1. Classify each of the following changes as either chemical (C) or physical (P).

   a. dissolving salt in water _____________________________
   b. frying an egg _____________________________________
   c. burning a plastic bag _______________________________
   d. mixing part A and part B of an epoxy together and letting it cure _____________________________
   e. mixing together salt and sand ___________________________

   If you feel uncomfortable with any of your choices, please indicate below which choices and the reason for your discomfort.
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________

2. Identify each of the following as a pure substance (PS) or mixture (M). If a pure substance, further classify it as an element (E) or compound (C). If a mixture, further classify it as a homogeneous (homo-) or heterogeneous (hetero-) mixture.

   a. plant stem _____________________________
   b. the contents of a glass of ice water ___________________
   c. air ______________________________________
   d. wooden pencil _____________________________
   e. Windex window cleaner _______________________

   If you feel uncomfortable with any of your choices, please indicate below which choices and the reason for your discomfort.
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
3. Make the following conversions. Potentially useful conversion factors are at the bottom of this page. Show your work to the right of each problem.

a. \(6 \text{ ft} = \underline{\quad} \text{ cm}\)

b. \(4020 \text{ cg} = \underline{\quad} \text{ g}\)

c. \(45.6 \text{ mL} = \underline{\quad} \text{ cm}^3\)

d. \(8.45 \text{ km} = \underline{\quad} \text{ mm}\)

e. \(7.332 \text{ mm}^2 = \underline{\quad} \text{ cm}^2\)

f. \(45.67 \text{ mL} = \underline{\quad} \text{ L}\)

g. \(1.54 \text{ dg} = \underline{\quad} \text{ cg}\)

h. \(4.25 \text{ mol} = \underline{\quad} \text{ molecules}\)

\((1 \text{ mol} = 6.02 \times 10^{23} \text{ molecules})\)

i. \(250 \text{ eggs} = \underline{\quad} \text{ dozen eggs}\)

j. \(55 \text{ L} = \underline{\quad} \text{ cL}\)

4. An object has dimensions of 13 cm x 25 cm x 20 cm. If the mass of the object is 20 kg, what is the density of the object in g/cm\(^3\) and kg/m\(^3\)?

5. Label each of the following as a chemical property (C) or physical property (P).

a. boiling point ______________

b. color ______________

c. does not react with water ______________

d. density ______________

e. reacts violently with alcohol ______________
6. Identify each of the following as a pure substance (PS) or mixture (M).
   a. salt water ______________________________
   b. milk _______________________________
   c. copper wire ______________________________
   d. a solution of hydrogen chloride in water ____________________________
   e. uniodized table salt ______________________________

   Use this space to give any discussion you feel necessary about your above choices.
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

7. Make the following conversions. Show any work you do to the right. Some potentially useful conversion factors are given at the bottom of the problem.
   a. 83.4 L = ______ mL
   b. 45 m² = _____ mm²
   c. 190 lb. = _______ kg
   d. 32.5 g = _______ cg
   e. 1.3 hrs = ______ s
   f. 12.2 cL = ______ kL
   g. 7.43 kg = ______ mg
   h. 14.2 g = _______ mol
      (If 35 g = 1 mol)
   i. 2.5 x 10²³ molecules = _______ mol
      (If 6.02 x 10²³ molecules = 1 mol)
   j. 45.0 cg = ______ mg
8. Make the following conversions. Show your work to the right.

45 cm = _______ dm

37.5 mL = _______ L

45 cm$^3$ = _______ L

75.0-g of NaBr = _______ mol NaBr

75.0-L of an ideal gas at STP = _______ mol of ideal gas at STP

(1 mol of ideal gas at STP = 22.4-L of ideal gas at STP)

9. Classify each of the following substances as either a pure substance or a mixture.
   a. Ice cube
   b. air
   c. honey
   d. Coca-Cola
   e. copper wire

Knowing that you sometimes sit there thinking: “Hummm - I know this has this in it, but is that what he wants or does he want the simple answer?” I give you the option in the following few lines of indicating any of these kinds of thoughts you may have running through your mind. If you have doubts about some of your answers now is the time to share them with me.

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

10. Which of the following would be homogeneous mixtures and which would be heterogeneous mixtures?
   a. black coffee
   b. smoggy air
   c. a fish tank containing algae
   d. salad dressing that has been sitting for a long time
   e. an inlet body of water with an oil slick
11. Make the following metric conversions. If you do some mathematical work show it to the right of the respective problem.

- 0.0054-g = _________ kg
- 17.25 mL = _________ kL
- 13.65 m = _________ cm
- 56.2 x 10^5 cm = _________ km
- 83.4 mL = _________ cc

12. A rectangular box has dimensions of 2 cm x 2 cm x 5 cm.

a. What is its volume in cm³?

b. What is its volume in m³? (Be careful here - think about this one.)

13. Indicate whether each of the following would fall into the category of a physical or chemical change. In the lines below you may discuss some of your thought process if you have questions about some of them.

a. an egg is hardboiled ______________________

b. an ice cube melts when it is placed in iced tea _________________________

c. chlorox and ammonia are mixed in a commode to produce a toxic gas (don’t do this at home) __________________________

d. a soda pop goes flat after sitting open for a long time ____________________

e. a leaf turns red in the fall __________________________

Further explanations:
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
14. Identify each of the following as either a pure substance or a mixture. Further identify each pure substance as an element or a compound and each mixture as homogeneous or heterogeneous. Again in the lines below you may discuss some of your thought process if you have questions about some of them.

   a. black coffee ___________________________
   b. chocolate syrup on vanilla ice cream ______________________________
   c. whole blood __________________________
   d. gasoline ______________________________
   e. sugar _______________________________

Further explanations: ________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

15. Chlorine is a green noxious gas used in a wide variety of applications. It will react in the presence of sodium metal to form a white crystalline material known as sodium chloride (table salt). Chlorine is never found in elemental form in nature since it is highly reactive with everything. One of the major sources of chlorine is the electrolysis of sea water - chlorine is produced as well as sodium hydroxide. Identify the elements, compounds, chemical changes and physical changes in the description above.

16. Make the following conversions.

   17.3 cm = ________ m
   42.2 kg = ________ g
   15.0 mL = ________ L
   9.3 x 10^4 cm = ________ km
   53 cm^3 = ________ mL

17. Which of the following are chemical changes and which are physical changes?

   a. melting of table salt ___________________________
   b. burning of gasoline __________________________
   c. breaking of window glass ______________________
   d. the melting of window glass ____________________
   e. the combination of hydrogen and oxygen to make water ___________________
18. Which of the following are chemical properties and which are physical properties?

a. water boils at 100 °C _____________________________
b. sodium starts on fire when thrown in water _____________________
c. a diamond burns in the presence of oxygen ________________________
d. mercury (II) oxide is an orange-red compound ____________________
e. sodium carbonate gives off bubbles of carbon dioxide when treated with hydrochloric acid ______________________________

19. Consider the following separations of materials. State whether a chemical or physical process is involved in each separation.

a. salt is obtained by evaporating seawater _____________________
b. hydrogen and oxygen are obtained by running an electric current through water _____________________
c. gold is obtained from river water by panning (letting the heavy metal separate from the flowing water). _____________________
d. sodium metal is obtained from sodium chloride _____________________
e. iron filings are separated from a mixture of iron and sulfur by using a magnet ___________________________

20. Identify each of the following as a pure substance or a mixture. Further identify pure substances as elements or compounds, and mixtures as homogeneous or heterogeneous.

a. water and sand in the same bottle _________________________
b. paint, which contains a liquid solution and a dispersed solid pigment __________
c. a sugar solution with no sugar evident at the bottom ___________________
d. a sugar solution with solid sugar laying on the bottom __________________
e. air __________________________

21. Solid iodine, contaminated with salt, was heated until the iodine vaporized. The violet vapor of iodine was then cooled to give the pure solid. Solid iodine and zinc metal powder were mixed and ignited to give a white powder. Identify each physical and chemical change in this description.

22. Classify each of the following as a chemical or physical change.

A piece of aluminum heats up when you hold a match under it ______________
The water in an ice tray freezes after being placed in the freezer ______________
A piece of iron metal rusts _____________________________
A raw egg is hard boiled _____________________________
Melting of table salt _____________________________
23. The following are properties of substances. Decide whether each is a physical property or a chemical property.

Chlorine gas liquefies at -35 °C ___________________________
Hydrogen burns in chlorine ____________________________
Sodium is a soft, silvery metal __________________________
Sugar burns in the presence of oxygen _______________________
Iodine sublimes - that is, goes directly from solid to gas ________________

24. Make the following conversions. Show your work to the right.

0.050-m = _________ mm
235.6-mg = _________ kg
0.000621-L = _________ cm³
153000-mm = _______ cm
4.22 x 10⁵-ms = _______ s

25. Identify each of the following as a pure substance (PS) or a mixture (M). If it is a pure substance, further classify it as an element or compound. If a mixture, further classify it as homogeneous (homo) or heterogeneous (hetero-).

a. seawater _____________
b. gasoline ___________
c. distilled water _______________
d. salt dissolved in water _________________
e. clean air _______________

If you have concerns about any of your answers, please share your concerns below.

________________________________________________________________________

________________________________________________________________________

26. Label each of the following as either a chemical change or a physical change.

a. Natural gas is converted into plastic in a chemical plant _________
b. Sand and baking soda are mixed together _____________________
c. A puddle from a rainy day evaporates over time ________________
d. Water is converted to hydrogen and oxygen in a fuel cell __________
e. Rubber from a tree is converted to a tire _____________________
27. State the SI unit of measurement of each of the following quantities.
   a. length ________________
   b. time ________________
   c. mass ________________
   d. amount of substance __________________
   e. temperature

28. Make the following conversions.
   a. 15 m = _____ cm
   b. 4.35 kg = _____ g
   c. 13.2 ms = _____ s
   d. 7.472 L = _____ mL
   e. 9.35 x 10^-4 g = _____ mg

29. Indicate for each of the following substances whether it is a pure substance (PS) or a mixture (M). If a pure substance, further designate it as either an element (E) or a compound (C). If it is a mixture, indicate whether it is homogeneous (homo) or heterogeneous (hetero). If you care to clarify any of your choices, room is provided at the bottom.

   apple ____________________
   helium ____________________
   Coca-Cola® ________________
   A current US quarter ____________
   bacon ____________________
   diamond ____________________
   pure water ________________
   neon ____________________
   ocean water ________________
   table sugar ________________

Clarifications:
30. In the process of attempting to characterize a substance, a chemist makes the following observations. The substance is a silvery white. It melts at 649 °C and boils at 1105 °C. Its density at 20 °C is 1.738 g/cm³. The substance burns in air, producing an intense white light. It reacts with chlorine to give a brittle white solid. The substance can be pounded into sheets or drawn into wires. It is a good conductor of electricity.

a. Which of these characteristics are physical properties?

b. Which of these characteristics are chemical properties?

c. Based on the properties outlined above, would you expect the material to be a metal or a nonmetal? Which properties support your answer?

31. Make the following conversions. Show any work to the right.

a. 14.2 m = _______ cm

b. 0.457 kg = _______ g

c. 15 km² = _______ m²

d. 450.0 cm³ = _______ mL

e. 13.5 L = _______ cm³
32. a. In most other countries around the world, the price of gasoline is stated in terms of the local currency per liter, rather than per gallon. If the current price of gasoline in the US is $2.29, what would this cost be in dollars/liter?

b. Ethylene glycol (a major component of antifreeze) has a density of 1.114 g/mL. What volume of ethylene glycol is required to obtain 55.5 g of ethylene glycol?

c. A mole, a unit with which you will become familiar shortly, of potassium contains 39.0983 grams. How many moles of potassium are contained in 154.2-g of potassium?

33. Carry out the following conversions. Show your work to the right.

a. 32 feet = _______ m

b. 210 pounds = _______ kg

c. 65 miles/hour = _______ m/s

d. 8.0 pounds/gallon = _______ kg/m^3

e. 0.705 inches = _______ mm
34. Make the following conversions.
   a. 3.25 mL = _____ L
   b. 0.325 g = _____ mg
   c. 42.5 cm³ = _____ mL
   d. 45 °C = _____ K

35. State whether each of the following substances is a pure substance or mixture. If a pure substance, further indicate whether it is an element or a compound. If a mixture, indicate whether it is a homogeneous or heterogeneous mixture.
   a. highly purified water __________________________
   b. clean air ______________________
   c. sea water ______________________
   d. gasoline _______________________
   e. sugar water __________________________

Chance for comments: If you feel a little uncertain about any of your answers, please take a moment and express your reasons for concern here. For example, if you classify one and think, “Hum, what if it had this in it?”, please indicate that concern here.

_________________________________________________________
_________________________________________________________
_________________________________________________________
_________________________________________________________
36. Make the following metric conversions.
   a. \(1.254 \text{ km} = \ldots \text{ m}\)
   b. \(453 \text{ mL} = \ldots \text{ L}\)
   c. \(3.24 \times 10^2 \text{ mg} = \ldots \text{ cg}\)
   d. \(0.00436 \text{ mL} = \ldots \text{ cm}^3\)

37. Make the following conversions. Show your work to the right. Report your answers to the appropriate number of significant figures.
   a. \(91.2 \text{ cm} = \ldots \text{ ft.}\)
   b. \(1250 \text{ s} = \ldots \text{ hours}\)
   c. \(3.27 \times 10^{-4} \text{ gal} = \ldots \text{ L}\)
   d. \(51 \text{ cm}^2 = \ldots \text{ in}^2\)
   e. \(180 \text{ lb} = \ldots \text{ kg}\)

38. A material of mass 56.5-g has a volume of 41.2-mL. What is its density in g/mL AND g/L?

39. From the brief description of potassium below, list three physical properties and two chemical properties.

   Three physical properties __________________________________________
   Two chemical properties ________________________________________

   Potassium is never found free in nature, but is obtained by electrolysis of the chloride or hydroxide. It is one of the most reactive and electropositive of metals and, apart from lithium, it is the least dense known metal. It is soft and easily cut with a knife. It is silvery in appearance immediately after a fresh surface is exposed.

   It oxidizes very rapidly in air and must be stored under argon or under a suitable mineral oil. As do all the other metals of the alkali group, it decomposes in water with the evolution of hydrogen. It usually catches fire during the reaction with water. Potassium and its salts impart a lilac color to flames.

40. State whether each of the following is a pure substance or mixture. If a pure substance, also indicate whether it is an element or a compound.

a. incredibly pure water ____________________________

b. Ca(NO₃)₂ dissolved in water ______________________

c. a sample of pure hydrogen gas _____________________

d. diamond ___________________________

e. contents of a balloon filled with hydrogen and oxygen __________

41. a. In a petroleum refinery, crude oil is taken in and one of the separation steps called fractionating involves separating the components of crude oil based on their differences in boiling point. Is the fractionation of the components of crude oil a chemical change or a physical change? _______________________

b. In one of the lab experiments coming up you will separate the components of a color marker using chromatography. In chromatography, the different components of a mixture are separated based on their relative affinity for a solvent and a piece of paper on which the solvent is placed. Is the separation of components of a mixture by chromatography a chemical change or a physical change? __________________________

c. In a hydrogen fuel cell, hydrogen and oxygen are combined to water and the energy released as electricity in the process can be used to power electronic devices. Is the conversion of hydrogen and oxygen to water a chemical or physical change? __________

42. Make the following conversions.

a. 165.7 mL = ______ cm³

b. 165.7 mL = ______ cc

c. 45.0 cm² = ______ mm²

d. 8.73 x 10⁴ mg = _______ cg

e. 6.5 L = ______ mL
43. Make the following conversions.
   a. 14.5 cm = ______  in
   b. 13.2 gal = ______  L
   c. 150 lb = ______  kg
   d. 45 °F = ______  K
   e. 52.3 cm³ = _____ in³

44. a. A cylinder of iron has a mass of 51.6-g and a volume of 6.50 mL. What is the density of iron?

   b. Another sample of iron had a mass of 98.3-g. What is the volume of this sample?