

HONOUR CHEMISTRY (Semester 1): FINAL EXAM (Practice Test)

$$1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr} = 101.325 \text{ kPa}$$

$$T_K = T_C + 273.15$$

$$\text{STP} = 22.4 \text{ L/mol @ } 0.00^\circ\text{C \& } 101.325 \text{ kPa (1 atm)}$$

$$\text{SATP} = 24.8 \text{ L/mol @ } 25.0^\circ\text{C \& } 100. \text{ kPa}$$

$$R = 0.0821 \frac{\text{L} \cdot \text{atm}}{\text{K} \cdot \text{mol}} \quad \text{or} \quad 8.314 \frac{\text{L} \cdot \text{kPa}}{\text{K} \cdot \text{mol}}$$

$$D = \frac{m}{V}$$

$$n = \frac{m}{M}$$

$$C = \frac{n_{\text{solute}}}{V_{\text{solution}}}$$

$$C_1V_1 = C_2V_2$$

$$PV = nRT$$

$$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\chi_1 = \frac{n_1}{n_{\text{Total}}} = \frac{P_1}{P_{\text{Total}}}$$

$$P_{\text{Total}} = P_1 + P_2 + P_3 + \dots$$

$$n_{\text{Total}} = n_1 + n_2 + n_3 + \dots$$

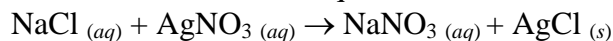
$$\% \text{ error} = \left| \frac{\text{Theoretical} - \text{Experimental}}{\text{Theoretical}} \right| \times 100\%$$

$$\% \text{ yield} = \frac{\text{Experimental}}{\text{Theoretical}} \times 100\%$$

Part A: Multiple Choice (The real final exam will not have that many multiple choice questions but the questions below cover most of the main concepts taught.)

- A physical property is demonstrated by
 - table sugar being digested in the intestine.
 - vinegar dissolving scale from an old tea kettle.
 - wood burning in a fire place.
 - oil floating on water.
- The separation technique that could be used to describe making coffee from a coffee machine is
 - distillation
 - chromatography
 - filtration
 - extraction
- In the mid 1800's an economical method of producing steel was developed. This situation is best described by
 - the needs of society encouraging a new technology.
 - an event in the environment causing a change in technology.
 - a new technology prompting a change in society.
 - a new discovery influencing technology.
- The properties that are characteristic of non-metals are
 - dull, brittle, non-conductors.
 - shiny, malleable, non-conductors.
 - dull, brittle, conductors.
 - malleable, ductile, conductors.
- The atomic number of an atom is the
 - sum of the number of protons and neutrons.
 - number of neutrons only
 - sum of the number of protons, neutrons, and electrons.
 - number of protons only
- The model of an atom developed by Niels Bohr was described as
 - plum pudding
 - nuclear
 - electron levels
 - solid sphere
- An element in Group 15, Period 3 of the periodic table will have how many valence electrons?
 - 5
 - 15
 - 1
 - 3
- What happens to non-metal atoms in the formation of ionic compounds?
 - They lose electrons and form negative ions.
 - They lose electrons and form positive ions.
 - They gain electrons and form negative ions.
 - They gain electrons and form positive ions.

20. What is the best word translation of the chemical equation?

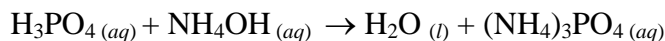


- A. A salt solution reacts with a solution of silver nitrate to produce a sodium nitrate solution and a silver chloride precipitate.
- B. A sodium chloride solution reacts with a solution of silver nitrate to produce a sodium nitrate solution and a silver chloride precipitate.
- C. Table salt reacts with a silver nitrate solution to produce a sodium nitrate solution and a silver chloride solution.
- D. A sodium chloride solution reacts with a silver nitrate solution to produce a sodium nitrate solution and a silver chloride solution.

21. The law of conservation of mass predicts that the

- A. initial mass will be equal to the sum of the masses of the reactants and the sum of the masses of the products.
- B. sum of the masses of the reactants will be equal to the sum of the masses of the products.
- C. sum of the masses of the products subtracted from the masses of the reactants will be equal to the initial mass.
- D. initial mass added to the mass of the reactants will be equal to the sum of the masses of the products.

22. Use the unbalanced chemical equation to answer the question.



If correctly balanced, this chemical equation would have 3 moles of

- A. ammonium phosphate and phosphoric acid
- B. ammonium phosphate and ammonium hydroxide
- C. ammonium hydroxide and phosphoric acid
- D. ammonium hydroxide and water

23. The number of grams in six moles of liquid carbon tetrachloride is

- A. 461.43
- B. 922.86
- C. 47.46
- D. 153.81

24. Surface tension may be described as the

- A. force of attraction between molecules of the same substance
- B. attraction of molecules of one substance towards molecules of a different substance
- C. pull of liquid molecules towards the surface of the liquid
- D. tendency of molecules to be pulled from the surface to the interior of a liquid

25. Water can absorb large amounts of heat and still remain liquid because of its high

- A. freezing point
- B. density
- C. specific heat capacity
- D. melting point

26. Some observations were recorded for a substance.

- I. The substance is a white crystalline solid.
- II. The substance dissolves in water.
- III. A solution of the substance conducts electricity.

The substance is most likely

- A. $\text{C}_6\text{H}_{12}\text{O}_6$
- B. AlCl_3
- C. CO_2
- D. CCl_4

27. A chemist wishes to make 200. mL of a 0.600 mol/L solution of $\text{KOH}_{(aq)}$. What volume of 2.00 mol/L stock solution will be required for this dilution?

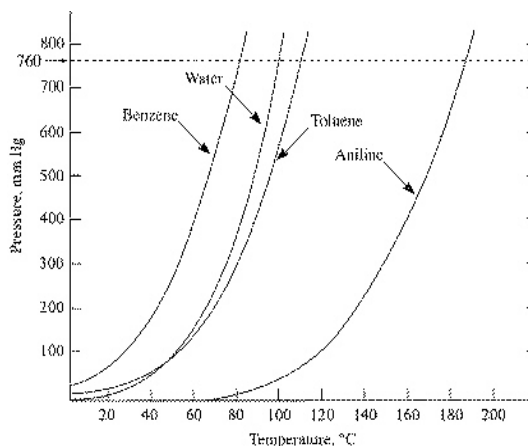
- A. 670. mL
- B. 60.0 mL
- C. 1.67×10^4 mL
- D. 240. mL

28. A student prepared four aqueous solutions of an ionic compound.
- | | |
|---|--|
| I. 0.20 mol of solute in 5.0 L of solution | II. 0.50 mol of solute in 2.0 L of solution |
| III. 3.0 mol of solute in 15 L of solution | IV. 1.0 mol of solute in 3.0 L of solution |
- The most dilute solution is
- | | | | |
|---------------|--------------|-------------|--------------|
| A. III | B. IV | C. I | D. II |
|---------------|--------------|-------------|--------------|
29. Materials used in the titration between a known concentration acid and an unknown concentration of base are
- | | | | |
|-------------------|------------------------------|-------------------|---|
| I. pipette | II. Erlenmeyer flasks | III. buret | IV. beakers to hold the original acid and base |
|-------------------|------------------------------|-------------------|---|
- What material can be left wet when used in the titration analysis?
- | | | | |
|---------------|--------------|-------------|--------------|
| A. III | B. II | C. I | D. IV |
|---------------|--------------|-------------|--------------|
30. Which pair of aqueous solutions would produce a precipitate when mixed?
- | | |
|--|---|
| A. $\text{MgCl}_2(aq)$ and $\text{Na}_2\text{SO}_4(aq)$ | B. $\text{KF}(aq)$ and $\text{NiBr}_2(aq)$ |
| C. $\text{Na}_2\text{S}(aq)$ and $\text{Cr}(\text{NO}_3)_3(aq)$ | D. $\text{KCl}(aq)$ and $\text{Mg}(\text{NO}_3)_2(aq)$ |
31. The concentration of Cl^- available in 110. mL of a solution containing 5.55 g of CaCl_2 is
- | | | | |
|-----------------------|--------------------------|-----------------------|-----------------------|
| A. 0.668 mol/L | B. 0.005 50 mol/L | C. 0.909 mol/L | D. 0.455 mol/L |
|-----------------------|--------------------------|-----------------------|-----------------------|
32. Students made the following statements in describing the gas phase.
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|--|
| I. Gas particles do not attract or repel each other. |
| II. Molecules of different gases at the same temperature have the same average speed. |
| III. Collisions of gas particles are perfectly elastic and no energy is lost during collisions. |
| IV. Molecules of gases are particles of negligible volume compared to the spaces between them. |
- Which statements are postulates of the kinetic molecular theory?
- | | | | |
|-------------------------|--------------------------|---------------------------|--------------------------|
| A. I, II, and IV | B. I, III, and IV | C. II, III, and IV | D. I, II, and III |
|-------------------------|--------------------------|---------------------------|--------------------------|
33. The new volume of a fixed mass of gas whose pressure is increased from 100 kPa to 400 kPa at a constant temperature is
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|--|---|
| A. four times the original volume | B. one half the original volume |
| C. one fourth the original volume | D. two times the original volume |
34. Decreasing the volume of a gas at constant temperature causes the pressure to increase because
- | |
|--|
| A. the molecules are striking a smaller area with a greater force |
| B. the molecules are moving faster |
| C. there are more molecules |
| D. the molecules are striking a smaller area with the same force |
35. Three 1.0 L flasks contain He, N_2 , and H_2S at SATP. Which statement indicates the relative number of molecules in the flasks?
- | |
|--|
| A. All three flasks contain the same number of molecules. |
| B. The flask of H_2S contains the most molecules. |
| C. The flask of He contains the most molecules. |
| D. The flask of N_2 contains the most molecules. |
36. A student collects 1.00 L of a gaseous hydrocarbon at 27°C and 101 kPa. The mass of the sample is 1.79 g. The hydrocarbon has the structural formula
- | | | | |
|----------------------------------|----------------------------------|-------------------------|----------------------------------|
| A. C_3H_8 | B. C_2H_6 | C. CH_4 | D. C_2H_4 |
|----------------------------------|----------------------------------|-------------------------|----------------------------------|

37. Carbon dioxide gas is sometimes used to carbonate beverages. A sample of carbon dioxide occupies a volume of 180. mL at 35.0°C and 88.9 kPa. The volume occupied by the gas at STP is
- A. 178 mL B. 140. mL C. 181 mL D. 155 mL
38. How many moles of oxygen are needed to burn 3.00 moles of butane (C₄H_{10(g)}) in a butane lighter?
- A. 19.5 B. 2.15 C. 6.52 D. 13.0
39. Hydrofluoric acid, HF_(aq), is not stored in glass containers, SiO_{2(s)}, because it reacts with glass. The products of the reaction are SiF_{4(aq)} and water. Calculate the mass of HF_(aq) that is needed to react completely with 60.0 g of SiO_{2(s)}
- A. 89.5 g B. 79.9 g C. 5.00 g D. 20.0 g
40. A remedy for an upset stomach is produced when a tablet is dissolved in water. The balanced chemical equation is
- $$\text{C}_6\text{H}_8\text{O}_7(\text{aq}) + 3 \text{NaHCO}_3(\text{aq}) \rightarrow \text{Na}_3\text{C}_6\text{H}_5\text{O}_7(\text{aq}) + 3 \text{CO}_2(\text{g}) + 3 \text{H}_2\text{O}(\text{l})$$
- What volume of CO_{2(g)} at STP conditions would result if a tablet containing 16 g of C₆H₈O_{7(aq)} was used?
- A. 6.8 L B. 11 L C. 5.6 L D. 1.9 L
41. Plants remove CO_{2(g)} from the air during photosynthesis. The overall reaction is
- $$6 \text{CO}_2(\text{g}) + 6 \text{H}_2\text{O}(\text{l}) \rightarrow \text{C}_6\text{H}_{12}\text{O}_6(\text{s}) + 6 \text{O}_2(\text{g})$$
- Assuming that the temperature is 10.0°C and the pressure is 80.0 kPa, the volume of CO_{2(g)} needed to produce 160. g of C₆H₁₂O_{6(s)} is
- A. 198 L B. 157 L C. 26.1 L D. 235 L
42. Lead(II) chromate can be produced by the reaction of Pb(NO₃)_{2(aq)} with K₂CrO_{4(aq)}. What volume of 0.250 mol/L Pb(NO₃)_{2(aq)} is needed to produce 100. g of PbCrO_{4(s)}?
- A. 12.9 L B. 1.24 L C. 0.390 L D. 25.0 L
43. In the theoretical reaction 2 B_(aq) + 3 D_(aq) → E_(aq) + 4 F_(aq), the concentration of D_(aq) is 0.40 mol/L. If 25.0 mL of aqueous B is needed to react completely with 30.0 mL of aqueous D, the concentration of B_(aq) is
- A. 0.32 mol/L B. 0.72 mol/L C. 0.48 mol/L D. 0.40 mol/L
44. Ammonia phosphate can be produced by reacting phosphoric acid with ammonium hydroxide. The balanced equation is H₃PO_{4(aq)} + 3 NH₄OH_(aq) → (NH₄)₃PO_{4(aq)} + 3 H₂O_(l). The mass of ammonium phosphate produced from 325 mL of 0.500 mol/L ammonium hydroxide is
- A. 24.2 g B. 8.08 g C. 6.12 g D. 72.7 g
45. When 0.137 g of an unknown carbonate, X₂CO₃, were reacted with CaCl₂ solution, the mass of the precipitate formed was 0.100 g. Assuming that X represents an alkali metal, which statement about the experiment is correct?
- A. The mass of XCl formed is 0.100 g. B. X₂CO₃ should be in excess.
C. Calcium chloride should be in excess. D. The filtrate contains carbonate and calcium ions.
46. If 5.01 g of Na₂CrO₄ is reacted with 10.2 g of Pb(NO₃)_{2(aq)}, then one can conclude that
- A. Na₂CrO₄ is the limiting reagent B. 10.0 g of lead(II) chromate are produced
C. lead(II) nitrate is in excess D. Pb(NO₃)_{2(aq)} is the limiting reagent

47. In a titration, a 20. mL sample of $\text{NaOH}_{(aq)}$ was neutralized by 14.9 mL of 0.13 mol/L $\text{H}_2\text{SO}_4_{(aq)}$. The concentration of the base is
 A. 0.35 mol/L B. 0.048 mol/L C. 8.7 mol/L D. 0.19 mol/L
48. A substance whose water solution does NOT conduct a current is a(n)
 A. polar substance. B. nonelectrolyte C. electrolyte D. ionic substance
49. If the temperature of a closed liquid-vapor equilibrium system is raised, its vapour pressure
 A. decreases. B. increases. C. remains the same. D. shows no relationship.
50. Why would a camper near the top of Mt. Everest find that water boils at less than 100°C ?
 A. There is greater atmospheric pressure than at sea level. B. The atmosphere has more moisture.
 C. There is less atmospheric pressure than at sea level. D. The atmosphere has less moisture.
51. At its triple point, water can
 A. have only three pressure values. B. exist in equilibrium in three different phases.
 C. only be present as vapour. D. exist only as a solid.
52. A sample of helium diffuses 4.57 times faster than an unknown gas diffuses. What is the molar mass of the unknown gas?
 A. 12.0 g/mol B. 18.2 g/mol C. 38.8 g/mol D. 83.6 g/mol

53. According to the figure to the right, what is the most volatile substance shown?



- A. benzene
 B. water
 C. toluene
 D. aniline

54. Why is ice less dense than liquid water?
 A. The molecules in liquid water can crowd together more compactly than in ice.
 B. Liquid water's energy level is lower than that of ice.
 C. Liquid water molecules are farther apart than the molecules in ice.
 D. Liquid water has fewer chemical impurities than ice has.
55. The critical temperature of a substance is the
 A. temperature which the vapour pressure of the liquid is equal to the external pressure.
 B. temperature at which the vapour pressure of the liquid is equal to 760 mm Hg.
 C. temperature at which the solid, liquid and vapour phases are all in equilibrium.
 D. lowest temperature above which a substance cannot be liquefied at any applied pressure.
56. Unlike in an ideal gas, in a real gas
 A. all particles move in the same direction. B. all particles have the same kinetic energy.
 C. the particles cannot diffuse. D. the particles exert attractive forces on each other.

57. Using the table below, what is the partial pressure of water vapor in oxygen gas collected by water displacement at 10.°C and 750. mm Hg?

Temperature (°C)	0	5	10	15	20	25	30	35	40	50
Water Vapour Pressure (mm Hg)	4.6	6.5	9.2	12.8	17.5	23.8	31.8	42.2	55.3	92.5

- A. 9.2 mm Hg B. 740.8 mm Hg C. 750. mm Hg D. 759.2 mm Hg
58. A 1.00 L sample of a gas has a mass of 1.92 g at STP. What is the molar mass of the gas?
 A. 1.92 g/mol B. 19.2 g/mol C. 22.4 g/mol D. 43.0 g/mol
59. The ideal gas law is equivalent to Charles's law when
 A. the number of moles and the pressure are constant. C. volume of the gas is 22.4 L.
 B. the number of moles and the temperature are constant. D. $R = 0$.
60. A gas sample with a mass of 2.50 g is collected at 20.0°C and 732.5 mm Hg. The volume is 1.28 L. What is the molar mass of the gas?
 A. 1.26 g/mol B. 2.04 g/mol C. 13.7 g/mol D. 48.8 g/mol
61. The balanced equation for the complete combustion of methane is $\text{CH}_4(g) + 2 \text{O}_2(g) \rightarrow 2 \text{H}_2\text{O}(g) + \text{CO}_2(g)$. If 50. L of methane at STP are burned, what volume of carbon dioxide will be produced at STP?
 A. 17 L B. 25 L C. 50. L D. 100. L

Answers

- | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|
| 1. D | 11. D | 21. B | 31. C | 41. B | 51. B | 61. C |
| 2. C | 12. C | 22. D | 32. B | 42. B | 52. D | |
| 3. C | 13. B | 23. B | 33. C | 43. A | 53. A | |
| 4. A | 14. C | 24. D | 34. D | 44. B | 54. C | |
| 5. D | 15. B | 25. C | 35. A | 45. C | 55. D | |
| 6. C | 16. A | 26. B | 36. A | 46. D | 56. D | |
| 7. A | 17. A | 27. B | 37. B | 47. D | 57. A | |
| 8. C | 18. C | 28. C | 38. A | 48. B | 58. D | |
| 9. A | 19. B | 29. B | 39. B | 49. B | 59. A | |
| 10. A | 20. B | 30. C | 40. C | 50. C | 60. D | |

Numerical Response

(The real exam will contain some short answer questions that require small amount of calculations. They are liked the multiple choice questions involving calculations, except with no choices shown. They will be mixed in with the multiple choice section.)

Part B: Extended Response

(The real final exam will contain long answer questions of some but not all of the following topics.)

- Average Atomic Mass with Mass Numbers of Isotopes and their Relative Percentage Abundance
- Balancing and Writing Chemical Equations
- Writing Complete and Net-Ionic Chemical Equations
- Finding Molecular and Empirical Formula from % Masses of Elements in a Compound
- Simple Stoichiometry (mass, solution and/or gas) with no Limiting Reagents
- Advanced Stoichiometry (mass, solution and/or gas) with Limiting Reagents
- % Error Calculation and Error Analysis
- Calculations involving Combined Gas Law, Ideal Gas Law (with Density and Molar Mass Derivations), Partial Pressures, Mole Fractions, and Effusion