# CE CHEMISTRY SUMMER ASSIGNMENT – 2022-2023

The summer assignment is due **Tuesday, August 16, 2022**.

Please submit the packet one of three ways:

- **MAIL**: You can *mail* the packet to "Oakland Catholic High School, Attn: Mrs. Sforza" (*144 North Craig Street, Pittsburgh, PA 15213*).
- **DROP OFF**: *Deliver* it to the school and Ms. Brown will place it in Mrs. Sforza's mailbox. Please note that the school's summer hours are **8am-2pm**, so you can drop it off between those hours. After 2pm, the school will be *closed* for the day and you will be unable to enter.
- **ELECTRONIC**: Electronic submission on Schoology in the temporary course for the summer. Please use an app like Camscanner to make <u>one</u> submission with pictures of all pages (*Schoology course code: RBPW-M49B-BFZZ9*).
- If you will be <u>on vacation</u> or <u>out of the country</u> around the due time, you will need to turn in the summer assignment <u>*before*</u> the due date. A deduction of *10% per day* will be made to any assignments submitted late.

Your answers will be graded for correctness. Expect a test on the information contained in this packet within the <u>first week</u> of returning to school. I can be reached via email over the summer at asforza@oaklandcatholic.org. Have fun ☺

## Course Requirements

You must MEMORIZE the following ions. They will not be given to you on any Oakland Catholic exam or on any of your Pitt exams.

### Cations That You Need to Know
Group 1A, Group 2A, $Al^{3+}$, and $NH_4^+$ (ammonium ion)

### Anions That You Need to Know

| | | | |
|---|---|---|---|
| $F^-$ | fluoride | $Cl^-$ | chloride |
| $I^-$ | iodide | $Br^-$ | bromide |
| $O^{2-}$ | oxide | $N^{3-}$ | nitride |
| $S^{2-}$ | sulfide | $P^{3-}$ | phosphide |
| $CO_3^{2-}$ | carbonate | $OH^-$ | hydroxide |
| $NO_3^-$ | nitrate | $NO_2^-$ | nitrite |
| $SO_4^{2-}$ | sulfate | $SO_3^{2-}$ | sulfite |
| $PO_4^{3-}$ | phosphate | $C_2H_3O_2^-$ | acetate |
| $CrO_4^{2-}$ | chromate | $Cr_2O_7^{2-}$ | dichromate |
| $MnO_4^-$ | permanganate | $CN^-$ | cyanide |
| $ClO_4^-$ | perchlorate | $ClO_3^-$ | chlorate |
| $ClO_2^-$ | chlorite | $ClO^-$ | hypochlorite |
| $SCN^-$ | thiocyanate | $O_2^{2-}$ | peroxide |

**Note: ALL answers should be rounded to the proper number of <u>significant figures</u> and include units. Circle or <u>underline</u> your final answers. Please be aware that you may have to research extra information (ex. densities) on the internet. I suggest using your chem I notes as reference.**

1) What is the difference between weight and mass? What are the SI units for each?

2) Perform the following conversions involving the liter: 1L = _____$dm^3$ = ____$cm^3$ = ____$m^3$

3) Write the number 1200 three ways: to 2, 3, and 4 significant figures

4) Solve for y with the correct number of sig figs: $\dfrac{6.2 \times 10^{-2}}{17} = \dfrac{4.5 \times 10^{-4}}{y}$

5) Which one of the following cannot possibly be correct, because the value given is much too large or much too small?

   a) The distance from Oakland to downtown Pittsburgh is about 5 km.
   b) The width of this sheet of paper is about 22 cm.
   c) The thickness of a coin is about 1 $\mu$m
   d) The diameter of an atom is about 0.2 nm
   e) The duration of one year is about 30 Ms (megaseconds)

6) Electrons in a beam of electrons travel 187cm in 52.1 $\mu$s. Calculate the speed of the electrons in m/s. [cm is centimeter; $\mu$s is microsecond and m/s is meters per second]

7) A container has a volume of $1.05 \times 10^3$ cm$^3$. When filled with gas, the mass of the container + gas is 837.6 g. The mass of the container alone is 836.2g. To the correct number of significant figures, what is the density of the gas?

8) Perform the following conversion: What is the cost of gasoline in $US per gallon for fuel in London that costs £0.75 per liter? (£1 = $2.03)

9) Describe how you would separate and recover into four separate containers the following four components of a mixture:  liquid water, iron filings, sodium chloride dissolved in water, and beach sand grains.

10) Classify each of the following as to pure substances or mixtures.  If an item is a mixture, specify if it is heterogeneous or homogeneous.
   a)  Concrete -
   b)  Seawater -
   c)  Magnesium -
   d)  Gasoline -
   e)  Air -
   f)  Tomato juice -
   g)  Iodine crystals -
   h)  Nickel –

11) How would you separate a mixture of granulated sugar and beach sand of comparable grain size?

12) Name the following elements:
   a)  H
   b)  Mg
   c)  Pb
   d)  Si
   e)  F
   f)  Sn
   g)  Cu
   h)  Ca
   i)  Ba
   j)  Se
   k)  Tl
   l)  V
   m)  Au
   n)  Zr

13) A solid white substance A is heated strongly in the absence of air.  It decomposes to form a new white solid B and a gas C.  The gas has exactly the same properties as the product obtained when carbon is burned with excess oxygen.  What can you say about whether solids A and B and the gas C are elements or compounds?

14) In the process of attempting to characterize a substance, a chemist makes the following observation:  The substance is a silvery white, lustrous metal.  It burns in air, producing an intense white light.  It reacts with chlorine to give a brittle white solid.  The substance can be pounded into thin sheets or down into wires.  It is a good conductor of electricity.  Which of these characteristics are physical and which are chemical properties?

15) Write the following measurements in "long form"

    a) $6.5 \times 10^{-9}$ cm

    b) $3.35 \times 10^{-4}$ mL

    c) $2.5 \times 10^{-3}$ mol

    d) $4.23 \times 10^{-12}$ m$^3$

    e) $12.5 \times 10^{-8}$ s

    f) $3.5 \times 10^3$ L

    g) $6.54 \times 10^9$ fs

16) Convert
    a) $2.52 \times 10^3$ kg to g

    b) 0.0023 mm to nm

    c) $6.25 \times 10^{-4}$ s to ms

17) A 200.0 mg piece of gold can be hammered into a sheet that is 2.4 ft by 10 ft. What is the thickness of the sheet in m?

18) Convert the following temperatures
    a) 1000K to °C

    b) 273°C to K.

19) Identify the following as an exact number (E) or a measurement (M).

    a) the mass of a paper clip - _____
    b) the surface area of a dime - _____
    c) the number of inches in a mile - _____
    d) the number of ounces in a pound - ____
    e) the number of microseconds in a week- _____
    f) the mass of 15 ounce can of coffee - __

    g) the number of students in your first period class last year - _____
    h) the temperature of the sun - _____
    i) the mass of a postage stamp - _____
    j) the number of mL in a cubic meter of water - _____
    k) the average height of students in school – _____

20) What is the number of significant figures in the following measured quantities?
    a) 1282 kg - _____
    b) 0.00296 s - _____
    c) 8.070 mm - _____
    d) 8070 mm - _____

    e) 0.0105 L - _____
    f) $9.7750 \times 10^{-4}$ cm- __
    g) $1.689 \times 10^{-3}$ km - __
    h) 0.0234 m$^2$ - _____

    i) 7,194,300 cm - ____
    j) 435.983 K - _____
    k) 204.080 g – _____

21) Round each of the following numbers to three significant figures and express each in scientific notation.

   a) 143700                              d) 6.764 x 10$^4$

   b) 0.09750                             e) 33987.22

   c) 890,000                             f)  -6.5559

22) Carry out the following operations, and express the answer with the appropriate number of significant figures:

   a) 1.24056 + 75.80

                                          c) 8900 x 112.3

   b) 23.67 – 75

                                          d) 78132/2.50

23) A lake has an area of 15500 mi$^2$ express the answer is m$^2$?

24) If a person has 285 mg of cholesterol per 100. mL of blood, and a total blood volume of 5.3 L, how many grams of cholesterol does the person have in total in his blood?

25) An asthma drug dose is 6.0 mg/kg of body mass.  What should the dose be for 175 lb person?

26) If an electric car goes 225 km on a single charge, how many charges are required for the 2850 mile trip from New York to Los Angeles?  Assume the car is fully charged at the start of the trip in New York.

27) At 1.00 atm and 25.0°C, air has a density of 1.19 g/L.  What is the mass, in kilograms, of air in a classroom that measures 26 ft by 41 ft by 8.0 ft?

28) Surgeons removed 10. kg of fat from a patient by a procedure called liposuction.  One fat cell has a mass of 0.80 µg.  How many fat cells were removed?

29) Two students determine the percentage of lead in samples as a laboratory exercise.  The true value is 22.52%.  Student #1 had results that were 22.52%, 22.48%, and 22.52%.  Student #2 had results that were 22.64%, 22.58%, and 22.62%.
   a) Calculate the average for each student and tell which data set is more accurate


   b) Which student was the most precise?  Why?


30) The production of sodium hydroxide in the United States during 2013 was 25.83 billion pounds.
   a) how many grams of NaOH were produced during 2013?


   b) the density of NaOH is 2.130 g/cm$^3$.  How many cubic meters of NaOH were produced?


31)  Mercury is traded by the "flask", a unit that has a measure of 34.5 kg.  What is the volume of a "flask" of mercury in liters at 25°C.


32) A 26.27 g sample of a solid is placed in a flask.  Toluene, in which the solid is insoluble, is added to the flask so that the total volume of the solid together is 50.00 mL.  The solid and toluene together have a mass of 52.65g.  The density of the toluene at the experimental temperature is 0.864 g/mL.  What is the density of the solid?


33) The world record for the marathon is 2 hours 4 minutes and 26 seconds.  The race length is 26 miles and 385 yards.  What was the average speed during the race is km/hr?

34) The annual global increase in carbon dioxide, the major green house gas, are 5.5 gigatons from fossil-fuels, 6.5 gigatons from industrial activity and 1.6 gigatons from deforestation. What is the total annual increase in carbon dioxide in kg. (NOTE 1 metric ton is 1000kg).

35) The US quarter has a mass of 5.67 g and is 1.55 mm thick.
   a) How many quarters would have to be stacked to reach 575 ft, the height of the Washington Monument? (*question continued on next page*)

   b) What would be the mass of this stack?

   c) What would be the dollar value of the stack?

   d) As of May 2012, the national debt was 15.7 trillion dollars. How many of these stacks would be needed to pay of the national debt?

36) A 15.0 cm long cylindrical glass tube, sealed at one end, is filled with ethanol. The mass of ethanol needed to fill the tube is 9.64 g. The density of ethanol is 0.789 g/mL. Calculate the inner diameter of the tube in centimeters.

37) Gold is an alloy (mixed) with other metals to increase its hardness from jewelry making. Consider a piece of gold jewelry that has a mass of 8.95 g and a volume of 0.760 cm$^3$. The piece contains only gold and silver. Assuming the total volume of the jewelry piece is the sum of the volumes of the gold and silver it contains, calculate the percentage of gold (by mass) in the piece. Show work.

38) How many liters of water are in the Pacific Ocean if it has a water volume of 139 million cubic miles?

39) What are the six most abundant elements in the human body, in order by mass percentage?

40) A student finds that 15.20 g of nitrogen will react with 17.37 g, 34.74 g, or 43.43 g of oxygen to form three different compounds.  What are the empirical formulas of these three compounds? Show work.

| Compound 1: | Compound 2: | Compound 3: |
|---|---|---|
| | | |

41) How many protons, neutrons, and electrons are in each of the following:

a)  $^{55}Mn$

b)  $^{40}Ar$

c)  $^{65}Zn^{2+}$

d)  $^{79}Se^{2-}$

e)  $^{184}W$

f)  $^{235}U$

42) The following nuclides are used in medicine.  Indicate how many protons and neutrons there are in each.

a)  phosphorus-32

b)  chromium-51

c)  cobalt-60

d)  technetium-99

e)  iodine-131

f)  thallium-201

43) Fill in all the gaps in the table assuming all the atoms are neutral.

| Symbol | $^{39}K$ | | | | |
|---|---|---|---|---|---|
| Protons | | 25 | | | 82 |
| Neutrons | | 30 | 64 | | |
| Electron | | | 48 | 56 | |
| Mass # | | | | 137 | 207 |

44) Fill in the gaps of the table:

| Symbol | $^{52}Cr^{3+}$ | $^{131}I^-$ | | | |
|---|---|---|---|---|---|
| Protons | | | 47 | | 33 |
| Neutrons | | | 60 | 69 | 42 |
| Electron | | | 46 | 48 | |
| Net Charge | | | | 2+ | 3- |

45) Write the symbol for each of the following elements and indicate whether it is a metal, metalloid, or nonmetal.

a) silver
b) helium
c) phosphorous
d) aluminum

e) cadmium
f) calcium
g) bromine
h) arsenic

46) How many hydrogen atoms are there in the following?
a) $C_2H_5OH$
b) $Ca(C_2H_3COO)_2$
c) $(NH_4)_2HPO_4$

47) Write the empirical formula to each of the following molecular formulas
a) $S_4N_4$

b) $C_7H_{14}$

c) $C_6H_{10}O_2$

d) $P_4O_6$

e) $C_6H_{10}F_8$

f) $Si_3O_9$

48) Each of the following elements can form an ion in a chemical reaction. By referring to the periodic table or other references, predict the charge of the most stable ion of each:
a) Al

b) Ca

c) S

d) I

e) Cs

49) Predict the formula and the name of the compound formed by the following pairs of elements.
a) Ga and F -
b) Li and H, -
c) Al and I -

50) The most common charge associated with silver in its compound is +1. Indicate the formulas you would expect for compounds formed between Ag and

a) iodine
b) sulfur
c) fluorine

51) Predict the formulas between the two ions:
a) calcium and bromine

b) ammonium and chlorine

c) aluminum and acetate

d) potassium and sulfate

e) magnesium and phosphate

52) Predict whether each of the following compounds is ionic or covalent:
   a) $B_2H_6$
   b) $CH_3OH$
   c) $LiNO_3$
   d) $Sc_2O_3$
   e) CsBr
   f) NOCl
   g) $NF_3$
   h) $Ag_2SO_4$

53) Give the chemical formula for
   a) chloride ion
   b) chlorite ion
   c) chlorate
   d) perchlorate ion
   e) hypochlorite ion

54) Name the following ionic compounds using the stock naming system:
   a) $AlF_3$
   b) $Fe(OH)_2$
   c) $Cu(NO_2)_2$
   d) $Ba(ClO_4)_2$
   e) $Li_3PO_4$
   f) $Hg_2S$
   g) $Ca(C_2H_3O_2)_2$
   h) $Cr_2(CO_3)_3$
   i) $K_2CrO_4$
   j) $(NH_4)_2SO_4$
   k) $SrSO_4$
   l) $ZnHPO_4$
   m) $SnI_2$

55) Write the chemical formulas for the following compounds,
   a) copper (I) oxide
   b) potassium acetate
   c) aluminum hydroxide
   d) zinc nitrate
   e) mercury (I) bromide
   f) iron (III) carbonate
   g) magnesium nitride
   h) potassium hypochlorite
   i) iron (II) sulfite

56) Provide the names or chemical formula, as appropriate, for each of the following acids.
   a) sulfurous acid
   b) HBr
   c) Hypochlorous acid
   d) Hydroiodic acid
   e) $H_2CO_3$
   f) $HC_2H_3O_2$
   g) Nitrous acid

57) Provide the name or chemical formula appropriate, for each or the following molecular substances.
   a) $NF_3$
   b) dinitrogen tetroxide
   c) $SF_6$
   d) $IF_5$
   e) $XeO_3$

58) Write the balanced chemical equation for each of the following substances,
   a) zinc carbonate can be heated to form zinc oxide and carbon dioxide.



   b) On treatment with hydrofluoric acid, silicon dioxide forms silicon tetrafluoride and water.



   c) sulfur dioxide reacts with water to form sulfurous acid.



59) The element oxygen has three naturally occurring isotopes:  oxygen – 16, oxygen -17, and oxygen – 18.  Discuss the similarities and differences between these three types of atoms.



60) Consider the elements Ar, H, Ga, Al, Ca, Br, Ge, K, and O.  Pick the one that best fits each of the following descriptions.

   a) an alkali metal
   b) an alkaline earth metal
   c) a noble gas
   d) a halogen

   e) a metalloid
   f) a nonmetal listed in group 1
   g) a metal that forms a 3+ ion
   h) an element that resembles aluminum

61) Give the chemical names for each of the following common compounds.

   a) NaCl

   b) $NaHCO_3$

   c) NaOCl

   d) NaOH

   e) $(NH_4)_2CO_3$

   f) $CaSO_4$

   g) $Mg(OH)_2$

   h) CaO



62) For the reaction:  $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$, give a complete list of the bonds that are broken and the bonds that are formed as the reactants are converted to products.  You will have to draw the Lewis structures of each compound.