient for water when the following equation is balanced?
   \[
   \text{As(OH)}_3(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{As}_2(\text{SO}_4)_3(\text{aq}) + \text{H}_2\text{O}(\text{l})
   \]
   a. 1
   b. 2
   c. 4
   d. **6**
   e. 12

26. You take an aspirin tablet (a compound consisting solely of carbon, hydrogen, and oxygen) with a mass of 1.00 g, burn it in air, and collect 2.20 g of carbon dioxide and 0.400 g of water. The molar mass of aspirin is between 170 and 190 g/mol. The molecular form of aspirin is
   a. C₆H₈O₅
   b. **C₉H₆O₄**
   c. C₈H₁₀O₅
   d. C₁₀H₆O₄
   e. none of these

27. Suppose the reaction \( \text{Ca}_3(\text{PO}_4)_2 + 3\text{H}_2\text{SO}_4 \rightarrow 3\text{CaSO}_4 + 2\text{H}_3\text{PO}_4 \) is carried out starting with 103 g of \( \text{Ca}_3(\text{PO}_4)_2 \) and 26.7 g of \( \text{H}_2\text{SO}_4 \). How much phosphoric acid will be produced?
   a. 26.7 g
   b. **17.8 g**
   c. 239.8 g
   d. 40.0 g
   e. 65.1 g

28. An oxide of iron has the formula Fe₃O₄. What mass percent of iron does it contain?
   a. 0.72%
   b. 28%
   c. 30%
   d. 70%
   e. **72%**

29. A chloride of rhenium contains 63.6% rhenium. What is the formula of this compound?
   a. ReCl
   b. **ReCl₂**
   c. ReCl₅
   d. ReCl₇
   e. Re₂Cl₃
30. The empirical formula of styrene is CH; its molar mass is 104.1. What is the molecular formula of styrene?

a. C₂H₄
b. C₆H₈
c. C₁₀H₁₂
d. C₆H₁₀
e. none of these

31. Adipic acid contains 49.32% C, 43.84% O, and 6.85% H by mass. What is the empirical formula?

a. C₃H₅O₂
b. C₃H₅O₄
c. C₁₀HO₃
d. C₂H₄O₄
e. C₃HO₃

32. Vitamin C contains the elements C, H, and O. It is known to contain 40.9% C and 4.58% H by mass. The molar mass of vitamin C has been found to be about 180. The molecular formula for vitamin C is:

a. C₂H₃O₂
b. C₃H₄O₃
c. C₄H₆O₄
d. C₆H₈O₆

33. When 223.0 g of ethylene (C₂H₄) burns in oxygen to give carbon dioxide and water, how many grams of CO₂ are formed?

a. 699.7 g
b. 349.9 g
c. 174.9 g
d. 7.95 g
e. 286.4 g

34. Determine the coefficient for O₂ when the following equation is balanced in standard form (smallest whole number integers)

\[ \text{C}_4\text{H}_{10}(g) + \text{O}_2(g) \rightarrow \text{CO}_2(g) + \text{H}_2\text{O}(g) \]

a. 4
b. 8
c. 10
d. 13
e. 20

35. \[ w\text{PCl}_5 + x\text{H}_2\text{O} \rightarrow y\text{POCl}_3 + z\text{HCl} \]

The above equation is properly balanced when

a. \( w = 1, x = 2, y = 2, z = 4 \)
b. \( w = 2, x = 2, y = 2, z = 2 \)
c. \( w = 2, x = 2, y = 2, z = 1 \)
d. \( w = 1, x = 1, y = 1, z = 2 \)
e. none of these
36. A 6.35-g sample of potassium chlorate was decomposed according to the following equation:

\[ 2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2 \]

How many moles of oxygen are formed?

a. 2.49 g
b. 0.0518 mol
c. 0.0345 mol
d. **0.0777 mol**
e. none of these

37. How many grams of H\textsubscript{2}O will be formed when 32.0 g H\textsubscript{2} is mixed with 18.0 g of O\textsubscript{2} and allowed to react to form water?

a. **20.3 g**
b. 286 g
c. 10.1 g
d. 5.1 g
e. 144 g

38. A 15-g sample of lithium is reacted with 15 g of fluorine to form lithium fluoride: \[ 2\text{Li} + \text{F}_2 \rightarrow 2\text{LiF} \]. After the reaction is complete, what will be present?

a. 2.16 moles lithium fluoride only
b. 0.789 moles lithium fluoride only
c. 2.16 moles lithium fluoride and 0.395 moles fluorine
d. **0.789 moles lithium fluoride and 1.37 moles lithium**
e. none of these

39. The following two reactions are important in the blast furnace production of iron metal from iron ore (Fe\textsubscript{2}O\textsubscript{3}):

\[ 2\text{C(s)} + \text{O}_2(\text{g}) \rightarrow 2\text{CO(g)} \]
\[ \text{Fe}_2\text{O}_3 + 3\text{CO(g)} \rightarrow 2\text{Fe} + 3\text{CO}_2(\text{g}) \]

Using these balanced reactions, how many moles of O\textsubscript{2} are required for the production of 2.35 kg of Fe?

a. **31.6 moles**
b. 14.0 moles
c. 126 moles
d. 42.1 moles
e. 1.76 moles

40. The reaction of 11.9 g of CHCl\textsubscript{3} with excess chlorine produced 13.3 g of CCl\textsubscript{4}, carbon tetrachloride:

\[ 2\text{CHCl}_3 + 2\text{Cl}_2 \rightarrow 2\text{CCl}_4 + 2\text{HCl} \]

What is the percent yield?

a. 100.%
b. 43.4%
c. **86.8%**
d. 112%
e. 57.8%