

Chemistry 11



Complete Workbook

- ★ Aligned with Alberta curriculum
- ★ Contains Chemistry 20 practice questions and answers

2020 EDITION

TABLE OF CONTENTS

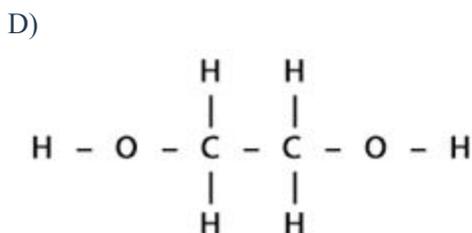
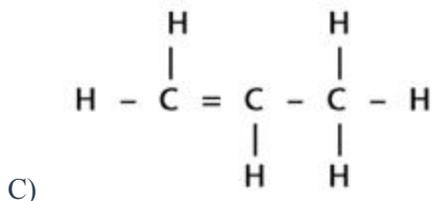
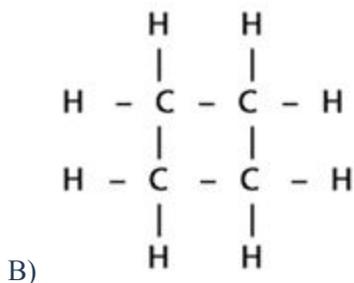
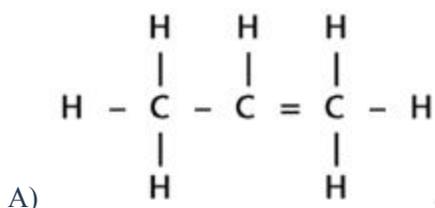
The Diversity of Matter and Chemical Bonding	2
Forms of Matter	8
Matter as Solutions, Acids, and Bases	12
Quantitative Relationships in Chemical Changes	18
Answer Key	21

The Diversity of Matter and Chemical Bonding

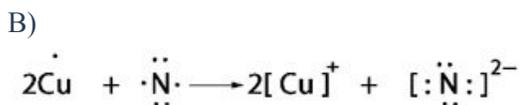
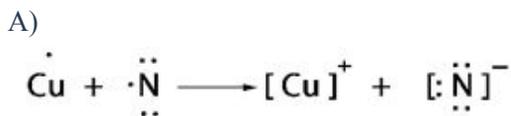
- The atom with the highest electronegativity is
 - Li
 - Be
 - N
 - F
- In which one of the following substances will hydrogen bonding be weakest?
 - $\text{H}_2\text{O}_{(l)}$
 - $\text{HF}_{(l)}$
 - $\text{C}_2\text{H}_4(\text{OH})_{2(l)}$
 - $\text{H}_2\text{S}_{(l)}$
- The following liquids are placed in separate burets: carbon tetrachloride (CCl_4), benzene (C_6H_6), 1,2-dichloroethane ($\text{CH}_2\text{ClCH}_2\text{Cl}$) and glacial acetic acid (CH_3COOH). A thin stream of liquid is allowed to flow from each buret and a negatively charged ebonite rod is held near each stream. What is the expected result of this activity?
 - only the acetic acid is attracted to the charged rod
 - each liquid is attracted to the charged rod
 - both benzene and carbon tetrachloride are attracted to the charged rod
 - both 1,2-dichloroethane and acetic acid are attracted to the rod.
- Which of the following bonds would be most polar?
 - $\text{O} - \text{O}$
 - $\text{F} - \text{H}$
 - $\text{N} - \text{O}$
 - $\text{O} - \text{Cl}$
 - None of these bonds are polar
- A diatomic molecule with a polar covalent bond will:
 - must be polar
 - may be ionic
 - share pairs of electrons equally
 - must be non-polar
- Which of the following statements regarding reactivity and the periodic table is (are) true?
 - Alkali metals become more reactive as the period increases
 - Halogens become more reactive as the period decreases
 - Noble gases are virtually inert
 - all of the above
 - a and c only
- Which of the following chemical formulas represent a pure substance containing covalent bonds?
 - NaCl
 - Cl_2
 - NiO
 - Ni_2O_3
- Which of the following statements regarding solid molecular compounds is true?
 - They have a low melting point
 - They conduct electricity when dissolved in water
 - They are malleable
 - They are always polyatomic
 - a and d
- One would expect an ionic compound with a ratio of 1:1 would produce a 3D crystalline structure that is:
 - cubic
 - triangular
 - circular
 - hexagonal
 - octagonal

10. When salt dissolves in water, the sodium ions are surrounded by the positive oxygen ends of the water molecule.
A) True
B) False
11. Which of the following atoms is believed to contain three lone pairs of electrons?
A) S
B) P
C) N
D) Cl
12. is the atomic ratio of Al:P:H:O in the compound aluminum hydrogen phosphate?
A) 1:3:3:4
B) 2:3:3:6
C) 2:3:3:12
D) 1:1:6:12
13. Which of the following statements regarding solid molecular compounds is true?
A) They have a low melting point
B) They conduct electricity when dissolved in water
C) They are malleable
D) They are always polyatomic
E) a and d
14. Which of the following is not a characteristic of an ionic compound?
A) They are neutral in charge
B) They are brittle
C) They conduct electricity when dissolved in solution
D) They are comprised of metals and non metals
E) All of the above are characteristics of ionic compounds
15. In the liquid state, CH_3F molecules are attracted to one another by:
A) dipole-dipole forces only
B) London dispersion forces, dipole-dipole and hydrogen bonding forces
C) London dispersion forces, and hydrogen bonding forces
D) London dispersion forces and dipole-dipole forces
16. What type(s) of intermolecular bonding will be found in CH_3COOH ?
A) London dispersion forces and hydrogen bonding
B) dipole-dipole attractions
C) London dispersion forces, hydrogen bonding, dipole-dipole forces
D) covalent bonding and London dispersion forces
17. Which of the following statements regarding atomic radius is true?
A) Atomic radius increases as we move from top to bottom in a specific group on the periodic table
B) Atomic radius and ionic radius are the same thing
C) Atomic radii increases from left to right across a specific period
D) The atomic radius of an atom is always smaller than the ionic radius
E) All of the above are true
18. When the element gold forms an ionic bond with sulfur to form Au_2S_3 , how many electrons are transferred to each sulfur atom?
A) 4
B) 2
C) 3
D) 6

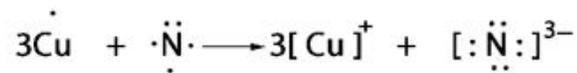
19. Which structural formula does not follow the normal rules expected when covalent bonds form?



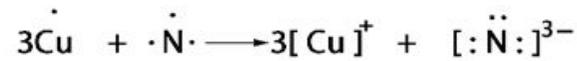
20. Which electron dot diagram correctly shows the formation of the ionic compound copper(I) nitride?



C)



D)



21. How many unshared electron pairs will surround carbon in the Lewis structure for CH_4 :

A) 0

B) 2

C) 4

D) 6

E) 8

22. In which one of the following substances will hydrogen bonding be strongest?

A) $\text{H}_2\text{O}_{2(l)}$

B) $\text{HF}_{(l)}$

C) $\text{CH}_3\text{OH}_{(l)}$

D) $\text{H}_2\text{S}_{(l)}$

23. The name for the weak intermolecular attraction between slightly charged particles, believed to be caused by uneven charges in one molecule being attracted by the uneven charges in nearby molecules, is

A) dipole-dipole forces

B) London forces

C) hydrogen bonding

D) covalent bonding

24. Which of the following is not considered a type of intermolecular force?

A) London dispersion

B) Hydrogen bonding

C) dipole – dipole

D) interionic

E) all of the above are considered intermolecular forces

25. The primary difference between an ionic and a covalent bond is
- In ionic bonds electrons are transferred; in covalent bonds electrons are shared
 - In ionic bonds electrons are shared; in covalent bonds electrons are transferred
 - In ionic bonds ions are shared; in covalent bonds ions are transferred
 - In ionic bonds ions are transferred; in covalent bonds ions are shared
26. An element A combines with another element B to form a compound. In the process where A atoms lose 3 electrons each and B atoms gain 3 electrons each, the compound has the formula
- A_3B_3
 - A_3B
 - AB_3
 - AB
27. Electron dot diagrams are used to represent the Lewis model of the arrangement of electrons in atoms. Which of the following statements regarding electron dot diagrams is incorrect?
- Pairs of dots around the symbol represent the bonding capacity of the atom
 - The element symbol represents the nucleus and filled energy levels of the atom
 - Dots represent the valence electrons of the atom
 - Four valence orbitals are represented by the four sides of the element symbol
28. In an imaginary compound with the formula XZ_2 , if the Z atoms gain two electrons to become Z^{2-} ions, then the charge of each X ion must be
- 1+
 - 2+
 - 3+
 - 4+
29. The substance which exhibits the weakest van der Waals forces is
- Cl_2
 - Rn
 - S_8
 - CH_4
30. Which of the following chemical formulas represent a pure substance containing ionic bonds?
- H_2O
 - NO_2
 - CH_4
 - $ZnCl_2$
31. Based on the principles of electronegativity, one would expect group 1 elements to bond most readily with:
- themselves
 - group 2 elements
 - group 13 elements
 - group 17 elements
 - noble gases
32. Which of the following is not considered a type of intermolecular force?
- London dispersion
 - Hydrogen bonding
 - dipole – dipole
 - interionic
 - all of the above are considered intermolecular forces
33. SO_3 is a molecular compound.
- True
 - False

42. A correct name for the compound $\text{Fe}(\text{ClO}_4)_3$ is
A) ferrous chlorate
B) iron(II) chlorite
C) iron(III) perchlorate
D) ferric hypochlorite
43. Which of the following atoms is believed to contain three lone pairs of electrons?
A) S
B) P
C) N
D) Cl
44. The compound which has the most ionic character is
A) NaI
B) CsF
C) ZnCl_2
D) HCl
45. When the element gold forms an ionic bond with sulfur to form Au_2S_3 , how many electrons are transferred to each sulfur atom?
A) 4
B) 2
C) 3
D) 6
46. Electronegativity can be defined as:
A) The relative ability of an atom to attract electrons
B) The energy change that occurs when an electron is accepted by an atom
C) The amount of energy required to remove an electron from an atom
D) The amount of energy required to separate neutrons and protons in an

atom

E) The total charge of an ion

47. Which of the following is NOT an organic substance?
A) $\text{Mg}(\text{CN})_2$
B) CH_4
C) $\text{C}_2\text{H}_5\text{OH}$
D) CH_3COOH
48. When salt dissolves in water, the sodium ions are surrounded by the positive oxygen ends of the water molecule.
A) True
B) False
49. The systematic name for BaH_2 is
A) barium dihydrogen
B) barium dihydride
C) barium (II) hydrate
D) barium hydride
50. Which of the following bonds between elements will have the greatest electronegativity difference?
A) C — O
B) Na — Cl
C) Mg — Cl
D) Ba — O
E) Ca — F

Forms of Matter

1. A gas does not exhibit ideal behavior at very low temperatures and very high pressures because, under these conditions, there are significant attractions between molecules so that the volume of the gas is smaller than the ideal volume.
A) True

- B) False
2. A temperature of -270°C on the Celsius temperature scale is equivalent to _____ on the Kelvin temperature scale.
- A) 543 K
B) 3 K
C) 0 K
D) 271 K
3. The boiling point of chlorine is 172 K. This temperature corresponds to approximately
- A) -172°C
B) -101°C
C) -82°C
D) 101°C
4. The density of a gas at 27°C and 104 kPa pressure and is 2.67 g/L. What is the molar mass of this?
- A) 44.0 g/mol
B) 108 g/mol
C) 28.0 g/mol
D) 64.0 g/mol
5. What must be the volume of a container to hold 5.00 mol of nitrogen gas, N_2 , at 40°C and 720 mm Hg pressure?
- A) 18.6 L
B) 126.6 L
C) 135.6 L
D) 17.5 L
6. At 373 K and 110 kPa, it was found that 1.00 L of a gas weighed 2.95 g. Its molecular mass is
- A) 19.7 g/mol
B) 33.8 g/mol
C) 41.6 g/mol
D) 83.2 g/mol
7. 6.34 L of $\text{CO}_2(\text{g})$ are collected over water at 16°C and 98.4 kPa pressure. If the vapour pressure of water at 16°C is 1.8 kPa, what is the volume of the dry gas at 30°C and 90.5 kPa pressure?
- A) 6.23 L
B) 7.10 L
C) 6.45 L
D) 7.23 L
8. An oxygen sample has a volume of 4.50 L at 25°C and 115 kPa. How many oxygen molecules does it contain?
- A) 1.26×10^{23}
B) 5.03×10^{22}
C) 2.51×10^{24}
D) 1.26×10^{22}
9. Body temperature is about 308 K. On a cool day, what volume of air at 273 K must a person with a lung capacity of 2.00 L breathe in to fill the lungs?
- A) 2.46 L
B) 1.77 L
C) 1.23 L
D) 3.54 L
10. Which set of pressures are equivalent?
- A) 151.6 kPa, 1260 torr, 1.42 atm
B) 116.9 kPa, 912 torr, 1.50 atm
C) 121.6 kPa, 912 torr, 1.20 atm
D) 140 kPa, 1000 torr, 1.40 atm
11. Gases approach ideal behavior at conditions of:
- A) high pressure and low temperature
B) high pressure and high temperature
C) low pressure and low temperature
D) low pressure and high temperature
12. The boiling point of chlorine is 172 K. This temperature corresponds to approximately
- A) -172°C

- B) -101°C
 C) -82°C
 D) 101°C
13. 6.34 L of $\text{CO}_{2(g)}$ are collected over water at 16°C and 98.4 kPa pressure. If the vapour pressure of water at 16°C is 1.8 kPa, what is the volume of the dry gas at 30°C and 90.5 kPa pressure?
 A) 6.23 L
 B) 7.10 L
 C) 6.45 L
 D) 7.23 L
14. It is found that 250 mL of gas at STP has a mass of 1.75 g. What is the molar mass of the gas?
 A) 89.9 g/mol
 B) 97.9 g/mol
 C) 171 g/mol
 D) 157 g/mol
15. 5.0 L samples of $\text{O}_{2(g)}$ and $\text{H}_{2(g)}$ are in at the same temperature and pressure. Which statement is false?
 A) Molecules of each gas strike the walls of the container with the same frequency.
 B) Molecules of each gas have the same average kinetic energy.
 C) On average, the H_2 molecules move faster than the O_2 molecules.
 D) Both samples contain the same number of molecules.
16. A correct expression of Charles' Law is:
 A) $\frac{P_1}{V_1} = \frac{P_2}{V_2}$
 B) $P_1V_1 = P_2V_2$
 C) $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
 D) $P_1T_1 = P_2T_2$
17. A 5.0 L container at 100°C and 100 kPa is filled with oxygen gas, $\text{O}_{2(g)}$. If the container is filled with helium gas, $\text{He}_{(g)}$, at the same conditions, which quantity will not change?
 A) number of molecules
 B) mass
 C) average speed of the molecules
 D) collision frequency
18. At 373 K and 110 kPa, it was found that 1.00 L of a gas weighed 2.95 g. Its molecular mass is
 A) 19.7 g/mol
 B) 33.8 g/mol
 C) 41.6 g/mol
 D) 83.2 g/mol
19. Body temperature is about 308 K. On a cool day, what volume of air at 273 K must a person with a lung capacity of 2.00 L breathe in to fill the lungs?
 A) 2.46 L
 B) 1.77 L
 C) 1.23 L
 D) 3.54 L
20. Popcorn pops because increased
 A) temperature results in increased pressure within the corn hull
 B) temperature results in decreased pressure within the corn hull
 C) pressure results in increased temperature within the corn hull
 D) pressure results in decreased temperature within the corn hull

21. 0.50 mol of $\text{N}_{2(g)}$, 0.25 mol $\text{He}_{(g)}$ and 0.75 mol of $\text{CO}_{2(g)}$ are in a closed container at STP. What is the partial pressure of the $\text{CO}_{2(g)}$?
- A) 0.25 atm
B) 0.75 atm
C) 0.50 atm
D) 1.00 atm
22. 6.34 L of $\text{CO}_{2(g)}$ are collected over water at 16°C and 98.4 kPa pressure. If the vapour pressure of water at 16°C is 1.8 kPa, what is the volume of the dry gas at 30°C and 90.5 kPa pressure?
- A) 6.23 L
B) 7.10 L
C) 6.45 L
D) 7.23 L
23. 5.0 L samples of $\text{O}_{2(g)}$ and $\text{H}_{2(g)}$ are in at the same temperature and pressure. Which statement is false?
- A) Molecules of each gas strike the walls of the container with the same frequency.
B) Molecules of each gas have the same average kinetic energy.
C) On average, the H_2 molecules move faster than the O_2 molecules.
D) Both samples contain the same number of molecules.
24. A small amount of water is boiled in a pop can. If the pop can is quickly sealed and placed into a tub of cool water, one would expect the pop can to
- A) crumple
B) remain in the same basic shape
C) explode
D) none of the above
25. It is not possible for 5.00 g samples of $\text{O}_{2(g)}$ and $\text{SO}_{2(g)}$ to occupy equal volumes

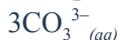
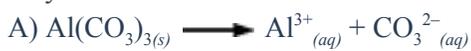
at 27°C and 100 kPa pressure.

- A) True
B) False
26. A 10.0 L sample of ethane gas is at STP. If the temperature rises by 25°C and the pressure drops by 7.3 kPa, the new volume can be calculated by the expression:
- A)
- $$10.0 \text{ L} \times \frac{298 \text{ K}}{273 \text{ K}} \times \frac{109.0 \text{ kPa}}{94.0 \text{ kPa}}$$
- B)
- $$10.0 \text{ L} \times \frac{273 \text{ K}}{296 \text{ K}} \times \frac{101.3 \text{ kPa}}{94.0 \text{ kPa}}$$
- C)
- $$10.0 \text{ L} \times \frac{298 \text{ K}}{273 \text{ K}} \times \frac{101.3 \text{ kPa}}{94.0 \text{ kPa}}$$
- D)
- $$10.0 \text{ L} \times \frac{273 \text{ K}}{298 \text{ K}} \times \frac{101.3 \text{ kPa}}{94.0 \text{ kPa}}$$
27. 60.0 mL of neon are stored at 38.5°C and 700 torr. The volume expands to 68.3 mL when the temperature and pressure are changed. If the final pressure is 560 torr, what is the final temperature?
- A) 69.1°C
B) 10.7°C
C) 110.7°C
D) 7.40°C
28. The boiling point of chlorine is 172 K. This temperature corresponds to approximately
- A) -172°C
B) -101°C
C) -82°C
D) 101°C

29. The density of a gas at 27°C and 104 kPa pressure and is 2.67 g/L. What is the molar mass of this?
- A) 44.0 g/mol
 - B) 108 g/mol
 - C) 28.0 g/mol
 - D) 64.0 g/mol
30. As the temperature of a fixed volume of gas increases, the pressure will
- A) decrease
 - B) increase
 - C) not change
 - D) change the orientation of the molecules in the gas

Matter as Solutions, Acids, and Bases

1. Aluminum carbonate is a compound of low solubility. The equation that correctly represents how it will dissociate in water, even though to a very limited extent is



2. A student has 250 mL of solution of $\text{pOH} = 5.00$. If a pH meter is used to determine the pH of this solution, the pH reading will be
- A) 5.00
B) 1.00
C) 9.00
D) 10.50
3. A substance dissolves in water to form a conducting solution that does not affect litmus. This evidence indicates a/an:
- A) acid substance that has ionized in solution.
B) neutral ionic substance that has dissociated in solution.
C) base substance that has dissociated in solution.
D) base substance that has ionized in solution.
4. 500 mL of 0.500 mol/L $\text{NaNO}_3(aq)$ is diluted by adding an equal volume of water to the solution. What mass of $\text{NaNO}_3(s)$ will be dissolved in 50 mL of the diluted solution?
- A) 1.06 g
B) 0.266 g

C) 0.500 g

D) 2.12 g

5. In order for a solution to conduct electricity,
- A) there must be charged particles in the solution.
B) there must be a molecular substance present.
C) there must be a precipitate in the solution.
D) there must be neutral molecules in the solution.
6. The pH of a solution is -1.00 . What is the hydrogen ion concentration?
- A) 10 M
B) 1 M
C) 1.00×10^{10} M
D) 1.00×10^{-10} M
7. In order to dilute 100.0 mL of 8.00 mol/L HCl to a concentration of 0.150 mol/L, how much water should be added?
- A) 5.33 L
B) 5.23 L
C) 12.0 L
D) 2.00 L
8. The concentration of a solution made by diluting 25.0 mL of 0.551 mol/L KCl to 300 mL is
- A) 0.0459 mol/L
B) 6.61 mol/L
C) 0.551 mol/L
D) 0.332 mol/L
9. The mass of lithium fluoride contained in 120 mL of a 1.80 mol/L solution is
- A) 4.10 g
B) 1.50 g
C) 5.60 g
D) 0.216 g

10. What volume of 18.6 mol/L $\text{H}_2\text{SO}_{4(aq)}$ was used to prepare 40.0 L of 0.400 mol/L sulfuric acid solution?
- A) 8.60 mL
 B) 0.860 L
 C) 2.17 L
 D) 1.09 L
11. A 0.55 mol/L solution of CaCl_2 is totally dissociated into $\text{Ca}^{2+}_{(aq)}$ ions and $\text{Cl}^{-}_{(aq)}$ ions. The concentration of the chloride ions is
- A) 0.55 mol/L
 B) 1.1 mol/L
 C) 1.7 mol/L
 D) 2.2 mol/L
- 12.

Chemical	Solubility in Water	Conductivity of Solution	Effect of Solution on Litmus
1	high	low	none
2	high	low	blue to red
3	low	high	red to blue
4	high	high	blue to red
5	high	high	none

A possibility for the identity of chemical 2 is

- A) $\text{MgCl}_{2(s)}$
- B) $\text{Ca(OH)}_{2(s)}$
- C) $\text{C}_{12}\text{H}_{22}\text{O}_{11(s)}$
- D) $\text{H}_2\text{SO}_{4(aq)}$
- E) $\text{H}_3\text{PO}_{4(aq)}$

13. Refer to the information in question 2. A possibility for the identity of chemical 3 is
- A) $\text{MgCl}_{2(s)}$
 B) $\text{Ca(OH)}_{2(s)}$
 C) $\text{C}_{12}\text{H}_{22}\text{O}_{11(s)}$
 D) $\text{H}_2\text{SO}_{4(aq)}$
 E) $\text{H}_3\text{PO}_{4(aq)}$
14. In order for a solution to conduct electricity,
- A) there must be charged particles in the solution.
 B) there must be a molecular substance present.
 C) there must be a precipitate in the solution.
 D) there must be neutral molecules in the solution.
15. 4.82 μg of BPA is found in a plastic bottle having a mass of 300.0 g. What is the concentration of BPA in parts per billion (ppb) in this plastic?
- A) 0.0161 ppb
 B) 4.82 ppb
 C) 16.1 ppb
 D) 1.61 ppb
16. A solution of a strong acid has pH of 4.400. A solution of this same acid that is twice as concentrated will have a pH of
- A) 4.800
 B) 4.100
 C) 8.200
 D) 4.400
17. An aqueous solution means
- A) an acid is present
 B) a substance is dissolved or dissolving
 C) the solvent is water
 D) the solvent is alcohol

18. Calcium hydroxide dissociates when added to water.



Calcium hydroxide is an example of a:

- A) Bronsted-Lowry conjugate acid
 B) Arrhenius acid
 C) Bronsted-Lowry conjugate base
 D) Arrhenius base
19. What is the pH of a solution with a hydrogen ion concentration of 2.75×10^{-2} mol/L ?
 A) 1.569
 B) -1.569
 C) 2.000
 D) -2.000
20. As the temperature increases, the solubility of gases generally
 A) stays the same
 B) decreases
 C) increases
 D) may increase or decrease
21. What is the pH of a solution with a hydrogen ion concentration of 1.00×10^{-3} mol/L ?
 A) 1.000
 B) -1.000
 C) 3.000
 D) -3.000
22. The pH of a solution is -1.00. What is the hydrogen ion concentration?
 A) 10 M
 B) 1 M
 C) 1.00×10^{10} M
 D) 1.00×10^{-10} M
23. The concentration of a solution made by diluting 10.0 mL of 0.685 mol/L NaBr to 300 mL is
 A) 0.00228 mol/L
 B) 20.6 mol/L

- C) 0.0228 mol/L
 D) 0.0457 mol/L

24. The mass of lithium fluoride contained in 120 mL of a 1.80 mol/L solution is
 A) 4.10 g
 B) 1.50 g
 C) 5.60 g
 D) 0.216 g
25. An aqueous solution means
 A) an acid is present
 B) a substance is dissolved or dissolving
 C) the solvent is water
 D) the solvent is alcohol
- 26.

Chemical	Solubility in Water	Conductivity of Solution	Effect of Solution on Litmus
1	high	low	none
2	high	low	blue to red
3	low	high	red to blue
4	high	high	blue to red
5	high	high	none

A possibility for the identity of chemical 1 is

- A) $\text{MgCl}_{2(s)}$
 B) $\text{Ca(OH)}_{2(s)}$
 C) $\text{C}_{12}\text{H}_{22}\text{O}_{11(s)}$
 D) $\text{H}_2\text{SO}_{4(aq)}$
 E) $\text{H}_3\text{PO}_{4(aq)}$

27. Refer to the information in question 6.
A possibility for the identity of chemical 5 is
- $\text{MgCl}_{2(s)}$
 - $\text{Ca(OH)}_{2(s)}$
 - $\text{C}_{12}\text{H}_{22}\text{O}_{11(s)}$
 - $\text{H}_2\text{SO}_{4(aq)}$
 - $\text{H}_3\text{PO}_{4(aq)}$
28. An example of a substance that has low solubility in water is
- strontium hydroxide
 - calcium carbonate
 - sodium permanganate
 - zinc nitrate
29. The major entities present when $\text{Li}_2\text{SO}_{4(aq)}$ is placed in a water environment are:
- $\text{Li}^+_{(aq)}$, $\text{SO}_4^{2-}_{(aq)}$, $\text{H}_2\text{O}_{(g)}$
 - $\text{Li}_{(s)}$, $\text{SO}_{4(aq)}$, $\text{H}_2\text{O}_{(l)}$
 - $\text{Li}^+_{(aq)}$, $\text{SO}_4^{2-}_{(aq)}$, $\text{H}_2\text{O}_{(l)}$
 - $\text{Li}^+_{(aq)}$, $\text{SO}_4^{-}_{(aq)}$, $\text{H}_2\text{O}_{(aq)}$
30. A substance dissolves in water to form a conducting solution that turns red litmus blue. This evidence indicates a/an:
- acid substance that has ionized in solution.
 - neutral ionic substance that has dissociated in solution.
 - acid substance that has dissolved in solution.
 - base substance that has ionized in solution.
31. A substance dissolves in water to form a conducting solution that does not affect litmus. This evidence indicates a/an:
- acid substance that has ionized in solution.
 - neutral ionic substance that has dissociated in solution.
 - base substance that has dissociated in solution.
 - base substance that has ionized in solution.
32. The solubility of potassium nitrate at 50°C is 80 g per 100 mL of water. This means that 100 mL of a saturated solution of potassium nitrate at 50°C would contain 80 g of potassium nitrate.
- True
 - False
33. The concentration of a solution made by diluting 10.0 mL of 0.685 mol/L NaBr to 300 mL is
- 0.00228 mol/L
 - 20.6 mol/L
 - 0.0228 mol/L
 - 0.0457 mol/L
34. A student has 250 mL of solution of $\text{pOH} = 5.00$. If a pH meter is used to determine the pH of this solution, the pH reading will be
- 5.00
 - 1.00
 - 9.00
 - 10.50
35. The correct dissociation equation for Al(OH)_3 is
- $\text{Al(OH)}_{(s)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{Al}^{3+}_{(aq)} + 3\text{OH}^{-}_{(aq)}$
 - $\text{Al(OH)}_{(s)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{H}_3\text{O}^+_{(aq)} + 3\text{OH}^{-}_{(aq)}$
 - $\text{Al(OH)}_{3(s)} \longrightarrow \text{Al}^{3+}_{(aq)} + 3\text{OH}^{-}_{(aq)}$
 - $\text{Al(OH)}_{(s)} + 3\text{H}_2\text{O}_{(l)} \longrightarrow \text{Al}^{3+}(3\text{H}_2\text{O})_{(aq)} + 3\text{OH}^{-}_{(aq)}$
36. The correct equation showing the dissociation of strontium phosphate is
- $\text{SrPO}_{4(s)} \longrightarrow \text{Sr}^{2+}_{(aq)} + \text{PO}_4^{3-}_{(aq)}$
 - $\text{Sr}_3(\text{PO}_4)_{2(s)} \longrightarrow 3\text{Sr}^{2+}_{(aq)} + 2\text{PO}_4^{3-}_{(aq)}$
 - $\text{SrPO}_{4(s)} \longrightarrow \text{Sr}^{2+}_{(aq)} + 4\text{PO}_4^{3-}_{(aq)}$
 - $\text{Sr}_3(\text{PO}_4)_{2(s)} \longrightarrow \text{Sr}^{2+}_{(aq)} + \text{PO}_4^{3-}_{(aq)}$

37. An example of a substance that has low solubility in water is
- strontium hydroxide
 - calcium carbonate
 - sodium permanganate
 - zinc nitrate
38. The major entities present when $\text{Li}_2\text{SO}_4(aq)$ is placed in a water environment are:
- $\text{Li}^+_{(aq)}$, $\text{SO}_4^{2-}_{(aq)}$, $\text{H}_2\text{O}_{(g)}$
 - $\text{Li}_{(s)}$, $\text{SO}_4(aq)$, $\text{H}_2\text{O}_{(l)}$
 - $\text{Li}^+_{(aq)}$, $\text{SO}_4^{2-}_{(aq)}$, $\text{H}_2\text{O}_{(l)}$
 - $\text{Li}^+_{(aq)}$, $\text{SO}_4^{-}_{(aq)}$, $\text{H}_2\text{O}_{(aq)}$
39. The acetate ion, CH_3COO^- , acts as a modified Arrhenius base in aqueous solution. Which equation correctly shows this property?
- $\text{CH}_3\text{COO}^-_{(aq)} + \text{H}^+_{(aq)} \longrightarrow \text{CH}_3\text{COOH}_{(aq)}$
 - $\text{CH}_3\text{COOH}_{(aq)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{CH}_3\text{COO}^-_{(aq)} + \text{H}^+_{(aq)}$
 - $\text{CH}_3\text{COO}^-_{(aq)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{CH}_3\text{COOH}_{(aq)} + \text{OH}^-_{(aq)}$
 - $\text{CH}_3\text{COO}^-_{(aq)} + \text{H}^+_{(aq)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{CH}_3\text{COOH}_{(aq)} + \text{H}_3\text{O}^+_{(aq)}$
40. A solution of a strong acid has pH of 4.400. A solution of this same acid that is twice as concentrated will have a pH of
- 4.800
 - 4.100
 - 8.200
 - 4.400
41. In order to dilute 100.0 mL of 8.00 mol/L HCl to a concentration of 0.150 mol/L, how much water should be added?
- 5.33 L
 - 5.23 L
 - 12.0 L
 - 2.00 L
42. Comparing equal volumes of 0.002 mol/L $\text{CH}_3\text{COOH}_{(aq)}$ and 0.002 mol/L $\text{HCl}_{(aq)}$, which statement is correct?
- both solutions have the same pH
 - both solutions have the same concentration of hydrogen ions
 - 0.002 mol/L $\text{HCl}_{(aq)}$ has a higher pH than 0.002 mol/L $\text{CH}_3\text{COOH}_{(aq)}$
 - 0.002 mol/L $\text{CH}_3\text{COOH}_{(aq)}$ has a lower concentration of $\text{H}^+_{(aq)}$ in solution than 0.002 mol/L $\text{HCl}_{(aq)}$
43. A 0.55 mol/L solution of CaCl_2 is totally dissociated into $\text{Ca}^{2+}_{(aq)}$ ions and $\text{Cl}^-_{(aq)}$ ions. The concentration of the chloride ions is
- 0.55 mol/L
 - 1.1 mol/L
 - 1.7 mol/L
 - 2.2 mol/L
44. What volume of 18.6 mol/L $\text{H}_2\text{SO}_4(aq)$ was used to prepare 40.0 L of 0.400 mol/L sulfuric acid solution?
- 8.60 mL
 - 0.860 L
 - 2.17 L
 - 1.09 L
45. A substance dissolves in water to form a non-conducting solution that does not affect litmus. This evidence indicates a/an:
- acid substance that has ionized in solution.
 - neutral ionic substance that has dissociated in solution.
 - molecular substance that has dissolved in solution.
 - base substance that has ionized in solution.

46. A box containing baking soda or sodium bicarbonate, NaHCO_3 , can be left in a refrigerator to reduce food odours. This compound is used because:
- A) it is an Arrhenius acid
 - B) it acts as a weak modified Arrhenius base that neutralizes acidic food odours
 - C) it has an odour of its own that covers up food odours
 - D) it is a strong acid that reacts with food odours
47. A solution of a strong acid has pH of 4.400. A solution of this same acid that is twice as concentrated will have a pH of
- A) 4.800
 - B) 4.100
 - C) 8.200
 - D) 4.400
48. A solution is a _____ mixture having one phase.
- A) homogeneous
 - B) heterogeneous
 - C) conductive
 - D) clear and colourless
49. The concentration of a solution made by diluting 10.0 mL of 0.685 mol/L NaBr to 300 mL is
- A) 0.00228 mol/L
 - B) 20.6 mol/L
 - C) 0.0228 mol/L
 - D) 0.0457 mol/L
50. The solubility of potassium nitrate at 50°C is 80 g per 100 mL of water. This means that 100 mL of a saturated solution of potassium nitrate at 50°C would contain 80 g of potassium nitrate.
- A) True
B) False

Quantitative Relationships in Chemical Changes

- What mass of sulfur dioxide forms when 5.00 g of carbon disulfide burns?
 - 0.131 g
 - 8.41 g
 - 4.21 g
 - 2.10 g
- According to the law of conservation of matter, the equation $4 \text{Fe} + 3 \text{O}_2 \longrightarrow 2 \text{Fe}_2\text{O}_3$ is balanced.
 - True
 - False
- What is the mass of 3.012×10^{-5} mol of molybdic acid, $\text{H}_2\text{MoO}_4 \cdot \text{H}_2\text{O}$?
 - 4.898×10^{-3} g
 - 5.421×10^{-3} g
 - 5.421×10^7 g
 - 5.421×10^2 g
- For the reaction:

$$\text{CO}_{2(g)} + \text{H}_{2(g)} \longrightarrow \text{CO}_{(g)} + \text{H}_2\text{O}_{(l)}$$
 equal masses of the reactants are used. The limiting reagent will be $\text{CO}_{2(g)}$.
 - True
 - False
- In the following reaction find the missing reactant from the choices below:

$$\text{Na}_2\text{CO}_3 + ? \longrightarrow \text{H}_2\text{CO}_3 + \text{Na}_3\text{PO}_4$$
 - PO_4^{-3}
 - H_2PO_4
 - $\text{H}_2(\text{PO}_4)_2$
 - H_3PO_4
- When a piece of magnesium having a mass of 2.00 g is burned at 27.0°C and 103.72 kPa, 0.5000 L of oxygen is

consumed. What is the percentage purity of the magnesium?

- 50.5 %
 - 54.2 %
 - 25.0 %
 - 58.4 %
- If 8.75 g of potassium iodide in solution are mixed with an excess of lead (II) nitrate solution, the mass of precipitate formed is:
 - 48.4 g
 - 24.2 g
 - 12.1 g
 - 6.05 g
 -

A 0.225 mol/L $\text{Pb}(\text{NO}_3)_2$ solution was reacted with sufficient chromium (III) iodide to produce 6.31 g of precipitate.

The sum of the coefficients of the balanced chemical reaction is

- 6
 - 10
 - 4
 - 8
- The net ionic equation for the reaction between lead metal and an aqueous solution of silver nitrate is
 - $\text{Pb}_{(s)} + 2\text{AgNO}_{3(aq)} \longrightarrow \text{Pb}(\text{NO}_3)_2 + 2\text{Ag}_{(s)}$
 - $\text{Pb}_{(s)} + 2\text{NO}_3^{-(aq)} \longrightarrow \text{Pb}(\text{NO}_3)_2$
 - $\text{Pb}_{(s)} + 2\text{NO}_3^{-(aq)} + 2\text{Ag}^{+(aq)} \longrightarrow 2\text{Ag}_{(s)} + \text{Pb}^{2+(aq)}$
 - $\text{Pb}_{(s)} + 2\text{Ag}^{+(aq)} \longrightarrow 2\text{Ag}_{(s)} + \text{Pb}^{2+(aq)}$

10. Ethanol and oxygen react completely to produce 5.00 mol of products. Calculate the total number of moles of reactants if all chemicals are gases at the same temperatures and pressures.

A) 3.00 mol
 B) 1.00 mol
 C) 4.00 mol
 D) 5.00 mol

11. How many mL of 0.250 mol/L $\text{H}_2\text{SO}_{4(aq)}$ are required to react completely with 25.0 mL of 1.500 mol/L $\text{NaOH}_{(aq)}$?

A) 37.5 mL
 B) 75.0 mL
 C) 112.5 mL
 D) 150.0 mL

12.

A 0.225 mol/L $\text{Pb}(\text{NO}_3)_2$ solution was reacted with sufficient chromium (III) iodide to produce 6.31 g of precipitate.

The number of moles of precipitate produced is

A) 4.61 mol
 B) 0.0137 mol
 C) 2.38 mol
 D) 0.0265 mol

13. In an experiment, the total mass of all reactants was 5.30 g. There were three products formed. Two of the products masses added up to 4.15 g. What was the mass of the third product?

A) 1.15 g
 B) 5.30 g
 C) 4.15 g

D) 9.45 g

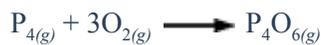
14. Which one of the following equations is correctly balanced?

A) $\text{N}_2 + 2\text{H}_2 \longrightarrow 2\text{NH}_3$
 B) $\text{C}_2\text{H}_2 + 2\text{O}_2 \longrightarrow 2\text{CO}_2 + \text{H}_2\text{O}$
 C) $2\text{H}_2\text{O}_2 \longrightarrow 2\text{H}_2\text{O} + \text{O}_2$
 D) $\text{Br}_2 + \text{KI} \longrightarrow \text{I}_2 + 2\text{KBr}$

15. How many moles of BaCl_2 form when 1.70 g of HCl reacts with excess barium hydroxide?

A) 0.0233 mol
 B) 0.0466 mol
 C) 0.0933 mol
 D) 0.0150 mol

16. 8.62 g of $\text{P}_{4(g)}$ reacts with 5.248 g of $\text{O}_{2(g)}$ as shown in the equation



What is the percentage yield for this reaction if 9.45 g of $\text{P}_4\text{O}_{6(g)}$ is produced?

A) 61.8%
 B) 82.4%
 C) 78.8%
 D) 26.2%

17. What mass of carbon dioxide forms when 8.00 g of coal (assume pure C) burns?

A) 3.66 g
 B) 29.3 g
 C) 58.6 g
 D) 14.7 g

18. What volume of oxygen gas is required to completely react with methanol if 6.00 L of gases are produced (assuming all substances are gases at the same temperature and pressure).

A) 2.00 L
 B) 3.00 L
 C) 4.00 L
 D) 5.00 L

19. What is the theoretical yield of ammonia, $\text{NH}_{3(g)}$, when 25.0 mL each of $\text{N}_{2(g)}$ and $\text{H}_{2(g)}$ react if all gases are measured at SATP?
- A) 25.0 mL
 - B) 75.0 mL
 - C) 16.7 mL
 - D) 37.5 mL
20. Using $\text{S}_{8(s)} + 8\text{O}_{2(g)} \longrightarrow 8\text{SO}_{2(g)}$, calculate the volume of products that results when 10.0 mg of sulfur burns. All gases are at STP.
- A) 6.99 mL
 - B) 0.873 mL
 - C) 55.9 mL
 - D) 0.312 mL

Answer Key

The Diversity of Matter and Chemical Bonding

1. D
2. D
3. A
4. B
5. A
6. D
7. B
8. E
9. A
10. B
11. D
12. C
13. E
14. E
15. D
16. C
17. A
18. B
19. A
20. C
21. A
22. A
23. A
24. D
25. A
26. D
27. A
28. D
29. D
30. D
31. D
32. D
33. A
34. A
35. D
36. A
37. D
38. A

39. C
40. A
41. B
42. C
43. D
44. B
45. B
46. A
47. A
48. B
49. D
50. E

Forms of Matter

1. A
2. B
3. B
4. D
5. C
6. D
7. B
8. A
9. B
10. C
11. D
12. B
13. B
14. D
15. A
16. C
17. A
18. D
19. B
20. A
21. C
22. B
23. A
24. A
25. A
26. C
27. B

- 28. B
- 29. D
- 30. B

Matter as Solutions, Acids, and Bases

- 1. B
- 2. C
- 3. B
- 4. A
- 5. A
- 6. A
- 7. B
- 8. A
- 9. C
- 10. B
- 11. B
- 12. E
- 13. B
- 14. A
- 15. C
- 16. B
- 17. C
- 18. D
- 19. A
- 20. B
- 21. C
- 22. A
- 23. C
- 24. C
- 25. C
- 26. C
- 27. A
- 28. B
- 29. C
- 30. D
- 31. B
- 32. B
- 33. C
- 34. C
- 35. C
- 36. B

- 37. B
- 38. C
- 39. C
- 40. B
- 41. B
- 42. D
- 43. B
- 44. B
- 45. C
- 46. B
- 47. B
- 48. A
- 49. C
- 50. B

Quantitative Relationships in Chemical Changes

- 1. B
- 2. A
- 3. B
- 4. A
- 5. D
- 6. A
- 7. C
- 8. B
- 9. D
- 10. C
- 11. B
- 12. B
- 13. A
- 14. C
- 15. A
- 16. C
- 17. B
- 18. B
- 19. C
- 20. A

