# Unit 1: Basic Chemistry

## Chapter 1: Introduction (pg. 23 & 24)

**2.** "The mass of the student is 56 kg." (Weight uses a force unit – Newton (N))

**4.** Physical property is a characteristic of a substance that does not involve changing the nature of the substance itself (examples: colour, texture, density, melting and boiling points). Chemical property is a characteristic of a substance that involves changing the nature of a substance (examples: reactivity, combustibility)

**6.** Element is a pure substance that consists of one kind of atom in a monoatomic, diatomic or polyatomic form. Compound is a pure substance that consists of two or more different kind of atoms in a molecular of ionic unit.

**14.** **(a)** mega- ($1{,}000{,}000 = 10^6$) **(b)** kilo- ($1{,}000 = 10^3$) **(c)** deci- ($0.1 = 10^{-1}$)
**(d)** centi- ($0.01 = 10^{-2}$) **(e)** milli- ($0.001 = 10^{-3}$) **(f)** micro- ($0.000\,001 = 10^{-6}$)
**(g)** nano- ($0.000\,000\,001 = 10^{-9}$) **(h)** pico- ($0.000\,000\,000\,001 = 10^{-12}$)

**16.** $T_F = \frac{9}{5}T_C + 32$ $T_C = \frac{5}{9}(T_F - 32)$

**19.** **(a)** 41°C **(b)** 11.3 F **(c)** $1.1 \times 10^4$ F **(d)** 233°C

**25.** **(a)** $1.4598 \times 10^2$ **(b)** $3.2 \times 10^2$ **(c)** $6.2 \times 10^{-3}$ **(d)** $9.9 \times 10^{10}$

**29.** **(a)** 10.6 m **(b)** 0.79 g **(c)** 16.5 $cm^2$ **(d)** $1 \times 10^6$ $g/cm^3$

**33.** \$10.15

## Chapter 2: Atoms, Molecules and Ions (pg. 53 to 55)

**4.** J. J Thomson: Cathode Ray, electrons, Plum-Pudding Model
R.A. Millikan: found the charge and mass of an electron using the Oil-Drop Experiment
E. Rutherford: Gold-Foil Experiment; Nuclear Model
J. Chadwick: discovered neutrons

**8.** $r_{atom} = 0.62$ mi

**10.** All atoms in the same element has the same number of protons (the number of protons defines an element). The main function of neutrons is to "glue" the protons together inside the nucleus to overcome to electrical repulsion between them. When elements are form from simpler elements after the Big Bang, some nuclei of the same elements end up with more or less neutrons than the most popular kind. Hence, atoms of the same element may have nuclei with different mass numbers. ${}^{A}_{Z}X$ is a symbol for the isotope or an atom where $A$ = mass number, $Z$ = atomic number and $X$ represents the corresponding element symbol.

**18.** Answers may vary:
Nonmetals: can be solids, liquids or gases at room temperature, poor heat and electric conductors
Metals: mostly solids at room temperature, excellent conductors of heat and electricity, malleable, ductile, shiny

**20.** Alkali Metals: elements in Group IA or 1 (very reactive metal). Ex: Potassium, Rubidium
Alkaline Earth Metals: elements in Group IIA or 2 (slightly less reactive metal). Ex: Calcium, Barium
Halogens: elements in Group VIIA or 17 (very reactive non-metals). Ex: Fluorine, Iodine
Noble Gases: elements in Group VIIIA or 18 (very stable non-metals–inert gases). Ex: Helium, Argon

**26.** Allotrope: element that can appear as different forms. (C – graphite and diamond; Oxygen – $O_2$ or $O_3$)

**28.** Monoatomic Cation: - a positive ion from a single atom (ex. $Ba^{2+}$)
Monoatomic Anion: - a negative ion from a single atom (ex. $F^-$)
Polyatomic Cation: - a positive ion from a molecule (ex. $NH_4^+$)
Polyatomic Anion: - a negative ion from a molecule (ex. $SO_3^{2-}$)

**36.** Molecular Formula - a chemical formula with the actual number of atoms in a molecular or an ionic unit.
Empirical Formula - a chemical formula where the numbers of different atoms are in the simplest ratio.

**38.** $P_4$ represents a molecular unit where 4 phosphorus atoms are chemically bonded.
4 P represents 4 individual phosphorus atoms.

**47.** **(a)** sodium chromate
**(b)** potassium hydrogen phosphate
**(c)** hydrogen bromide (or hydrobromic acid)
**(d)** hydrobromic acid
**(e)** lithium carbonate
**(f)** potassium dichromate
**(g)** ammonium nitrite
**(h)** phosphorus trifluoride
**(i)** phosphorus pentafluoride
**(j)** tetraphosphorus hexaoxide
**(k)** cadmium iodide
**(l)** strontium sulfate
**(m)** aluminum hydroxide
**(n)** sodium carbonate decahydrate

**49.** **(a)** $RbNO_2$ **(b)** $K_2S$ **(c)** $HBrO_{4\,(aq)}$ **(d)** $Mg_3(PO_4)_2$ **(e)** $CaHPO_4$
**(f)** $BCl_3$ **(g)** $IF_7$ **(h)** $(NH_4)_2SO_4$ **(i)** $AgClO_4$ **(j)** $Fe_2(CrO_4)_3$
**(k)** $CaSO_4 \bullet 2\ H_2O$

**Chapter 3: Stoichiometry** (pg. 87 to 91)

**4.** In order to calculate the average atomic mass of an element, we would need the mass numbers of the main atom as well as the isotopes along with their respective relative abundances or percentage abundances.

**10.** An atom has mass number, not molar mass. A mole of atoms ($6.022 \times 10^{23}$ atoms) of a particular element would have a mass equivalent to the average atomic mass in grams. Hence, the molar mass of an element is the average atom mass in g/mol.

**13.** $3.07 \times 10^{24}$ S atoms

**15.** 1.93 mol of Ca

**19.** $3.44 \times 10^{-10}$ g Pb

**59.** The balanced equations are as follows:

**(a)** $2\ C + O_2 \rightarrow 2\ CO$
**(b)** $2\ CO + O_2 \rightarrow 2\ CO_2$
**(c)** $H_2 + Br_2 \rightarrow 2\ HBr$
**(d)** $2\ K + 2\ H_2O \rightarrow 2\ KOH + H_2$
**(e)** $2\ Mg + O_2 \rightarrow 2\ MgO$
**(f)** $2\ O_3 \rightarrow 3\ O_2$
**(g)** $2\ H_2O_2 \rightarrow 2\ H_2O + O_2$
**(h)** $N_2 + 3\ H_2 \rightarrow 2\ NH_3$
**(i)** $Zn + 2\ AgCl \rightarrow ZnCl_2 + 2\ Ag$
**(j)** $S_8 + 8\ O_2 \rightarrow 8\ SO_2$
**(k)** $2\ NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2\ H_2O$
**(l)** $Cl_2 + 2\ NaI \rightarrow 2\ NaCl + I_2$
**(m)** $3\ KOH + H_3PO_4 \rightarrow K_3PO_4 + 3\ H_2O$
**(n)** $CH_4 + 4\ Br_2 \rightarrow CBr_4 + 4\ HBr$