1. Molecules can be described as

    A. mixtures of two or more pure substances.
    B. mixtures of two or more elements that has a specific ratio between component.
    C. two or more atoms/ions joined together.
    D. heterogeneous mixtures.
    E. homogeneous mixtures.

2. What is the chemical name of SnO?

    A. tin(I) oxide
    B. tin(II) oxide
    C. tin(III) oxide
    D. tin(IV) oxide
    E. none of the choices

3. A triple bond contains _____ electrons.

    A. 2   B. 3   C. 4   D. 5   E. 6

4. Identify the change in state that does not have an increase in entropy.

    A. water freezing
    B. water boiling
    C. ice melting
    D. dry ice subliming
    E. water evaporating

5. Which one is expected to have the largest dispersion force?

    A. C_3H_8
    B. $C_{12}H_{26}$
    C. F_2
    D. $BeC\ell_2$
    E. C_2H_6

6. Identify the diprotic acid.

    A. H_2O
    B. H_2SO_4
    C. CH_3COOH
    D. $Sr(OH)_2$
    E. $HC\ell O_4$

7. What volume (in mL) will a sample of F_2 gas occupy in a syringe at 5.5 atm, if the F_2 has a volume of 25.0 mL at 1.2 atm?

    A. 11 mL
    B. 17 mL
    C. 3.8 mL
    D. 5.5 mL
    E. 7.6 mL

8. Which particle has the highest penetrating power?

    A. alpha particle
    B. beta particle
    C. gamma particle
    D. delta particle
    E. eta particle

9. A substance that can't be chemically broken down into a simpler substance is

    A. a homogeneous mixture
    B. a heterogeneous mixture.
    C. a compound.
    D. a solution.
    E. an element

10. Select the correct formula for strontium nitride.

    A. Sr_3N_2
    B. $Sr(NO_3)_2$
    C. SrN
    D. Sr_2N_3
    E. $Sr(NO_2)_2$

11. Give the number of valence electrons in SO_4^{2-}?

    A. 28   B. 30   C. 34   D. 32   E. 36

12. Identify the substance that does not have $\Delta H_f^o = 0$, in its standard state.

    A. CO   B. Ca   C. H_2 D. O_2 E. Ne

13. Calculate the pOH of a solution with a pH value of 9.85 at 25 °C.

    A. 2.15
    B. 3.15
    C. 4.15
    D. 5.15
    E. 4.00

14. What are the temperature and pressure at STP?

A. 0 K and 1.00 atm
B. 25 °C and 30 in Hg
C. 300 K and 1 torr Hg
D. 0 °C and 1 mm Hg
E. 0 °C and 1.00 atm

15. Which of the following elements has the smallest ionization energy?

A. Na   B. Rb   C. F   D. K   E. C

16. Which of the following expressions for K_p does **not** match with the respective reaction?

A.   CO(g) + H₂O(g) ⇌ CO₂(g) + H₂(g) $K_p = \dfrac{P_{CO} \times P_{H_2O}}{P_{CO_2} \times P_{H_2}}$

B.   C(graphite) + CO₂(g) ⇌ 2 CO(g) $K_p = \dfrac{(P_{CO})^2}{P_{CO_2}}$

C.   NH₄HS(s) ⇌ NH₃(g) + H₂S(g) $K_p = P_{NH_3} \times P_{H_2S}$

D.   4 CuO(s) ⇌ 2 Cu₂O(s) + O₂(g) $K_p = P_{O_2}$

E.   H₂S(g) + I₂(s) ⇌ 2 HI(g) + S(s) $K_p = \dfrac{(P_{HI})^2}{P_{H_2S}}$

17. The overall reaction below is a smelting reaction.

    2 Aℓ₂O₃(ℓ) + 3 C(s) → 4 Aℓ(ℓ) + 3 CO₂(g)
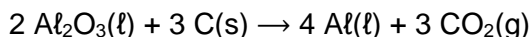
If the reaction resulted in 3.0 mol of Aℓ, how many moles of Aℓ₂O₃ were consumed?

A. 1.5 mol Aℓ₂O₃
B. 6.0 mol Aℓ₂O₃
C. 0.38 mol Aℓ₂O₃
D. 2.0 mol Aℓ₂O₃
E. 3.0 mol Aℓ₂O₃

18. Which of the following groups of elements in the periodic table are the most reactive conductors of electricity?

A. noble gases
B. alkaline Earth metals
C. halogens
D. transition metals
E. alkali metals

19. Rank the following solutions in decreasing order of osmotic pressure at 25 °C.

0.10 M NaHCO$_3$, 0.10 M C$_6$H$_{12}$O$_6$, 0.10 M CaCℓ$_2$, and 0.10 M Na$_2$SO$_4$

A. 0.10 M CaCℓ$_2$ = 0.10 M Na$_2$SO$_4$ > 0.10 M NaHCO$_3$ > 0.10 M glucose
B. 0.10 M glucose > 0.10 M NaHCO$_3$ >0.10 M CaCℓ$_2$ > 0.10 M Na$_2$SO$_4$
C. 0.10 M glucose > 0.10 M NaHCO$_3$ > 0.10 M CaCℓ$_2$ = 0.10 M Na$_2$SO$_4$
D. 0.10 M NaHCO$_3$ > 0.10 M Na$_2$SO$_4$ > 0.10 M CaCℓ$_2$ > 0.10 M glucose
E. 0.10 M Na$_2$SO$_4$ > 0.10 M CaCℓ$_2$ > 0.10 M NaHCO$_3$ > 0.10 M glucose

20. Which of the following pairs of atoms would both be diamagnetic?

A. Ne and Cu   B. K and Na   C. Zn and Mg   D. He and H   E. F and I

21. What radiation type is higher in frequency than visible light?

A. infrared
B. microwave
C. ultraviolet
D. radio
E. all are lower in frequency

22. A compound, **X**, has a solubility of 35.7 g/100 g H$_2$O. when 21.5 g of **X** are added to 65 g of water followed by enough shaking, the resulting mixture will result in

A. a heterogeneous solution
B. a homogenous mixture
C. a saturated solution
D. a chemical reaction
E. none of these

23. How many atoms of iron are found in 1.50 mol of Fe$_2$O$_3$?

A. 3.00
B. 160
C. 9.03 x 10^{23}
D. 1.93 x 10^{26}
E. 1.81 x 10^{24}

24. What volume of a 0.0880 M solution of C$_{12}$H$_{22}$O$_{11}$ would supply 1.81 g of solute?

A. 0.0601 mL
B. 1.66 x 10^4 mL
C. 16.6 mL
D. 60.1 mL
E. none of these

25. Which of the following solutions have a concentration of nitrate ion (NO$_3^-$) less than that in 0.0030 M Mg(NO$_3$)$_2$?

I.   0.0025 M Aℓ(NO$_3$)$_3$
II.   0.0040 M NaNO$_3$

      III.   0.0036 M Ca(NO$_3$)$_2$
      IV.   0.0054 M NH$_4$NO$_3$

A. I only
B. II and IV
C. III only
D. IV only
E. I and III

26. When a copper atom becomes a +1 cation

A. a proton is gained by the nucleus.
B. a proton is lost by the nucleus.
C. an electron is lost from the 3s sublevel.
D. an electron is lost from the 3d sublevel.
E. an electron is lost from the 4s sublevel.

27. Which transition would result in the shortest wavelength of light being emitted from a hydrogen atom?

A. n = 2 → n = 1
B. n = 5 → n = 6
C. n = 5 → n = 4
D. n = 4 → n = 1
E. n = 1 → n = 2

28. How many digits should be shown in the final answer for the following calculation?

$$(12.5 \text{ g} - 2.56 \text{ g}) \div 10.00 \text{ mL}$$

A. 1
B. 2
C. 3
D. 4
E. 5

29. What property do the following species share when in their most common form: sulfide ions, chloride ions, argon gas, potassium ions, and calcium ions?

A. They all have the same atomic radius
B. They all belong in the same period on the periodic table
C. They all belong in the same group on the periodic table
D. They all have the same number of electrons
E. They all have the same number of neutrons

30. What is the approximate mass percent of hydrogen in carbonic acid (H_2CO_3)?

A. 1%
B. 3%
C. 7%
D. 33%

E. 62%

31. If you had to make a buffer solution from potassium formate, which of the following reagents would you pair it with?

   A. formic acid
   B. sodium formate
   C. formaldehyde
   D. potassium iodide
   E. sodium hydroxide

32. Consider the following rate law: $Rate = k[NO]^2[H_2]$. What would be the effect on rate when doubling the concentration of NO?

   A. Rate would stay the same
   B. Rate would decrease
   C. Rate would double
   D. Rate would triple
   E. Rate would quadruple

33. What classic experiment demonstrated the wave-particle duality of light?

   A. The gold foil experiment
   B. The oil drop experiment
   C. The cathode ray tube
   D. The discovery of radioactivity
   E. The double slit experiment

34. What is the purpose of a salt bridge in a galvanic electrochemical cell?

   A. It adds additional current to the circuit.
   B. It provides a path for electrons to circulate.
   C. It balances the charges in both half reactions created from moving electrons.
   D. It helps neutralize the effect of unwanted neutralization reactions.
   E. It reverses the current allowing the cell to electroplate solid material on the anode.

35. Which of the following volumes would fit into a standard 1 L Erlenmeyer flask?

   A. 1,000,000 milliliters
   B. 5,000,000 microliters
   C. 0.000250 kiloliters
   D. 0.0000025 megaliters
   E. 500 centiliters

36. How many atoms are in one formula unit of ammonium nitrate?

   A. 3
   B. 4
   C. 7
   D. 9
   E. 10

37. How many neutrons are there in a single atom of a zinc-64 isotope?

    A. 30
    B. 32
    C. 34
    D. 48
    E. 64

38. A carbohydrate with empirical formula CH_2O has been determined to have a molar mass around 150 g/mol. What if the molecular formula for this carbohydrate?

    A. $C_7H_{18}O_3$
    B. $C_5H_5O_{10}$
    C. $C_4H_8O_4$
    D. $C_5H_{10}O_5$
    E. $C_{10}H_{20}O_{10}$

39. What is the oxidation state of manganese in $KMnO_4$?

    A. 0
    B. –3
    C. –5
    D. +7
    E. +9

40. If you took 10 measurements of a single solid on a working analytical balance and determined that all of the masses were very close to one another, but then realized that you never tared (zeroed) the balance, what conclusion can you make about your 10 values?

    A. They are precise but not accurate
    B. They are accurate but not precise
    C. They are neither precise nor accurate
    D. They are both precise and accurate
    E. None of these are valid conclusions