UNITS 1, 2, 3 GROUP PRACTICE PROBLEMS – ANSWERS

UNIT 1

1) Discuss how a sample of sugar could be classified as:
   A) Macroscopic material -A teaspoon of sugar
   B) Microscopic material -A crystal of sugar
   C) Particulate material -A molecular of sugar ($C_{12}H_{22}O_{11}$)
2) What are the four elements in Aristotle's theory of matter? earth, fire, air, water
3) What is the philosopher's stone and how does it relate to early chemistry? The philosopher's stone was a myth believed to transmute metal and bring eternal life.
4) The word pour is commonly used in reference to liquids, but not to solids or gases. Can a solid or gas be poured? Why or why not? If either answer is yes, can you give an example?
   Gases can be poured (there are gases that are heavier than air).
5) Is it possible to melt a piece of ice without seeing a change in temperature? Explain.
   Yes, in fact, substances melt (go from solid to liquid) without a temperature change. At 0^0C, ice will turn to liquid water with an increase in heat (energy) and no temperature change.
6) Classify the following as chemical or physical properties (if physical, indicate if its an intensive or extensive property)
   A) The mass of a chunk of nickel is 19 grams. Physical/Extensive
   B) When sulfur is exposed to water it burns. Chemical
   C) The color of copper is a rust-like color. Physical/Intensive
   D) Sugar can dissolve in water. Physical/Intensive
7) Classify the following changes as chemical or physical.
   A) Rusting car. Chemical
   B) Boiling water. Physical
   C) Digesting rice in the stomach. Chemical
   D) Dropping Alka Seltzer™ in water. Chemical
8) What is phlogiston? Does it exist? Phlogiston was a substance proposed by Becher as a reason for substance changes when burned. Phlogiston does not exist.
9) Indicate which category or categories each of the following substances belongs.

Substance	Hetero-geneous	Homo-geneous	Solution	Pure substance	Element	Compound
Pure NaCl		X		X		X
Al foil		X		X	X	
Filtered air		X	X			
Concrete	X					
Sand	X					
Plastic (polystyrene)		X		X		X
Astatine		X		X	X	
Salt water		X	X			

10) Write the chemical name or symbol for each of the following:

Krypton Kr	Aluminum Al	Chromium Cr
Carbon C	Chlorine Cl	Tellurium Te
Mercury Hg	Phosphorus P	Protactinium Pa

11) Write the chemical equation for the following described reactions. Identify the reactants and products (It is alright if your equation is not balanced, we will address this topic in a future unit).

A) Propane (C_3H_8) burns (in the presence of oxygen) to produce carbon dioxide (CO_2) and water.
$C_3H_8(l) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(g)$

B) Energy is required to separate NaCl into its elements.
$2\ NaCl(s) + \text{energy} \rightarrow 2\ Na(s) + Cl_2(g)$

12) Classify the following as kinetic or potential energy.
A) A running halfback. Kinetic energy
B) A bowling ball at the top of the stairs. Potential energy
C) Water flowing over the falls. Kinetic energy
D) A moving train. Kinetic energy
E) A strap holding down a bike on a trailer. Potential energy

13) Classify the following as an endothermic or exothermic reaction.
A) Ice melting. Endothermic
B) Wood burning. Exothermic
C) An ice pack (for sports injuries). Endothermic
D) A heating bad. Exothermic

UNIT 2

14) What are some of the advantages to having a SI (metric) system of measurement? To use an example:
In the English system instead of saying 18 inches we can say 1 ½ feet. Inches and feet are both length units in the same system.
The SI system is not so complex. Instead of saying 120 centimeters, we can say 1.2 meters. Meters and centimeters are both units in the same system. Here it is easier to see their relationship.
Also, the SI system is a universal system of measurement.

15) Write out a unit of measurement that is not used in the SI (metric) system.
Inches, pounds, yards, etc.

16) Match the following:

i) c 1 milligram	a. 1×10^{-2} gram
ii) a 1 centigram	b. 1×10^{3} gram
iii) b 1 kilogram	c. 1×10^{-3} gram
iv) d 1 decigram	d. 1×10^{-1} gram
v) e 1 microgram	e. 1×10^{-6} gram
vi) f 1 nanogram	f. 1×10^{-9} gram

17) What is the SI base unit for length? meter

18) What is larger 1000 dg or 10 kg? 10 kg

19) What is smaller 1 mL or 10 L? 1 mL

20) Change the following into scientific notation:
A) 123,000,000,000,000 1.23×10^{14}
B) 234,044,000 2.34044×10^{8}
C) 0.00000034 3.4×10^{-7}
D) 0.001002 1.002×10^{-3}

21) Change the following into ordinary decimal notation:
A) 5.432×10^{-5} 0.00005432
B) 3.21×10^{1} 32.1
C) 4.56×10^{12} 4,560,000,000,000
D) 8.99×10^{-2} 0.0899

22) Determine the following conversions:
A) How many kilograms are there in 50.0 grams?

$$50.0 grams \times \frac{1kg}{1000g} = 0.0500kg$$

B) How many mL are there in 4.58 L ?

$$4.58L \times \frac{1000mL}{1L} = 4580mL$$

C) How many micrometers are there in 0.0000563 millimeters?

$$0.0000563mm \times \frac{1m}{1000mm} \times \frac{1 \times 10^6\ \mu m}{1m} = 0.0563\mu m$$

D) How many deciseconds are there in 56,700 kiloseconds?

$$56{,}700ks \times \frac{1000s}{1ks} \times \frac{10ds}{1s} = 5.67 \times 10^8 ds$$

23) Determine the number of significant figures in the following:

A) 234.0012 7 sig figs
B) 0.004302 4 sig figs
C) 34.000 5 sig figs
D) 45.67900 7 sig figs
E) 300. 3 sig figs
F) 3.200 4 sig figs

24) Perform each calculation and express all answers in the correct number of significant figures.

A) 9.40 cm x 2.6 cm

$$\overset{3}{9.40}cm \times \overset{2}{2.6}cm = 24.44cm = 24cm$$

B) $\frac{0.084g}{0.640mL}$

$$\frac{\overset{2}{0.084}g}{\underset{3}{0.640}mL} = 0.13125g/mL = 0.13g/mL$$

C) $\frac{21.50g}{4.06cm \times 1.8cm \times 0.905cm}$

$$\frac{\overset{4}{21.50}g}{\underset{3}{4.60}cm \times \underset{2}{1.8}cm \times \underset{3}{0.905}cm} = \frac{\overset{4}{21.50}g}{\underset{2}{6.6}cm^3} = 3.3g/cm^3$$

D) 2.6 x 10^5 + 4.1 x 10^7

2.6 x 10^5 + 410 x 10^7 = 410 x 10^5 = 4.1 x 10^7

E) $\frac{(6.02 \times 10^2) \times 0.32000}{(5.325 + 21.0) \times (45.44 + 0.32)}$

$$\frac{\left(\overset{3}{6.02} \times 10^2\right) \times 0.3\overset{5}{2000}}{(5.325 + 21.0) \times (45.44 + 0.32)} = \frac{\overset{3}{193}}{\underset{3}{26.3} \times \underset{4}{45.76}} = \frac{\overset{3}{193}}{\underset{3}{1200}} = 0.161$$

25) Calculate the volume of a piece of metal that has a length of 4.5 cm, a height of 3.6 cm, and a width of 8.9 cm.

<u>V = l x w x h</u>

V = 4.5 cm x 3.6 cm x 8.9 cm = 144.18 cm^3 = 140 cm^3

26) A piece of copper has a volume of 51 cm^3 and a mass of 457.00 grams, what is its density in g/mL?

$$D = \frac{m}{V} = \frac{457.00g}{51cm^3} = 8.96g/cm^3 = 9.0g/cm^3$$

27) Convert 25.0°C to

A) °F °F = 1.8°C + 32 °F = (1.8 x 25.0) + 32 = 77.0°F

B) K K = 273.1 + °C K = 273.1 + 25.0 = 298.1 K

28) Convert 345 K to

A) °F (Do b) first) °F = 1.8°C + 32 °F = (1.8 x 72) + 32

B) °C °C = K – 273 °C = 345 – 273 = 72°C

29) Determine the SI base units for the following:

A) Time
B) Temperature
C) Length
D) Mass
E) Amount of substance

(a) second - s
(b) Kelvin – K
(c) meter – m
(d) mass – kg
(e) mole - mol

30) Complete the following:

A) 1 kilometer = meter
B) 1 meter = decimeter
C) 1 meter = centimeter
D) 1 meter = millimeter
E) 1 meter = micrometer
F) 1 meter = nanometer

(a) 1000
(b) 10
(c) 100
(d) 1000
(e) 1×10^6
(f) 1×10^9

31) Convert the following:

A) 6.7 g = kg
B) 545.4 mm = cm
C) 0.0458 ms = μs
D) 5,987 m = dm
E) 0.0303 mm = km
F) 0.678 kg = cg
G) 3.49 ng = μg

(a) 6.7×10^{-3} kg
(b) 54.54 cm
(c) 45.8 μs
(d) 59,870 dm
(e) 3.03×10^{-8} km
(f) 67,800 cg
(g) 3.49×10^{-3} μg

32) Change the following into ordinary decimal notation:

A) 5.67×10^6
B) 3.4003×10^{-3}

C) 8.8900×10^{-7}

D) 7.71×10^{1}

(a) 5,670,000
(b) 0.0034003
(c) 0.00000088900
(d) 77.1

33) Change the following into scientific notation:

A) 0.0450000
B) 3.21
C) 45,800,000
D) 230.01
E) 0.00056700

(a) 4.50000×10^{-2}
(b) 3.21×10^{0}
(c) 4.58×10^{7}
(d) 2.3001×10^{2}
(e) 5.6700×10^{-4}

34) Describe each (how it is measured) and give a SI unit for each.

A) Mass
B) Length
C) Time
D) Temperature
E) Volume

(a) balance, gram (or kg)
(b) ruler, centimeter
(c) stopwatch, second
(d) thermometer, Kelvin
(e) grad. Cylinder, liter

35) Calculate the volume (in mL) of a metal cube with the following dimensions:
length = 4.5 cm, width = 6.7 cm, height = 2.4 cm
72 cm^3

36) Calculate the volume (in cm^3) of a metal cylinder with the following dimensions:
radius = 93.4 cm, height = 67800 cm
1.86×10^9 cm^3

37) Calculate the volume of a metal cube (in cm^3) with the following dimensions:
length = 0.98 dm, width = 990 mm, height = 3.3 cm
3200 cm^3

38) 56.7 mL of water was added to a 100.0 mL graduated cylinder. A solid sample was placed into the graduated cylinder, completely submerged in the water. The water level rose to 89.4 mL. What is the volume of the solid sample (in cm^3)?
32.7 cm^3

39) Calculate the density (g/mL) of a solid sample have a mass of 367 grams and a volume of 89.4 cm^3.
4.11 g/mL

40) Calculate the volume (in L) of a solid sample having a mass of 57.8 grams and a density of 1.26 g/cm^3.
0.0459 Lb

41) The density of platinum metal is 21.5 g/cm^3. Calculate the mass (in g) of a block of platinum that has a volume of 0.876 L.
18,800 g

42) A lead block has a length of 0.22 meters, a width of 365 millimeters, a height of 4.8 decimeters, and a mass of 439 kilograms. Based on this information, what is the density of lead in g/cm^3?

11 g/cm^3

43) If the density of alcohol is 0.789 g/mL, how many mL of alcohol must be measured out for an experiment that requires 2.50 grams of alcohol?

3.17 mL

44) Suppose you wish to purchase a water bed that has the dimensions 2.45 m x 21.5 dm x 23 cm. How many kilograms of water does this bed contain? (The density of water is 1.00 g/cm^3)

1,200 kg

45) Convert the following and record your answers in scientific notation.

a) 0.225 dm to mm
b) 44,163 cs to ks
c) 0.00000000000991 kL to μL
d) 2.5 mg to ng
e) 20,190 μs to ms
f) 7,000 nL to kL

(a) 2.25×10^{1} mm
(b) 4.4163×10^{-1} ks
(c) 9.91×10^{-9} μL
(d) 2.5×10^{6} ng
(e) 2.019×10^{1} ms
(f) 7×10^{-9} kL

46) How many significant figures are in each of the following numbers?

a) 5.40 km
b) 210 μL
c) 801.5 g
d) 1,000 ns
e) 101.0100 mL
f) 1.2×10^{3} mm
g) 0.00120 cg
h) 0.0102 ds
i) 9.010×10^{-6} ks
j) 2,370.0 μg

(a) 3 f) 2
(b) 2 h) 3
(c) 1 i) 4
(d) 7 j) 5

47) Round off each of the following numbers to three significant figures

a) 15.9994 nL
b) 0.6654 s
c) 87,550 mg
d) 1.0080 kL
e) 4885 μm
f) 0.027225 s

(a) 16.0 nL
(b) 0.665 s
(c) 87,600 mg
(d) 1.01 kL
(e) 4890 μm
(f) 0.0272 s

48) Perform the following mathematical operations and express your answers to the proper number of significant figures and units.

a) 642 m x $(4.0 \times 10^{-5}$ m)
b) 17 g ÷ $(3.88 \times 10^{7}$ $cm^3)$
c) $(2.9 \times 10^{-5}$ cg) + $(8.1 \times 10^{-4}$ cg)
d) $(4.3 \times 10^{-5}$ $cm)^3$
e) $(5.40 \times 10^{-18}$ kg) / 769 mL
f) [59 cm x $(3.24 \times 10^{-2}$ cm)] ÷ $(4.80 \times 10^{4}$ cm)
g) [42 dm x $(4.02 \times 10^{23}$ dm)] ÷ 0.016 dm
h) 123.040 kg - 55.06 kg
i) 0.00000016 g/ 74.3 L
j) 10.0 ns + 54.600 ns

(a) 2.6×10^{-2} m^2
(b) 4.4×10^{-7} g/cm^3
(c) 8.4×10^{-4} cg
(d) 8.0×10^{-14} cm^3
f. 4.0×10^{-5} cm
g. 1.1×10^{27} dm
h. 67.98 kg
i. 2.2×10^{-9} g/L

(e) 7.02×10^{-21} kg/mL j. 64.6 ns

49) Convert the following temperatures

A) a) 250 Kelvin to Celsius
B) b) 17 Celsius to Kelvin
C) c) 89.5 Fahrenheit to Celsius
d) 339 Kelvin to Celsius
e) 55 Celsius to Kelvin
f) 383 Kelvin to Fahrenheit

(a) $-20^{o}C$
(b) 290. K
(c) $31.9^{o}C$
(d) $66^{o}C$
(e) 328 K
(f) $230.^{o}F$

50) The mass of a toy spoon is 7.5 grams, and its volume is 3.2 mL. What is the density of the toy spoon?

2.3 g/mL

51) A mechanical pencil had the density of $3.0 g/cm^3$. When the pencil was placed into 56.8 mL of water, the water level rose to 73.1 mL (the pencil being completely submersed).

A) What is the volume of the pencil?

16.3 mL

B) What is the mass of the pencil?

49 g

52) A screwdriver has the density of 5.5 g/mL. The mass of the screwdriver is 2.3 grams. What is the screwdriver's volume?

0.42 mL

53) A metal cylinder has a mass of 5.48 grams. The measured height is 5.6 cm and diameter is 445 dm.

A) What is the volume of the metal cylinder? $8.7 \times 10^{7}\ cm^3$
B) What is the density of the metal cylinder? $6.3 \times 10^{-8}\ g/cm^3$

54) Using two different instruments, I measured the length of my foot to be 27 centimeters and 27.00 centimeters. Explain the difference between these two measurements.

The two numbers imply different precision. The 27 centimeters is not as precise a measurement as the 27.00 centimeters.

55) Convert the following temperatures:

A) $32^{O}F$ to ^{O}C
B) $988^{O}C$ to ^{O}F
C) $-65.8^{O}F$ to ^{O}C to K
D) 243.8 K to ^{O}C to ^{O}F

(a) $0^{o}C$
(b) 1810. K
(c) $-54.3^{o}C$, 218.8 K
(d) $-29.4^{o}C$, $-20.8^{o}F$

56) Determine the number of significant figures in each of the following numbers:

A) 23,450,000 μg
B) 0.00340 kL
C) 24.90000 dm
D) 32,001,000 cs
E) 3.4500×10^{3} ng
F) 0.102 mL

(a) 4 d) 5
(b) 3 e) 5
(c) 7 f) 3

57) Calculate the following, answer using proper significant figures and units:

A) 43.00 dL + 19.1 dL

B) 6.500 ms + 120 ms

C) (13.980 cg – 11.0 cg) + (340 cg + 217 cg)

D) 2.7800×10^4 nm + 1.10×10^4 nm

E) 0.00450 mm x 3.0454 mm x 1.0000 mm

F) $\dfrac{0.0320m \times 9.100m \times 0.0045m}{4320m}$

G) $\dfrac{0.00321g}{0.02000mL} \times 2390mL$

H) $\dfrac{(4230g + 547g)}{0.1340cm \times 0.050cm \times 3.10cm}$

I) (8.900×10^8 km) x (3.20×10^{-5} km)

(a) 62.1 dL
(b) 130 ms
(c) 560 cg
(d) 3.88×10^4 nm
(e) 0.0137 mm^3
(f) 3.0×10^{-7} m^2
(g) 384 g
(h) 2.3×10^5 g/cm^3
(i) 2.85×10^4 km^2

<u>UNIT 3</u>

58) How did Dalton come up with the Atomic Theory?
By very little, if any experimentation. Dalton made observations during his weather studies, read of past discussions on the atom (including Democritus and Newton), and started making predictions about atoms being in existence. After his theory was put out into the scientific community, others agreed and disputed it. Today we accept the Atomic Theory because others to follow Dalton found enough evidence to support the theory.

59) Discuss the two compounds: carbon monoxide: CO and carbon dioxide: CO_2. Using Dalton's atomic theory, explain how these two compounds (and their elements) exist.
Discuss with group: The elements are carbon and oxygen. Carbon and oxygen atoms can not be created or destroyed to form the two compounds. All the atoms of carbon are identical and all atoms of oxygen are identical (except for the amount of neutrons). The atoms of carbon are different than the atoms of oxygen. Carbon combines with oxygen in a 1:1 ratio for carbon monoxide, carbon combines with oxygen in a 1:2 ratio for carbon dioxide.

60) Take the compounds: copper (I) oxide: Cu_2O and copper (II) oxide: CuO. If the mass ratio in Cu_2O is 12.0 grams Cu and 6.0 grams O; suggest the mass of O possible in CuO if Cu remains 12.0 grams.
According to the Law of Multiple Proportions:
For Cu_2O: ratio 12.0 g Cu: 6.0 g O For CuO: ratio 12.0 g Cu: 3.0 g O

61) Name three researchers did work with cathode ray tubes?
<u>Faraday, Crookes, Thomson</u>

62) Ernest Rutherford discovered protons as being positive hydrogen atoms. Is this correct? Yes, the isotope hydrogen with the mass number 1 contains no neutrons, one proton, and one electron. Therefore, if it loses one electron, it becomes just a proton.

63) In 1897, J. J. Thomson discovered electrons, in 1911 Ernest Rutherford discovered protons, and in 1940 James Chadwick discovered neutrons. Why do you think these subatomic particles were discovered in this order? Your opinion from your readings.

64) Complete the following table.

Atom	Charge	Ion	#p^+	#e^-
Sr	+2	Sr^{2+}	38	38-2=36
O	-2	O^{2-}	8	8+2=10
C	+4	C^{4+}	6	6-4=2
Fe	+3	Fe^{3+}	26	26-3=23
Sb	-3	Sb^{3-}	51	51+3=54
Br	-1	Br^-	35	35+1=36

65) The mass number of an atom is equal to
- A) The number of electrons in the nucleus
- B) The number of protons in the nucleus
- C) The number of neutrons in the nucleus
- D) <u>The sum of the protons and neutrons in the nucleus</u>

66) The number of protons found in an atom is equal to
- A) The number of electrons in the nucleus
- B) <u>The atomic number of the element</u>
- C) The number of neutrons in the nucleus
- D) The sum of the protons and neutrons in the nucleus

67) The number of neutrons found in an atom is equal to
- A) The number of electrons in the nucleus
- B) The mass number of the atom
- C) The number of protons in the nucleus
- D) <u>The difference between the mass number and the atomic number in the atom</u>

68) Why is Rutherford's model of the atom better than Thomson's?

69) Who helped Rutherford discover the nucleus of an atom by an experiment famously known as the 'Gold Foil Experiment.'? Marsden & Geiger

70) How are isotopes and average atomic masses related? The ATOMIC MASS of an element is the average of the masses of the naturally occurring isotopes of that element (based on the amount of each isotope for a particular element).

71) Complete the following table.

Element	Atomic Number	Mass Number	#p^+	#n^0	#e^-	Isotopic Notation
K	19	39	19	20	19	$^{39}_{19}K$
Br	35	80	35	45	35	$^{80}_{35}Br$
Ar	18	40	18	22	18	$^{40}_{18}Ar$
Cr	24	52	24	28	22	$^{52}_{24}Cr^{2+}$
Si	14	28	14	14	10	$^{28}_{14}Si^{4+}$

72) Write down the correct atomic mass for each of the following elements.

Tin <u>118.7 amu</u> Lithium <u>6.9 amu</u>

Antimony <u>121.8 amu</u> Argon <u>39.9 amu</u>

73) Naturally occurring copper is 69.09% ^{63}Cu (62.96 amu). The only other isotope is ^{65}Cu (64.96 amu). What is the atomic mass of copper?

100% - 69.09% = 30.91%

(0.6909 x 62.96) + (0.3091 x 64.96) =

43.50 + 20.08 = 63.58 amu

74) How does the modern periodic table differ from Mendeleev's periodic table?
Mendeleev's ordered elements based upon atomic weights (masses). Thanks to Mosley, we order elements based upon atomic numbers.

75) Fill in the blank periodic table as complete as possible.