GRADE 11 CHEMISTRY (30S)

Midterm Practice Examination

Answer Key

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Instructions

The midterm examination will be weighted as follows

Modules 1–3	100%

The format of the examination will be as follows:

Part A: Multiple Choice	49 x 1 = 49 marks
Part B: Fill-in-the-Blanks	15 x 1 = 15 marks
Part C: Short Answer	36 marks
Total Marks	100 marks

Include units with all answers as required.

Useful Information

You will need the following in order to complete this examination:

- writing utensils and eraser or correction fluid
- some scrap paper
- a ruler
- a scientific calculator

You will have a maximum of 2.5 hours to complete your midterm exam.

Part A: Multiple Choice (49 Marks)

For each Multiple Choice question, shade in the circle that corresponds to your answer on the Bubble Sheet at the end of this exam. DO NOT circle your answers directly on the exam.

Physical Properties of Matter *(20 marks)*

1. The pressure resulting from the collision of air molecules with objects is called
   a) Kinetic energy
   b) Atmospheric pressure
   c) Vapour pressure
   d) Sublimation

2. The pressure above a liquid in a sealed container caused by the collision of vaporized particles with the walls of their container is called
   a) Kinetic energy
   b) Vapour pressure
   c) Atmospheric pressure
   d) Sublimation

3. Which of the following statements does not agree with the kinetic theory of gases?
   a) Gas particles move in predictable patterns.
   b) Gas particles move independently of one another.
   c) Gas particles are spaced far apart from each other.
   d) Gas particles are in constant motion.

4. The average kinetic energy of the particles in a substance is
   a) Increased as the temperature of the substance increases.
   b) Unaffected by changes in the temperature of the substance.
   c) Increased as the temperature of the substance decreases.
   d) Equal to the total thermal energy absorbed by the substance.

5. What happens to the kinetic energy of the particles in a sample of gas as the temperature of the sample increases?
   a) It increases, then decreases
   b) It does not change
   c) It increases
   d) It decreases

6. Which of the following phase changes is NOT endothermic?
   a) Condensation
   b) Evaporation
   c) Melting
   d) Sublimation

7. The vaporization of a solid is also known as
   a) Condensation
   b) Deposition
   c) Evaporation
   d) Sublimation

8. The temperature at which the motion of particles theoretically ceases is
   a) 273 K
   b) –273 K
   c) 0 K
   d) 0°C

9. Which of the following is NOT a characteristic of liquids?
   a) Liquids have the ability to flow.
   b) The particles of a liquid are not attracted to each other.
   c) The particles of liquids are closer together than particles of gases.
   d) Liquids conform to the shape of their container.

10. Which are the first particles to evaporate from a liquid?
    a) Those with the lowest average kinetic energy.
    b) Those with the highest average kinetic energy.
    c) Those farthest from the surface of the liquid, regardless of kinetic energy.
    d) Those closest to the surface of the liquid, regardless of kinetic energy.

11. Which of these statements best explains why a liquid's rate of evaporation increases when the liquid is heated?
    a) The potential energy of the liquid increases, which in turn increases the rate of evaporation.
    b) The surface area of the liquid increases.
    c) More surface molecules have the energy required to overcome the attractive forces holding them in the liquid.
    d) The average kinetic energy of the liquid decreases.

12. If a liquid is sealed in an airtight container and kept at a constant temperature, how will its vapour pressure change over time?
    a) It rises at first, then falls over time.
    b) It rises at first, then remains constant.
    c) It remains constant.
    d) It rises continuously.

13. If a liquid is sealed in an airtight container, how will it be affected by an increase in temperature?
    a) The kinetic energy of the liquid particles will decrease.
    b) The vapour pressure above the liquid will increase.
    c) The vapour pressure of the liquid will decrease.
    d) Fewer particles will escape the surface of the liquid.

14. In a dynamic equilibrium between the liquid state and the gaseous state, the rate of condensation
    a) Is greater than the rate of evaporation.
    b) Is less than the rate of evaporation.
    c) Is equal to the rate of evaporation.
    d) Has no effect on the rate of evaporation.

15. When gas particles escape from the surface of a liquid below the boiling point, this is called
    a) Evaporation
    b) Boiling
    c) Sublimation
    d) Condensation

16. When a liquid is at its normal boiling point, atmospheric pressure is
    a) 0 atm
    b) 0.5 atm
    c) 1 atm
    d) 2 atm

17. When the atmospheric pressure is equal to the vapour pressure of a liquid, the liquid will
    a) Condense
    b) Freeze
    c) Boil
    d) Melt

18. Which of the following characteristics is true of most solids?
    a) Solids are viscous.
    b) Solids are incompressible.
    c) Solids generally melt easily.
    d) Solids are made up of particles in rapid motion.

19. If you wanted to make water boil at 75°C, instead of 100°C, you would have to
    a) Add more heat.
    b) Increase air pressure.
    c) Decrease the volume of water you are boiling.
    d) Heat the water at a higher altitude.

20. Which of the following is not a phase change?
    a) Vaporization
    b) Evaporation
    c) Sublimation
    d) Diffusion

Gases and the Atmosphere ***(12 marks)***

21. A device used to measure air pressure is called a
    a) Manometer
    b) Barometer
    c) Thermometer
    d) Millibar

22. Gas pressure is usually measured with an instrument called a
    a) Manometer
    b) Barometer
    c) Pascal
    d) Thermometer

23. Which scientist discovered that the pressure of the atmosphere changed according to altitude?
    a) Huygens
    b) Avogadro
    c) Pascal
    d) Torricelli

24. It is possible for equal volumes of gases, at standard pressure and temperature, to contain equal numbers of particles because
    a) Gas particles are spaced far apart.
    b) Gas particles are large in size.
    c) The volume of a gas is inversely proportional to its mass.
    d) This is not possible.

25. Equal volumes of nitrogen and oxygen, at the same temperature and pressure, would
    a) Have the same mass.
    b) Contain a different number of particles.
    c) Contain the same number of particles.
    d) Have different average kinetic energies.

26. Which of the following best describes Boyle's Law?
    a) The volume of a gas is directly proportional to its temperature, if the pressure is kept constant.
    b) The volume of a gas varies inversely with pressure, at a constant temperature.
    c) The pressure of a gas is directly proportional to its temperature, if the volume is kept constant.
    d) At constant volume and temperature, the total pressure of a gas is equal to the sum of its partial pressures.

27. A weather balloon is heated from room temperature to 58°C. As a result, the gas inside the weather balloon increases in volume. Which gas law explains this phenomenon?
    a) Gay-Lussac's Law
    b) Boyle's Law
    c) Charles' Law
    d) Combined Gas Law

28. Why does the pressure inside a container of gas increase if more gas is added to the container?
    a) There is an increase in the number of particles striking the wall of the container in the same period of time.
    b) An increase in gas causes an increase in temperature, which then increases pressure.
    c) As the volume of gas increases, the force of the collisions between particles and the container increases.
    d) As the gas pressure increases, the volume of gas decreases.

29. A gas is confined to a steel tank with a fixed volume. At 293 K, the gas exerts a pressure of 8.53 atm. After heating the tank, the pressure of the gas increases to 10.4 atm. What is the temperature of the heated gas?
    a) 357 K
    b) 326 K
    c) 240 K
    d) 926 K

30. According to Gay-Lussac's law
    a) Pressure is inversely proportional to temperature at a constant volume.
    b) Volume is inversely proportional to temperature at a constant pressure.
    c) Volume is directly proportional to temperature at a constant pressure.
    d) Pressure is directly proportional to temperature at a constant volume.

31. 4.0 L of a sample of gas at 1.0 atm of pressure is compressed into a 0.85 L tank. What is the pressure of the compressed gas, if the temperature remains constant?
    a) 0.15 atm
    b) 4.7 atm
    c) 0.21 atm
    d) 3.4 atm

32. A balloon is filled with 2.33 L of helium at 304 K. If the balloon is moved indoors where the temperature is 293 K, what will be the new volume of the balloon? Assume that pressure remains unchanged.
    a) 2.41 L
    b) 2.24 L
    c) 2.17 L
    d) 1.50 L

Chemical Reactions ***(17 marks)***

33. Calculate the number of moles in 21.2 g of hydrochloric acid (HCl).
    a) 0.581 moles
    b) 1.72 moles
    c) 21.0 moles
    d) 128 moles

34. What is the molar mass of $CaSO_4$?
    a) 108.1 g/mol
    b) 88.2 g/mol
    c) 136.2 g/mol
    d) 232.5 g/mol

35. How many moles are present in 165 g of manganese?
    a) 3.00
    b) 2.00
    c) 4.20
    d) 6.15

36. What is the formula mass of potassium chlorate, $KClO_3$?
    a) 122.6 μ
    b) 91.6 μ
    c) 193.6 μ
    d) 226.1 μ

37. How do the isotopes hydrogen–1 and hydrogen–2 differ?
    a) Hydogen–2 has one more electron than hydrogen–1.
    b) Hydrogen–2 has one more proton than hydrogen–1.
    c) Hydrogen–2 has one neutron, hydrogen–1 has none.
    d) Hydrogen–1 has one neutron, hydrogen–2 has 2 neutrons.

38. The fictional element Q has two naturally occurring isotopes with the following percent abundances: Q–20 is 25.0% abundant, and Q–22 is 75.0% abundant. What is the average atomic mass for Element Q?
    a) 20.5 g
    b) 21.0 g
    c) 21.5 g
    d) 42.0 g

39. What is the volume (in litres at STP) of 2.50 moles of carbon monoxide?
    a) 70.0 L
    b) 3.10 L
    c) 56.0 L
    d) 9.00 L

40. What is the number of moles in 500 L of He gas at STP?
    a) 0.05 moles
    b) 0.2 moles
    c) 20 moles
    d) 90 moles

41. What are the missing coefficients for the skeleton equation below?

$$Al_2(SO_4)_{3(aq)} + KOH_{(aq)} \rightarrow Al(OH)_{3(aq)} + K_2SO_{4(aq)}$$

    a) 1,6,2,3
    b) 2,3,1,1
    c) 1,3,2,3
    d) 4,6,3,2

42. Aluminum chloride and hydrogen gas are produced when strips of aluminum are placed in hydrochloric acid. What is the balanced equation for this reaction?
    a) $Al + 2HCl \rightarrow AlCl_2 + H_2$
    b) $Al + HCl_3 \rightarrow AlCl_3 + H$
    c) $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$
    d) $H + AlCl \rightarrow Al + HCl$

43. What type of reaction was described in Question #42?
    a) Synthesis
    b) Single-replacement
    c) Double-replacement
    d) Decomposition

44. When the equation $Fe + Cl_2 \rightarrow FeCl_3$ is balanced, what is the coefficient for Cl_2?
    a) 4
    b) 3
    c) 2
    d) 1

45. If a synthesis reaction takes place between potassium and chlorine, what is the product?
    a) PCl_2
    b) PCl
    c) KCl_2
    d) KCl

46. What is the balanced equation for the decomposition of lead(IV)oxide?
    a) $2PbO \rightarrow 2Pb + O_2$
    b) $PbO \rightarrow Pb + O_2$
    c) $PbO_2 \rightarrow Pb + 2O_2$
    d) $PbO_2 \rightarrow Pb + O_2$

47. Which of the following is an empirical formula?
    a) Sb_2S_3
    b) $C_{12}H_{26}$
    c) $C_2H_8N_2$
    d) P_4O_{10}

48. The reaction type that involves two simple substances combining to produce a single more complex substance is known as
    a) Decomposition
    b) Single replacement
    c) Combustion
    d) Synthesis

49. You are given the following empirical formula: CH_2O. Which of the following may be the corresponding molecular formula?
    a) $C_6H_8O_6$
    b) $C_2H_{12}O_6$
    c) $C_6H_{12}O_6$
    d) $C_6H_{12}O_3$

Part B: Fill-in-the-Blanks (15 Marks)

Use the Word Bank at the end of this exam to help you complete the "Fill in the Blank" questions. As each blank is worth one mark, some questions will have a total value of two marks. Note that there are MORE terms provided than you need, so read over the list carefully and choose the terms you want to use. The same term may be used more than once in this section.

Physical Properties of Matter *(5 marks)*

1. The temperature at which the vapour pressure of a liquid is equal to the external atmospheric pressure is called _____ point. ***Boiling***
2. Collisions between gas molecules are assumed to be perfectly _____. ***Elastic***
3. The _____ theory states that tiny particles in all forms of matter are in constant motion. ***Kinetic***
4. Unlike the other states of matter, _____ cannot flow. ***Solids***
5. The temperature at which the motion of particles theoretically ceases is known as _____ zero. ***Absolute***

Gases and the Atmosphere *(5 marks)*

6. Methane is considered to be a _____ gas. ***Greenhouse***
7. What we call _____ gas is actually not one gas, but a mixture of several naturally occurring gases in the atmosphere. ***Natural***
8. The _____ of natural gas has a direct effect on the carbon cycle, as the reaction produces both carbon dioxide and carbon monoxide. ***Combustion***
9. Today, the air on Earth is mostly _____ and oxygen gases, but this was not always the case. ***Nitrogen***
10. Blue-green algae produced oxygen gas through the process of _____. ***Photosynthesis***

Chemical Reactions *(5 marks)*

11. In a double-replacement reaction, the reactants are two _____ compounds. ***Ionic***
12. One-twelfth the mass of one carbon atom equals one _____ mass unit. ***Atomic***
13. The molar volume of a gas at _____ occupies 22.4 L. ***STP***
14. In a _____ reaction, one of the reactants is oxygen gas. ***Combustion***
15. Chemical equations must be balanced to satisfy the Law of _____ of mass. ***Conservation***

Part C: Short Answer (37 Marks)

Answer each of the questions below using the space provided. Pay attention to the number of marks that each question is worth, as this may help you decide how much information to provide for full marks. For questions that involve calculations, show your work and check your final answer for the correct number of significant figures and the appropriate unit.

Physical Properties of Matter *(5 marks)*

1. Describe the basic assumptions of the kinetic molecular theory of gases as far as:
   a) volume
   b) intermolecular forces
   c) collisions *(3 marks)*

   Answer:

   a) The volume of a gas particle is much less than the total volume of the gas. In other words, most of the volume of a gas is empty space. *(1 mark)*
   b) The particles of gases are so spread out that the intermolecular forces between them are negligible. In other words, gas particles do not really attract or repel each other. *(1 mark)*
   c) All collisions between gas particles are perfectly elastic. This means that there is no kinetic energy lost or gained during these collisions. *(1 mark)*

2. Two jars of water are sealed and then stored at a temperature of 20°C. One jar contains 75 mL of water, while the other contains 25 mL of water. Explain why, despite the difference in volume, the vapour pressure in both containers is the same. *(2 marks)*

   Answer:

   Vapour pressure is not dependent on volume of liquid, only on the kinetic energy of the molecules in the vapour. *(1 mark)*

   Since both jars contain water and are at the same temperature, their kinetic energies will be the same. *(1 mark)*

Gases and the Atmosphere ***(13 marks)***

3. A model hot air balloon has a volume of 35.0 L at a pressure of 100 kPa and a temperature of 80.0ºC. Calculate the new volume if the temperature is decreased to 15ºC (assume constant pressure). *(3 marks)*

   Answer:

   Convert temperature to Kelvin:

   80.0°C + 273 = 353 K; 15°C + 273 = 288 K *(1 mark)*

   $$\left(\frac{288\ \cancel{K}}{353\ \cancel{K}}\right) \times 35.0\ \text{L} = 28.6\ \text{L}$$ *(2 marks)*

4. A gas has a volume of 125 L at 325 kPa and 58.0°C. Use the Combined Gas Law to calculate the temperature in Celsius to produce a volume of 22.4 L at 101.3 kPa. Include the correct ratios for each part of the calculation, as well as a verbal prediction of each outcome. *(8 marks)*

   Answer:

   58.0°C + 273 = 331 K *(1 mark)*

   Volume is decreased, so temperature should decrease. *(1 mark)*

   This is the correct ratio: $\frac{22.4\ \text{L}}{125\ \text{L}}$ *(1 mark)*

   $$\text{New Temperature} = 331\ \text{K} \times \left(\frac{22.4\ \cancel{\text{L}}}{125\ \cancel{\text{L}}}\right) \times ?$$ *(1 mark)*

   Since pressure decreases, temperature should also decrease. *(1 mark)*

   This is the correct ratio: $\frac{101.3\ \text{kPa}}{325\ \text{kPa}}$ *(1 mark)*

   $$\text{New Temperature} = 331\ \text{K} \times \left(\frac{22.4\ \cancel{\text{L}}}{125\ \cancel{\text{L}}}\right) \times \left(\frac{101.3\ \cancel{\text{kPa}}}{325\ \cancel{\text{kPa}}}\right) = 18.5\ \text{K}$$ *(1 mark)*

   Convert Kelvin to Celsius: 18.5 K − 273 = −254°C. *(1 mark)*

5. Describe the strategies involved in one Air Quality Improvement initiative that you researched. *(2 marks, 1 mark per strategy discussed)*

   Answer:

   Answers will vary. (Module 2, Lesson 1)

   Your answer should be based on the research you did for Assignment 2.1: Air Quality Improvement Research. To get full marks, you must describe **two** of the strategies that are part of the initiative.

   Note: Read the question carefully. You are not agreeing with or critiquing the initiative. You are just describing it.

Chemical Reactions *(18 marks)*

6. Name each of the following. *(4 marks)*

   a) Cu_3N

   Answer:

   copper (I) nitride

   b) $FeCO_3$

   Answer:

   iron (II) carbonate

   c) $KMnO_4$

   Answer:

   potassium permanganate

   d) P_3N_5

   Answer:

   triphosphorous pentanitride

7. Write the chemical formula of the following compounds. *(5 marks)*

   a) mercury (II) iodide

   Answer:

   HgI_2

   b) rubidium perchlorate

   Answer:

   $RbClO_4$

   c) calcium phosphate

   Answer:

   $Ca_3(PO_4)_2$

   d) carbon tetrachloride

   Answer:

   CCl_4

   e) bromine pentafluoride

   Answer:

   BrF_5

8. List one isotope and identify how it is used. *(3 marks)*

   Answer:

   Answers will vary. (Module 3, Lesson 1)

   The applications of various isotopes can be found on page 9 of Module 3. For full marks in this question, you must include:

   - The isotope (^{131}I, ^{198}Au, etc.)
   - The field it is used in (Traces, Treatment, or Climatology/Geology)
   - What it is used for (measuring iodine levels, etc.)

   A sample answer could be:

   - In medical treatments, ^{60}Co is used to produce the gamma rays used to destroy brain tumours.

9. What is the empirical formula of a compound that is 40.7% carbon, 54.2% oxygen, and 5.1% hydrogen? *(4 marks)*

Answer:

$$\text{moles C} = 40.7\ \cancel{\text{g C}} \times \frac{1\ \text{mol C}}{12.0\ \cancel{\text{g C}}} = 3.39\ \text{moles C}$$

$$\text{moles H} = 5.1\ \cancel{\text{g H}} \times \frac{1\ \text{mol H}}{1.0\ \cancel{\text{g H}}} = 5.1\ \text{moles H}$$

$$\text{moles O} = 54.2\ \cancel{\text{g O}} \times \frac{1\ \text{mol O}}{16.0\ \cancel{\text{g O}}} = 3.39\ \text{moles O}$$ *(0.5 marks x 3 = 1.5 marks)*

$$\text{mole ratio of C} = \frac{3.39\ \text{mol}}{3.39\ \text{mol}} = 1$$

$$\text{mole ratio of H} = \frac{5.1\ \text{mol}}{3.39\ \text{mol}} = 1.5$$

$$\text{mole ratio of O} = \frac{3.39\ \text{mol}}{3.39\ \text{mol}} = 1$$ *(0.5 marks x 3 = 1.5 marks)*

$C_1H_{1.5}O_1 \rightarrow C_2H_3O_2$ *(1 mark)*

10. Find the number of moles of calcium in a 0.400 g calcium supplement capsule. Show all of your calculations. *(2 marks)*

Answer:

$$0.400\ \cancel{\text{g Ca}} \times \frac{1\ \text{mole Ca}}{40.1\ \cancel{\text{g Ca}}} = 9.98 \times 10^{-3}\ \text{mol}$$

NOTES

Grade 11 Chemistry
Midterm Practice Examination

Word Bank

Use the following word bank to help you complete the "Fill-in-the-Blank" portion of your Midterm Examination. Note that there may be MORE terms here than you need, so read over the list carefully before choosing the terms that you want to use. You can also use certain words more than once.

absolute
ammonia
atomic
atoms
boiling
carbon dioxide
carbon monoxide
combustion
composition
conservation
decrease
elastic
equilibrium
evaporation
gas
gases
glucose
greenhouse
helium
increase
intermolecular
ionic
kinetic
liquids
mass
methane
mixture
mole
natural
neutron
neutrons
nitrogen
photosynthesis
plasma
processed
refined
replacement
solids
STP
sublimation
water vapour

Grade 11 Chemistry
Midterm Practice Examination

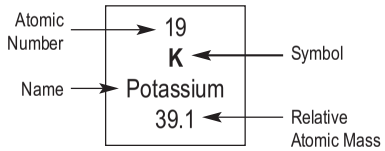
Bubble Sheet

Name: _____ _____ / 49

For each Multiple Choice question, shade in the circle that corresponds to your answer. DO NOT circle your answers directly on the exam.

	A	B	C	D		A	B	C	D		A	B	C	D		A	B	C	D
1.	❍	❍	❍	❍	14.	❍	❍	❍	❍	27.	❍	❍	❍	❍	40.	❍	❍	❍	❍
2.	❍	❍	❍	❍	15.	❍	❍	❍	❍	28.	❍	❍	❍	❍	41.	❍	❍	❍	❍
3.	❍	❍	❍	❍	16.	❍	❍	❍	❍	29.	❍	❍	❍	❍	42.	❍	❍	❍	❍
4.	❍	❍	❍	❍	17.	❍	❍	❍	❍	30.	❍	❍	❍	❍	43.	❍	❍	❍	❍
5.	❍	❍	❍	❍	18.	❍	❍	❍	❍	31.	❍	❍	❍	❍	44.	❍	❍	❍	❍
6.	❍	❍	❍	❍	19.	❍	❍	❍	❍	32.	❍	❍	❍	❍	45.	❍	❍	❍	❍
7.	❍	❍	❍	❍	20.	❍	❍	❍	❍	33.	❍	❍	❍	❍	46.	❍	❍	❍	❍
8.	❍	❍	❍	❍	21.	❍	❍	❍	❍	34.	❍	❍	❍	❍	47.	❍	❍	❍	❍
9.	❍	❍	❍	❍	22.	❍	❍	❍	❍	35.	❍	❍	❍	❍	48.	❍	❍	❍	❍
10.	❍	❍	❍	❍	23.	❍	❍	❍	❍	36.	❍	❍	❍	❍	49.	❍	❍	❍	❍
11.	❍	❍	❍	❍	24.	❍	❍	❍	❍	37.	❍	❍	❍	❍					
12.	❍	❍	❍	❍	25.	❍	❍	❍	❍	38.	❍	❍	❍	❍					
13.	❍	❍	❍	❍	26.	❍	❍	❍	❍	39.	❍	❍	❍	❍					

Periodic Table of the Elements



Group 1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1 H Hydrogen 1.0																	1 H Hydrogen 1.0	2 He Helium 4.0	1
3 Li Lithium 6.9	4 Be Beryllium 9.0												5 B Boron 10.8	6 C Carbon 12.0	7 N Nitrogen 14.0	8 O Oxygen 16.0	9 F Fluorine 19.0	10 Ne Neon 20.2	2
11 Na Sodium 23.0	12 Mg Magnesium 24.3												13 Al Aluminum 27.0	14 Si Silicon 28.1	15 P Phosphorus 31.0	16 S Sulphur 32.1	17 Cl Chlorine 35.5	18 Ar Argon 39.9	3
19 K Potassium 39.1	20 Ca Calcium 40.1		21 Sc Scandium 45.0	22 Ti Titanium 47.9	23 V Vanadium 50.9	24 Cr Chromium 52.0	25 Mn Manganese 54.9	26 Fe Iron 55.8	27 Co Cobalt 58.9	28 Ni Nickel 58.7	29 Cu Copper 63.5	30 Zn Zinc 65.4	31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0	35 Br Bromine 79.9	36 Kr Krpton 83.8	4
37 Rb Rubidium 85.5	38 Sr Strontium 87.6		39 Y Yttrium 88.9	40 Zr Zirconium 91.2	41 Nb Niobium 92.9	42 Mo Molybdenum 95.5	43 Tc Technetium (98)	44 Ru Ruthenium 101.1	45 Rh Rhodium 102.9	46 Pd Palladium 106.4	47 Ag Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.7	52 Te Tellurium 127.6	53 I Iodine 126.9	54 Xe Xenon 131.3	5
55 Cs Cesium 132.9	56 Ba Barium 137.3	57–70 Lanthanide Series	71 Lu Lutetium 175.0	72 Hf Hafnium 178.5	73 Ta Tantalum 180.9	74 W Tungsten 183.8	75 Re Rhenium 186.2	76 Os Osmium 190.2	77 Ir Iridium 192.2	78 Pt Platinum 195.1	79 Au Gold 197.0	80 Hg Mercury 200.6	81 Tl Thallium 204.4	82 Pb Lead 207.2	83 Bi Bismuth 209.0	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)	6
87 Fr Francium (223)	88 Ra Radium (226)	89–102 Actinide Series	103 Lr Lawrencium (257)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (264)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 Uun Ununnilium (268)	111 Uuu Unununium (272)	112 Cn Copernicium (277)		114 Uuq Ununquadium (285)		116 Uuh Ununhexium (268)		118 Uuo Ununoctium (293)	7

Inner Transition Elements

Lanthanide Series	57 La Lanthanum 138.9	58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Nd Neodymium 144.2	61 Pm Promethium (145)	62 Sm Samarium 150.4	63 Eu Europium 152.0	64 Gd Gadolinium 157.2	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Holmium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Ytterbium 173.0
Actinide Series	89 Ac Actinium (227)	90 Th Thorium 232.0	91 Pa Protactinium (231)	92 U Uranium 238.0	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Fermium (257)	101 Md Mendelevium (256)	102 No Nobelium (259)

Electronegativities Table

Group 1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 **H** 2.20																	1 **H** 2.20	2 **He** —
3 **Li** 0.97	4 **Be** 1.47												5 **B** 2.01	6 **C** 2.50	7 **N** 3.07	8 **O** 3.50	9 **F** 4.10	10 **Ne** —
11 **Na** 1.01	12 **Mg** 1.23												13 **Al** 1.47	14 **Si** 1.74	15 **P** 2.06	16 **S** 2.44	17 **Cl** 2.83	18 **Ar** —
19 **K** 0.91	20 **Ca** 1.04		21 **Sc** 1.20	22 **Ti** 1.32	23 **V** 1.45	24 **Cr** 1.56	25 **Mn** 1.60	26 **Fe** 1.64	27 **Co** 1.70	28 **Ni** 1.75	29 **Cu** 1.75	30 **Zn** 1.66	31 **Ga** 1.82	32 **Ge** 2.02	33 **As** 2.20	34 **Se** 2.48	35 **Br** 2.74	36 **Kr** —
37 **Rb** 0.89	38 **Sr** 0.99		39 **Y** 1.11	40 **Zr** 1.22	41 **Nb** 1.23	42 **Mo** 1.30	43 **Tc** 1.36	44 **Ru** 1.42	45 **Rh** 1.45	46 **Pd** 1.35	47 **Ag** 1.42	48 **Cd** 1.46	49 **In** 1.49	50 **Sn** 1.72	51 **Sb** 1.82	52 **Te** 2.01	53 **I** 2.21	54 **Xe** —
55 **Cs** 0.86	56 **Ba** 0.97	57–70 **Lanthanide Series**	71 **Lu** 1.14	72 **Hf** 1.23	73 **Ta** 1.33	74 **W** 1.40	75 **Re** 1.46	76 **Os** 1.52	77 **Ir** 1.55	78 **Pt** 1.44	79 **Au** 1.42	80 **Hg** 1.44	81 **Tl** 1.44	82 **Pb** 1.55	83 **Bi** 1.67	84 **Po** 1.76	85 **At** 1.96	86 **Rn** —
87 **Fr** 0.86	88 **Ra** 0.97	89–102 **Actinide Series**	103 **Lr** —	104 **Rf** —	105 **Db** —	106 **Sg** —	107 **Bh** —	108 **Hs** —	109 **Mt** —	110 **Uun** —	111 **Uuu** —	112 **Cn** —		114 **Uuq** —		116 **Uuh** —		118 **Uuo** —

Inner Transition Elements

Lanthanide Series	57 **La** 1.08	58 **Ce**	59 **Pr** 1.07	60 **Nd** 1.07	61 **Pm** 1.07	62 **Sm** 1.07	63 **Eu** 1.01	64 **Gd** 1.11	65 **Tb** 1.10	66 **Dy** 1.10	67 **Ho** 1.10	68 **Er** 1.11	69 **Tm** 1.11	70 **Yb** 1.06
Actinide Series	89 **Ac** 1.00	90 **Th**	91 **Pa** 1.14	92 **U** 1.30	93 **Np** 1.29	94 **Pu** 1.25	95 **Am** —	96 **Cm** —	97 **Bk** —	98 **Cf** —	99 **Es** —	100 **Fm** —	101 **Md** —	102 **No** —

Alphabetical Listing of the Elements and Their Atomic Masses

Element	Atomic Mass	Element	Atomic Mass	Element	Atomic Mass
Actinium	(227)	Gold	197.0	Praseodymium	140.9
Aluminum	27.0	Hafnium	178.5	Promethium	(145)
Americium	(243)	Hassium	(265)	Protactinum	(231)
Antimony	121.7	Helium	4.0	Radium	(226)
Argon	39.9	Holmium	164.9	Radon	(222)
Arsenic	74.9	Hydrogen	1.0	Rhenium	186.2
Astatine	(210)	Indium	114.8	Rhodium	102.9
Barium	137.3	Iodine	126.9	Rubidium	85.5
Berkelium	(247)	Iridium	192.2	Ruthenium	101.1
Beryllium	9.0	Iron	55.8	Rutherfordium	(261)
Bismuth	209.0	Krypton	83.8	Samarium	150.4
Bohrium	(264)	Lanthanum	138.9	Scandium	45.0
Boron	10.8	Lawrencium	(257)	Seaborgium	(263)
Bromine	79.9	Lead	207.2	Selenium	79.0
Cadmium	112.4	Lithium	6.9	Silicon	28.1
Calcium	40.1	Lutetium	175.0	Silver	107.9
Californium	(251)	Magnesium	24.3	Sodium	23.0
Carbon	12.0	Manganese	54.9	Strontium	87.6
Cerium	140.1	Meitnerium	(266)	Sulfur	32.1
Cesium	132.9	Mendelevium	(256)	Tantalum	180.9
Chlorine	35.5	Mercury	200.6	Technetium	(98)
Chromium	52.0	Molybdenum	95.9	Tellurium	127.6
Cobalt	58.9	Neodymium	144.2	Terbium	158.9
Copernicium	(277)	Neon	20.2	Thallium	204.4
Copper	63.5	Neptunium	(237)	Thorium	232.0
Curium	(247)	Nickel	58.7	Thulium	168.9
Dubnium	(262)	Niobium	92.9	Tin	118.7
Dysprosium	162.5	Nitrogen	14.0	Titanium	47.9
Einsteinium	(254)	Nobelium	(259)	Tungsten	183.8
Erbium	167.3	Osmium	190.2	Uranium	238.0
Europium	152.0	Oxygen	16.0	Vanadium	50.9
Fermium	(257)	Palladium	106.4	Xenon	131.3
Fluorine	19.0	Phosphorus	31.0	Ytterbium	173.0
Francium	(223)	Platinum	195.1	Yttrium	88.9
Gadolinium	157.2	Plutonium	(244)	Zinc	65.4
Gallium	69.7	Polonium	(209)	Zirconium	91.2
Germanium	72.6	Potassium	39.1		

Names, Formulas, and Charges of Common Ions

Positive Ions (Cations)

Name	Symbol	Name	Symbol
aluminum	Al^{3+}	magnesium	Mg^{2+}
ammonium	NH_4^+	**manganese(II)**	**Mn^{2+}**
barium	Ba^{2+}	manganese(IV)	Mn^{4+}
cadmium	Cd^{2+}	mercury(I)	Hg_2^{2+}
calcium	Ca^{2+}	mercury(II)	Hg^{2+}
chromium(II)	Cr^{2+}	**nickel(II)**	**Ni^{2+}**
chromium(III)	**Cr^{3+}**	nickel(III)	Ni^{3+}
copper(I)	Cu^+	potassium	K^+
copper(II)	**Cu^{2+}**	silver	Ag^+
hydrogen	H^+	sodium	Na^+
iron(II)	Fe^{2+}	strontium	Sr^{2+}
iron(III)	**Fe^{3+}**	tin(II)	Sn^{2+}
lead(II)	**Pb^{2+}**	**tin(IV)**	**Sn^{4+}**
lead(IV)	Pb^{4+}	zinc	Zn^{2+}
lithium	Li^+		

continued

Negative Ions (Anions)

Name	Symbol	Name	Symbol
acetate	$C_2H_3O_2^-$ (CH_3COO^-)	nitrate	NO_3^-
azide	N_3^-	nitride	N^{3-}
bromide	Br^-	nitrite	NO_2^-
bromate	BrO_3^-	oxalate	$C_2O_4^{2-}$
carbonate	CO_3^{2-}	hydrogen oxalate	$HC_2O_4^-$
hydride	H^-	oxide	O^{2-}
hydrogen carbonate or bicarbonate	HCO_3^-	perchlorate	ClO_4^-
chlorate	ClO_3^-	permanganate	MnO_4^-
chloride	Cl^-	phosphate	PO_4^{3-}
chlorite	ClO_2^-	monohydrogen phosphate	HPO_4^{2-}
chromate	CrO_4^{2-}	dihydrogen phosphate	$H_2PO_4^-$
citrate	$C_6H_5O_7^{3-}$	silicate	SiO_3^{2-}
cyanide	CN^-	sulfate	SO_4^{2-}
dichromate	$Cr_2O_7^{2-}$	hydrogen sulfate	HSO_4^-
fluoride	F^-	sulfide	S^{2-}
hydroxide	OH^-	hydrogen sulfide	HS^-
hypochlorite	ClO^-	sulfite	SO_3^{2-}
iodide	I^-	hydrogen sulfite	HSO_3^-
iodate	IO_3^-	thiocyanate	SCN^-

Common Ions

Cations (Positive Ions)

1^+ charge		2^+ charge		3^+ charge	
NH_4^+	Ammonium	Ba^{2+}	Barium	Al^{3+}	Aluminum
Cs^+	Cesium	Be^{2+}	Beryllium	Cr^{3+}	Chromium(III)
Cu^+	Copper(I)	Cd^{2+}	Cadmium	Co^{3+}	Cobalt(III)
Au^+	Gold(I)	Ca^{2+}	Calcium	Ga^{3+}	Gallium
H^+	Hydrogen	Cr^{2+}	Chromium(II)	Au^{3+}	Gold(III)
Li^+	Lithium	Co^{2+}	Cobalt(II)	Fe^{3+}	Iron(III)
K^+	Potassium	Cu^{2+}	Copper(II)	Mn^{3+}	Manganese
Rb^+	Rubidium	Fe^{2+}	Iron(II)	Ni^{3+}	Nickel(III)
Ag^+	Silver	Pb^{2+}	Lead(II)		
Na^+	Sodium	Mg^{2+}	Magnesium	4^+ charge	
		Mn^{2+}	Manganese(II)	Pb^{4+}	Lead(IV)
		Hg_2^{2+}	Mercury(I)	Mn^{4+}	Manganese(IV)
		Hg^{2+}	Mercury(II)	Sn^{4+}	Tin(IV)
		Ni^{2+}	Nickel(II)		
		Sr^{2+}	Strontium		
		Sn^{2+}	Tin(II)		
		Zn^{2+}	Zinc		

(continued)

Anions (Negative Ions)

1^- charge		1^- charge		2^- charge	
CH_3COO^- ($C_2H_3O_2^-$)	Acetate (or ethanoate)	HS^-	Hydrogen sulfide	CO_3^{2-}	Carbonate
				CrO_4^{2-}	Chromate
BrO_3^-	Bromate	OH^-	Hydroxide	$Cr_2O_7^{2-}$	Dichromate
Br^-	Bromide	IO_3^-	Iodate	O^{2-}	Oxide
ClO_3^-	Chlorate	I^-	Iodide	O_2^{2-}	Peroxide
Cl^-	Chloride	NO_3^-	Nitrate	SO_4^{2-}	Sulfate
ClO_2^-	Chlorite	NO_2^-	Nitrite	S^{2-}	Sulfide
CN^-	Cyanide	ClO_4^-	Perchlorate	SO_3^{2-}	Sulfite
F^-	Fluoride	IO_4^-	Periodate	$S_2O_3^{2-}$	Thiosulfate
H^-	Hydride	MnO_4^-	Permanganate		
HCO_3^-	Hydrogen carbonate (or bicarbonate)	SCN^-	Thiocynate	3^- charge	
				N^{3-}	Nitride
ClO^-	Hypochlorite			PO_4^{3-}	Phosphate
HSO_4^-	Hydrogen sulfate			P^{3-}	Phosphide
				PO_3^{3-}	Phosphite