1. **Correct Answer: B**

   Ammonia is a base.

2. **Correct Answer: E**

   Calcium ion makes insoluble product with sulfate and carbonate ions.

3. **Correct Answer: D**

   $$PV = nRT. \therefore \frac{P_1 V_1}{P_2 V_2} = \frac{T_1}{T_2} \text{ leading to } V_2 = \frac{P_1 V_1 T_2}{P_2 T_1} = \frac{432 \text{ mmHg x } 265 \text{ mL x } 298 \text{ K}}{355 \text{ mmHg x } 273 \text{ K}} = 352 \text{ mL}$$
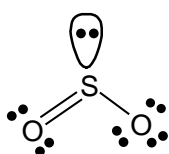
4. **Correct Answer: A**

   Work done by the system on the surroundings is negative. $W = -P\Delta V$
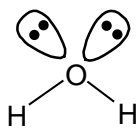
5. **Correct Answer: B**

   $$\upsilon\lambda = c, \text{ leading to } \lambda = \frac{C}{\upsilon} = \frac{3.00 \text{ x } 10^8 \text{ m.s}^{-1}}{2.1 \text{ x } 10^6 \text{ s}^{-1}} = 1.43 \text{ x } 10^2 \text{ m}$$

6. **Correct Answer: D**
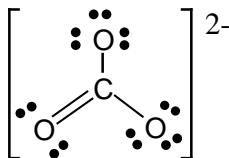
   Refer to the following drawing.
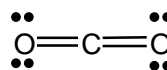
   

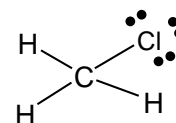   (A) Bent    (B) Bent    (C) Trig planar    (D) Linear    (E) Tetrahedral

7. **Correct Answer: C**

8. **Correct Answer: B**

   Given the proximity of Ca (group 2A) and $SO_4^{2-}$ (group 6A) in the periodic table, the combination of these elements is expected to form an ionic compound. Other listed options contain elements located in the nonmetal region of the periodic table and should combine to form covalent compounds.

9. **Correct Answer: D**

   At the molecular level, it is best to view solubility as driven by interactions. A solute will dissolve in a solvent when the solute-solvent attractive forces exceed the sum of the solute-solute and solvent-solvent attractions.

10. **Correct Answer: C**

    The following mathematical process supports the answer.

    $\Delta t_f = t^o_f - t_f = t_f - 0.00 \,°C$ (freezing point of water)

    $= -5.98 \,°C - 0.00 \,°C = -5.98 \,°C$

    $5.00 \text{ g } H_2O \text{ x } \dfrac{1 \text{ kg}}{1000 \text{ g}} = 0.00500 \text{ kg } H_2O$

    $-5.98 \,°C \text{ x} \dfrac{\text{mol/kg}}{-1.86 \,°C} \text{x } 0.00500 \text{ kg } H_2O = 0.0161 \text{ mol solute}$

    $\dfrac{1.60 \text{ g solute}}{0.0161 \text{ mol solute}} = 99.4 \text{ g/mol}$

11. **Correct Answer: A**

    Consult the rules of significant figures when rounding numbers. Convert the numbers so both contain the same exponent. For example, $1.5 \times 10^{-4}$ m could be represented as $0.15 \times 10^{-3}$ m. $2.7 \times 10^{-3}$ m + $0.15 \times 10^{-3}$ m = $2.85 \times 10^{-3}$. Since the number to be dropped is 5 and there is an even number before it the final value will not be rounded up. It will be 0.0028.

12. **Correct Answer: B**

    Molecules that contain R-O-R groups are designated as ethers.

13. **Correct Answer: C**

    Elemental manganese ($Mn^o$) contains 25 electrons. In the $2^+$ state, Mn contains 23 electrons. The number of neutrons is unnecessary information.

14. **Correct Answer: A**

    Calculations support this answer as shown in the following setup.

    $$K_{eq} = \dfrac{[ClBr]^2}{[Cl_2][Br_2]} = \dfrac{[0.030]^2}{[0.0020][0.0015]} = 3.0 \times 10^2$$

15. **Correct Answer: B**

The answer follows the rules of nomenclature.

16. **Correct Answer: E**

Given the reaction proceeds with second order with respect to reagent A, the permissible value of $x$ in the rate equation Rate = $k[A]^x$ is 2.

17. **Correct Answer: E**

pOH = 14 − 4.760 = 9.2.  [OH⁻] = $10^{-9.2}$ M = 5.75 x $10^{-10}$ M

18. **Correct Answer: C**

The balanced equation is $C_3H_8$ + 5 $O_2$ → 3 $CO_2$ + 4 $H_2O$

19. **Correct Answer: D**

PV = nRT. $\therefore$ V $\propto$ T leading to $\frac{V_1}{V_2} = \frac{T_1}{T_2}$. $\therefore$ $T_2 = \frac{V_2 T_1}{V_1} = \frac{1.530 \text{ L x } 298.15 \text{ K}}{1.150 \text{ L}}$
        = 369.7 K − 273.15 K = 123.5 °C

20. **Correct Answer: D**

21. **Correct Answer: C**

% C = $\frac{\text{total amu C}}{\text{total amu } C_{12}H_{22}O_{11}}$ x 100 = $\frac{144 \text{ amu C}}{342 \text{ amu } C_{12}H_{22}O_{11}}$ x 100 = 42.1 %

22. **Correct Answer: C**

23. **Correct Answer: B**

The geometry is tetrahedral.

24. **Correct Answer: B**

The experimental work of J.J. Thompson in the 1890's provided evidence for the discovery of electrons and mass to charge ration of this species by comparing the deflection of cathode rays by electric and magnetic fields.

25. **Correct Answer: D**

The answer is supported by the equation [concentration of solution] x [stoichiometry of $Fe^{2+}$ ion] = 0.015 x 2 = 0.030 M. The volume of solutions does not factor into the answer.

26. **Correct Answer: A**

Answer A represents the only physical property, all others options (Answers B, C, and D) describe chemical processes.

27. **Correct Answer: A**

The volume (V) of a box is determined by multiplying the length of the three sides. 24 inch x (1.00 m/39.37 inch) = 0.61 m. V = 1.4 m x 1.4 m x 0.61 = 1.2 $m^3$.

28. **Correct Answer: A**

Since isotopes of the same element differ by the number of neutrons, the atomic weight and atomic number of these species will also be different. The number of protons and electrons are the same for isotopes.

29. **Correct Answer: D**

The answer follows the conditions for equilibrium.

30. **Correct Answer: A**

The answer follows the rules of nomenclature.

31. **Correct Answer: E**

The reaction profiles of chemical reactions are identified by several key regions. The area(s) associated with the apex (or apices) of the reaction curve are denoted as an activated complex(s).

32. **Correct Answer: B**

$$5.0 \text{ mol } Mg_3N_2 \text{ x } \frac{3 \text{ mol } Mg(OH)_2}{1 \text{ mol } Mg_3N_2} = 15 \text{ mol } Mg(OH)_2.$$
$$6.0 \text{ mol } H_2O \text{ x } \frac{3 \text{ mol } Mg(OH)_2}{6 \text{ mol } H_2O} = 3.0 \text{ mol } Mg(OH)_2.$$
3.0 mol $Mg(OH)_2$ is theoretical yield, since 6 mol water will run out first.

33. **Correct Answer: A**

Collision on the wall is pressure.

34. **Correct Answer: B**

$$\text{Density} = \frac{m}{V} = \frac{\text{mass of 1 mol gas at STP}}{\text{Volume of 1 mol gas at STP}} = \frac{16.043 \text{ g/mol}}{22.4 \text{ L/mol}} = 0.716 \frac{g}{L}$$

35. **Correct Answer: A**

Sugar does not dissociate into ions in aqueous solution.
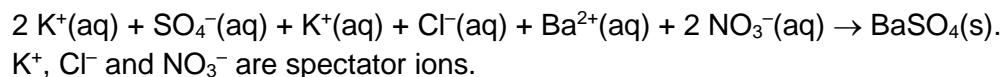
36. **Correct Answer: D**

In a trigonal pyramid geometry the central atom is surrounded by five electron pairs.

37. **Correct Answer: C**

Answers A, D, and E do not represent diatomic chemical species. Thought both oxygen and chlorine are diatomic, only chlorine is colored (yellow).

38. **Correct Answer: E**

Chlorine's atomic number is 17 (has 17 protons). A neutral Cl atom also has 17 electrons. The number of neutrons for an isotope is determined by the difference between the mass number (35) and the atomic number (17) which is 35 – 17 = 18.

39. **Correct Answer: C**

2 $K^+$(aq) + $SO_4^-$(aq) + $K^+$(aq) + $Cl^-$(aq) + $Ba^{2+}$(aq) + 2 $NO_3^-$(aq) $\rightarrow$ $BaSO_4$(s).
$K^+$, $Cl^-$ and $NO_3^-$ are spectator ions.

40. **Correct Answer: D**

As ions, alkaline earth metals (group IIA) and halides (group VIIA) exist as 2+ and 1- species, respectively. The answer supports the combination of these species into a neutral compound.