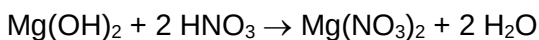


WYSE Academic Challenge
Chemistry Test (Sectional) – 2016

1. **Correct Answer: D**

$$\frac{0.100 \text{ mol NaOH}}{\text{L}} \times 0.0264 \text{ L NaOH} \times \frac{1 \text{ mol H}_3\text{PO}_4}{3 \text{ mol NaOH}} \times \frac{1}{0.030 \text{ L H}_3\text{PO}_4} = 0.0293 \text{ M}$$

2. **Correct Answer: D**



3. **Correct Answer: E**

$$PV = nRT. \therefore \frac{P_1 V_1}{P_2 V_2} = \frac{T_1}{T_2} \text{ leading to } P_1 V_1 = P_2 V_2 \text{ in this situation.}$$

$$\therefore V_2 = \frac{P_1 V_1}{P_2} = \frac{725 \text{ mmHg} \times 415 \text{ mL}}{760 \text{ mmHg}} = 396 \text{ mL}$$

4. **Correct Answer: B**

5. **Correct Answer: E**

6. **Correct Answer: A**

Atom	mass	mol	mol ratio
C	74.03 g	6.17	5.02
H	8.70 g	8.70	7.07
N	17.27 g	1.23	1.00

Leading to the empirical formula as C₅H₇N.

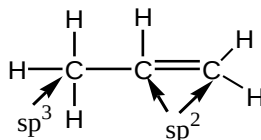
7. **Correct Answer: B**

$$E = h\nu \text{ and } \nu\lambda = c \text{ give } E = \frac{hc}{\lambda} \text{ leading to } \lambda = \frac{hc}{E} = \frac{6.626 \times 10^{-34} \text{ J} \cdot \text{s} \times 3.00 \times 10^8 \text{ m} \cdot \text{s}^{-1}}{2.25 \times 10^{-19} \text{ J}} = 8.83 \times 10^{-7} \text{ m.}$$

8. **Correct Answer: E**

Zinc has the highest oxidation potential (more positive value relate to more spontaneous process).

9. **Correct Answer: C**



According to the following structure:

10. Correct Answer: A

Hydrogen bonding contributes at higher magnitude to the intermolecular force and happens when nonbonding pair of electrons are available on the atoms such as F, O, N that serve as the inner atom.

11. Correct Answer: E

The following mathematical process supports the answer

$$X_{\text{hex}} = n_{\text{hex}} / (n_{\text{hex}} + n_{\text{naph}}),$$

$$n_{\text{hex}} = 50.0 \text{ mL} \times (0.877 \text{ g/mL}) \times (1 \text{ mol}/86.2 \text{ g}) = 0.509 \text{ mol},$$

$$n_{\text{hex}} = 20.0 \text{ g} \times (1 \text{ mol}/128.2 \text{ g}) = 0.156 \text{ mol},$$

$$X_{\text{hex}} = 0.509 \text{ mol} / (0.509 \text{ mol} + 0.156 \text{ mol}) = 0.765,$$

$$P_{\text{hex}} = (X_{\text{hex}})(P^{\circ}_{\text{hex}}) = (0.765)(100. \text{ torr}) = 76.5 \text{ torr}$$

12. Correct Answer: A

The answer is supported by the following calculations

$$5.50 \text{ M} = \frac{5.50 \text{ mol KOH}}{1 \text{ L H}_2\text{O}}, \quad 5.50 \text{ M KOH} \times 0.340 \text{ L} = 1.87 \text{ mol KOH}$$

$$\text{Mass of solute (KOH)} = 1.87 \text{ mol KOH} \times \frac{56.1 \text{ g KOH}}{1 \text{ mol}} = 105. \text{ g KOH}$$

13. Correct Answer: A

Using the guidelines for constructing Lewis structures and the assignment of atomic charges, the atoms corresponding to answer A are neutrally charged. Answer E is not valid since it does not contain 18 valence electrons.

14. Correct Answer: B

Compounds, mixtures, and pure substances can contain more than one element, thus, the answer B is correct. Multiple element types cannot be created from one element.

15. Correct Answer: B

The answer is supported by the following calculation:

$$\text{Amt of acetanilide dissolved in 42.0 mL of water} = \frac{5.5 \text{ g acetanilide}}{100. \text{ mL water}} \times 42.0 \text{ mL} = 2.31 \text{ g}$$

$$\text{Amt of acetanilide recovered} = 3.5 \text{ g} - 2.31 \text{ g} = 1.19 \text{ g}$$

$$\text{Percent recovery of acetanilide} = \frac{1.19 \text{ g of recovered acetanilide}}{3.5 \text{ g of original acetanilide}} \times 100 = 34\%$$

16. Correct Answer: D

The answer follows the expected boiling point trend for periodic table groups.

17. Correct Answer: A

Systems at equilibrium will favor the product(s) if K_{eq} is large, an exothermic process ($-\Delta H$), and the forward reaction rate is greater than the reverse. The mechanism type and activation energy may impact the reaction, but are not indicators of the position of equilibrium.

18. Correct Answer: D

This answer follows the rules of nomenclature.

19. Correct Answer: B

Since reaction rate is largely determined by the collision of reactants, any factor that changes the frequency of these collisions will affect reaction rate. With irreversible reactions, the concentration of products does not impact rate. However, changing temperature, the concentration of reactants, surface area, or the addition of a catalyst alters the number of collisions or changes the mechanistic pathway of the reaction.

20. Correct Answer: E

Conjugate pairs are one proton away. Water acts as an acid in presence of ammonia (a weak base).

21. Correct Answer: B

$$0.0526 \text{ L KOH} \times \frac{0.724 \text{ mol KOH}}{1 \text{ L KOH}} \times \frac{1 \text{ mol HNO}_3}{1 \text{ mol KOH}} \times \frac{1 \text{ L HNO}_3}{0.439 \text{ mol HNO}_3} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 86.7 \text{ mL}$$

22. Correct Answer: A

$PV = nRT$. $PV = \frac{m}{M}RT$ leading to $D = \frac{m}{V} = \frac{PM}{RT}$. $\therefore D \propto M$. This leads to CO_2 as the answer since; it has the greatest molar mass among the choices.

23. Correct Answer: D

$q = mc_p \Delta t$, meaning Δt is inversely proportional to c_p . Lower value of c_p will cause higher temperature rise.

24. Correct Answer: C

$$\% \text{ O} = \frac{\text{total amu O}}{\text{total amu C}_8\text{H}_{10}\text{N}_4\text{O}_2} \times 100 = \frac{32 \text{ amu O}}{194 \text{ amu C}_{12}\text{H}_{12}\text{O}_{11}} \times 100 = 16.5 \%$$

25. Correct Answer: C

It follows the increasing order of orbital energy for occupancy and no vacant orbital in the earlier sublevels.

26. Correct Answer: C

All spectator ions (Na^+ and SO_4^{2-}) are eliminated.

27. Correct Answer: D

Metal-nonmetal bonds are typically ionic.

28. Correct Answer: A

Under normal atmospheric pressure sublimation causes this change.

29. Correct Answer: D

The answer that does not fit with our current understanding of atomic structure is that of D. While the number of electrons and protons are equal, this need not be the case with the number of protons and neutrons.

30. Correct Answer: C

Since the Na^+ and Cl^- ions both exist as reactant and product in the precipitation of MgSO_3 , these ions are considered spectator ions.

31. Correct Answer: E

Mark's results give an average closer to the accepted value, thus more accurate. Lisa's results give an average farther off from the accepted value, but they form better cluster, thus more precise.

32. Correct Answer: E

The answer follows the known properties associated with noble gases.

33. Correct Answer: C

Calculations support this answer as shown in the following setup.

$$K_{eq} = \frac{[HI][HI]}{[H_2][I_2]} = \frac{[0.230][0.230]}{[0.015][0.015]} = \frac{0.0529}{0.00023} = 230 \text{ or } 2.3 \times 10^2$$

34. Correct Answer: C

This answer follows the rules of nomenclature.

35. Correct Answer: B

$12 \text{ mol H}_2 \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol H}_2} = 12 \text{ mol H}_2\text{O}$. $7 \text{ mol O}_2 \times \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol O}_2} = 14 \text{ mol H}_2\text{O}$
 12 mol H₂ is limiting reactant since it will run out first and will end the reaction.

36. Correct Answer: A

Inspection of experiments 1 and 2 reveals when the concentration of Cl₂ is doubled, the rate quadruples. Equations 2 and 3 show the rate increases by a factor 8 when both [NO] and [Cl₂] double. The rate law is thus Rate = $k[\text{NO}]^1[\text{Cl}_2]^2$. To determine the rate constant, substitute the data from experiment 1 into the rate law and solve for k .

$$\begin{aligned} \text{Rate} &= k[\text{NO}]^1[\text{Cl}_2]^2 \\ 0.50 \text{ M/hr} &= k(0.10)^1(0.30)^2 \\ k &= \frac{0.50 \text{ M/hr}}{(0.10 \text{ M})^1(0.30 \text{ M})^2} \\ k &= 56/\text{M}^2\text{hr} = 56 \text{ L}^2\text{mol}^{-2}\text{hr}^{-1} \end{aligned}$$

37. Correct Answer: B

The three quantum numbers n , l , and m_l describe the traits of electrons in an atom. The orbital angular momentum quantum number (l) determines the shape of an orbital. When $l = 0$, the orbital has s character and a spherical shape.

38. Correct Answer: D

The answer is supported by the calculation

$$\begin{aligned} 2.00 \text{ m} &= \frac{2.00 \text{ mol KClO}_4}{1 \text{ kg H}_2\text{O}}, 2.00 \text{ mol KClO}_4 \times \frac{138.6 \text{ g}}{1 \text{ mol}} = 277 \text{ g KClO}_4 \\ \% \text{ mass KClO}_4 &= \frac{\text{mass of KClO}_4}{\text{total mass}} = \frac{277 \text{ g}}{277 \text{ g} + 1 \text{ kg}} \times 100 = 21.7 \% \end{aligned}$$

39. Correct Answer: E

The answer follows the guidelines for permitted combinations of quantum numbers. All positive integers of n are allowed, l must be less than n , m must be an integer and between positive and negative l , and s can be $+\frac{1}{2}$ or $-\frac{1}{2}$.

40. Correct Answer: B

The answer is self-evident.