SUMMER PACKET FOR HONORS CHEMISTRY
NAME: _____

Note on Collaboration: Authentic collaboration where students discuss the skills, contents, and processes required to complete the following questions is not only permitted but encouraged and very much in keeping with the practice of science as implemented in academia and industry.

Students are cautioned however that there is a *significant* difference in both ethical behavior, adherence to the Honor Code, and benefit derived from work done between authentic collaboration and either simply seeking the answers from or providing the answers to a peer.

Multiple Choice: Read Carefully, Select the BEST Response.

LAB SAFETY

1. Long hair in the laboratory must be

    a. Cut short
    b. Held away from the experiment in one hand
    c. Always neatly groomed
    d. Tied back or kept entirely out of the way with a hair band, hairpins, or other confining device.

2. If you do not understand a direction or part of a lab procedure, you should

    a. Figure it out as you do the lab
    b. Try several methods until something works
    c. As the instructor before proceeding
    d. Skip it and go on to the next part

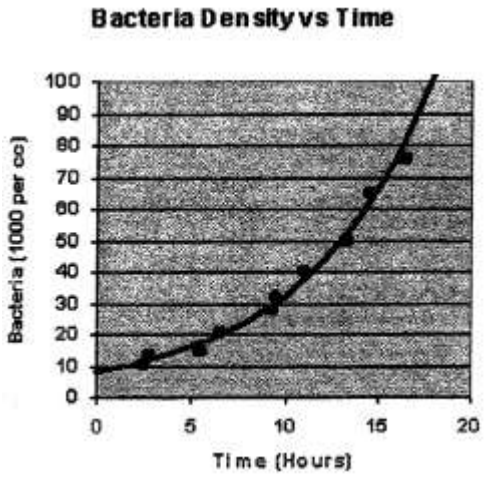
3. If you wear contact lenses into a school laboratory class, you should

    a. Take them out before starting the lab
    b. Not worry about wearing protective goggles for the lab
    c. Advise your science instructor that you wear contact lenses
    d. Keep the information to yourself

4. A gene test shows promising results in providing early detection for colon cancer. However, 10% of all test results are falsely positive; that is, results indicate that cancer is present when the patient is, in fact, cancer-free. Given this false positive rate, how many people out of 10,000 would have a false positive result and be alarmed unnecessarily?

   a. 10
   b. 100
   c. 1000
   d. 9000

Use the following graph to answer question 2-4



5. How many hours did it take in the graph to the right for bacteria populations to reach 30,000 per cc?

   a. 5 hours
   b. 10 hours
   c. 15 hours
   d. 20 hours

6. About how many bacteria per cc were there after 15 hours?

   a. 5
   b. 65
   c. 5,000
   d. 65,000

7. Describe the shape of the graph as it changes with time:

    a. Increasing only
    b. Decreasing only
    c. Increasing then decreasing
    d. Decreasing then increasing

8. Classify the following statement, "Bald Eagle eggs in northern Maine will have thinner shells than those from birds in southern Alaska due to increased levels of pesticides in the water".

    a. Theory
    b. Fact
    c. Law
    d. Hypothesis

9. Classify the following statement, "Ancient human like species existed 2 million years ago".

    a. Theory
    b. Fact
    c. Law
    d. Hypothesis

10. Classify the following statement, "The inverse-square law for gravity and Newton's Laws of motion explain why orbits are in the shape of ellipses".

    a. Theory
    b. Fact
    c. Law
    d. Hypothesis

11. Which one of the following is not a hypothesis?

    a. The foraging patterns of *S. carpocapsae*, as measured by directional response, are affected by electrical fields.
    b. If I give a plant an unlimited amount of sunlight, then the plant will grow to its largest possible size.
    c. Marsh grass growth is limited by available nitrogen
    d. Prairie fires replenish the nutrients in the soil.

12. Either Colonel Mustard or Reverend Green killed Professor Plum. But whoever ran off with Mrs. White did not kill the professor. Since Reverend Green ran off with Mrs. White, Colonel Mustard killed Professor Plum. This is an example of which type of reasoning?

    a. Inductive
    b. Deductive

13. Since some grapes are purple, and all grapes are fruit, some fruit is purple. This is an example of which type of reasoning?

    a. Inductive
    b. Deductive

14. Why is Sarah so mean to Janice? The only thing I can think of is that she's jealous. Jealousy is what's making her mean. This is an example of which type of reasoning?

    a. Inductive
    b. Deductive

USE THE FOLLOWING GRID AND ACCOMPANYING INFORMATION/CLUES TO ANSWER QUESTIONS 15-17

		latitude				longitude			
		40.3109 N	40.6656 N	41.0072 N	41.0237 N	88.1863 W	88.2694 W	88.3907 W	88.4584 W
days	May 3								
	May 6								
	May 9								
	May 12								
longitude	88.1863 W								
	88.2694 W								
	88.3907 W								
	88.4584 W								

BACKGROUND INFORMATION AND CLUES FOR QUESTIONS 15-17.

Maddie and her father enjoy looking for "geocaches" - little boxes that people hide in certain places and then publish coordinates so that others can find them. They've uncovered several new geocaches this month. Using only the clues below, figure out the day each was found, as well as the latitude and longitude where they found it, and determine what they discovered inside the box. Remember, as with all grid-based logic puzzles, no option in any category will ever be used more than once.

1. The cache at 40.6656 N was found on May 3.
2. The box found on May 12 was either the box at 40.6656 N or the box at 88.4584 W.
3. The box at 41.0072 N was either the cache found on May 9 or the case at 88.1863 W.
4. The case at 88.1863 W was found 3 days before the cache at 41.0237 N.
5. The box found on May 6 was at 88.3907 W.

15. What was the longitude of the box found on May 3rd?

a. 88.1863 W
b. 88.2694 W
c. 88.3907 W
d. 88.4584 W

16. What was the latitude of the box found on May 12th?

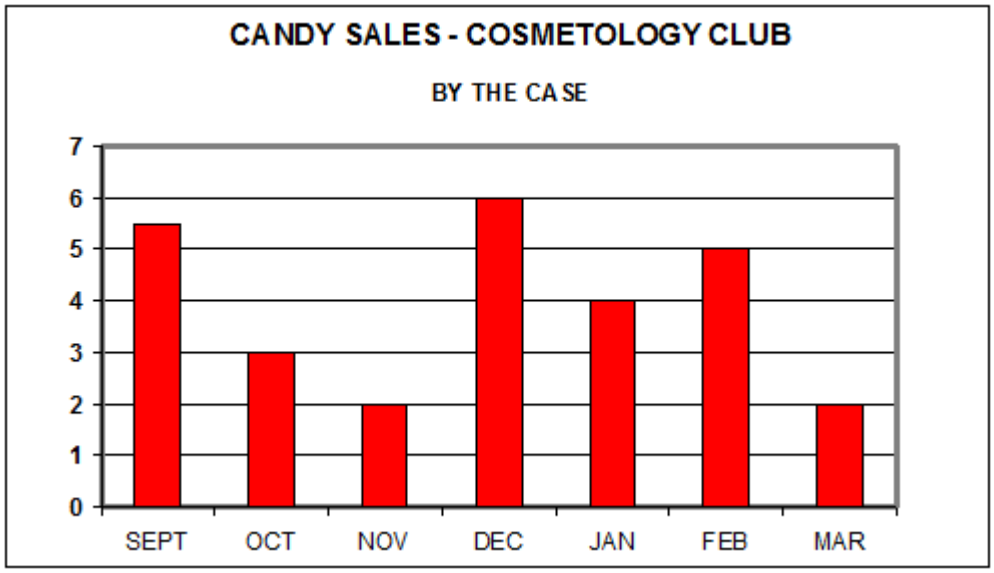
    a. 40.3109 N
    b. 40.6656 N
    c. 41.0072 N
    d. 41.0237 N

17. What date was the box at latitude 41.0072N found?

    a. May 3
    b. May 6
    c. May 9
    d. May 12

STEM UNIT 02 – MATHEMATICS OF SCIENCE

STUDY THE BAR GRAPH BELOW AND USE IT TO ANSWER QUESTIONS 18-22



18. What does the scale on the left beginning with 0 and ending with 7 represent?

    a. Number of students selling candy
    b. Number of cases of candy sold
    c. Number of candy in each case
    d. Number of days each month that candy was sold

19. Which two months had approximately the same amount of candy sold?

    a. September & February
    b. October & March
    c. November & March
    d. September & December

20. The amount of candy sold in December is twice the amount of candy sold in which other month?

    a. October
    b. March
    c. January
    d. September

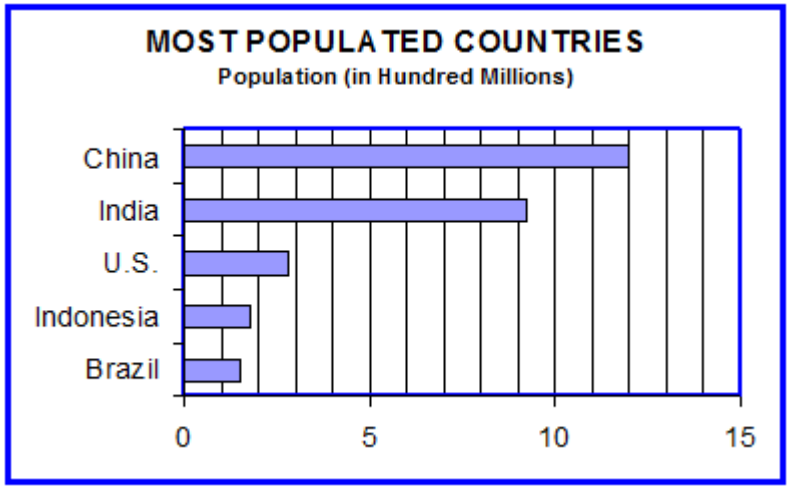
21. What was the total amount of candy sold during the school year shown in the graph?

    a. 27.5 cases
    b. 43 cases
    c. 35.5 cases
    d. 23 cases

22. Which month showed a 100% increase in sales over the month of November?

    a. March
    b. January
    c. December
    d. April

STUDY THE BAR GRAPH BELOW AND USE IT TO ANSWER QUESTIONS 23-24



23. Which two countries have the closest population?

    a. China and Brazil
    b. U.S. and Indonesia
    c. Indonesia and Brazil
    d. India and China

24. About how many more people live in India than in the U.S.?

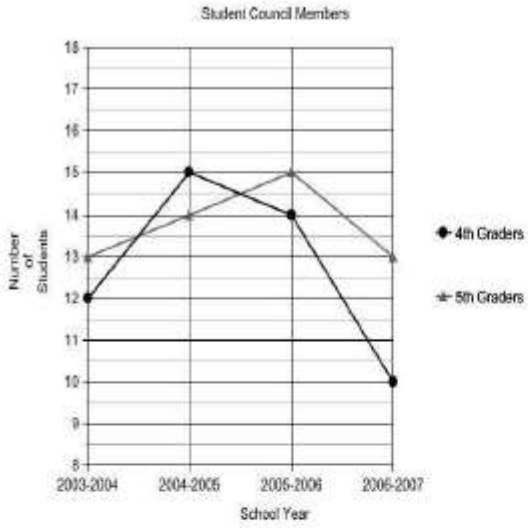
    a. 250 million
    b. 650 million
    c. 100 million
    d. 80 million

The data table below shows the number of fourth grade students and the number of fifth grade students who were part of the student council each year over a four year period. Use the table to answer question 25.

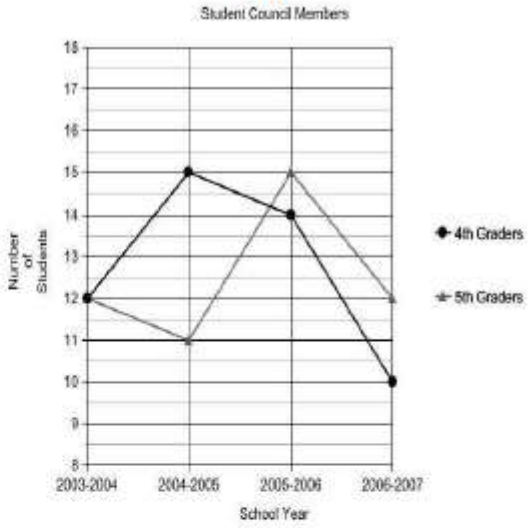
	4th Grade	5th Grade
2003-2004	12	13
2004-2005	15	11
2005-2006	14	15
2006-2007	10	12

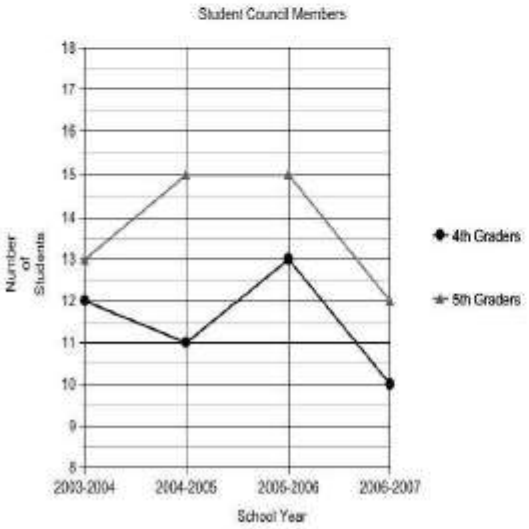
25. Which one of the following graphs correctly displays the data provided?

(A)

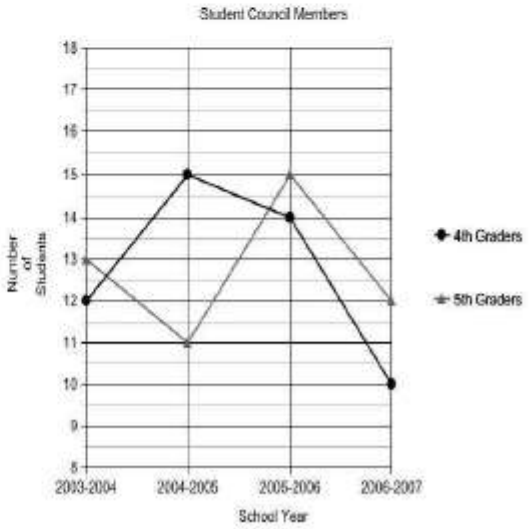


(B)





(C)



(D)

Use the following information and data table to answer question 26.

Two New York City island cruise companies, Happy Sailing and Sunny Waters, make six trips around Manhattan every day of the week except Sunday. The total number of passengers per day for each company is shown in the table below.

	Total number of passengers	
Weekday	Happy Sailings	Sunny Waters
Monday	240	200
Tuesday	235	180
Wednesday	210	195
Thursday	190	185
Friday	200	220
Saturday	260	240

26. In a plot analyzing number of passengers per trip by weekday, what would be the best option for scaling the dependent variable axis?

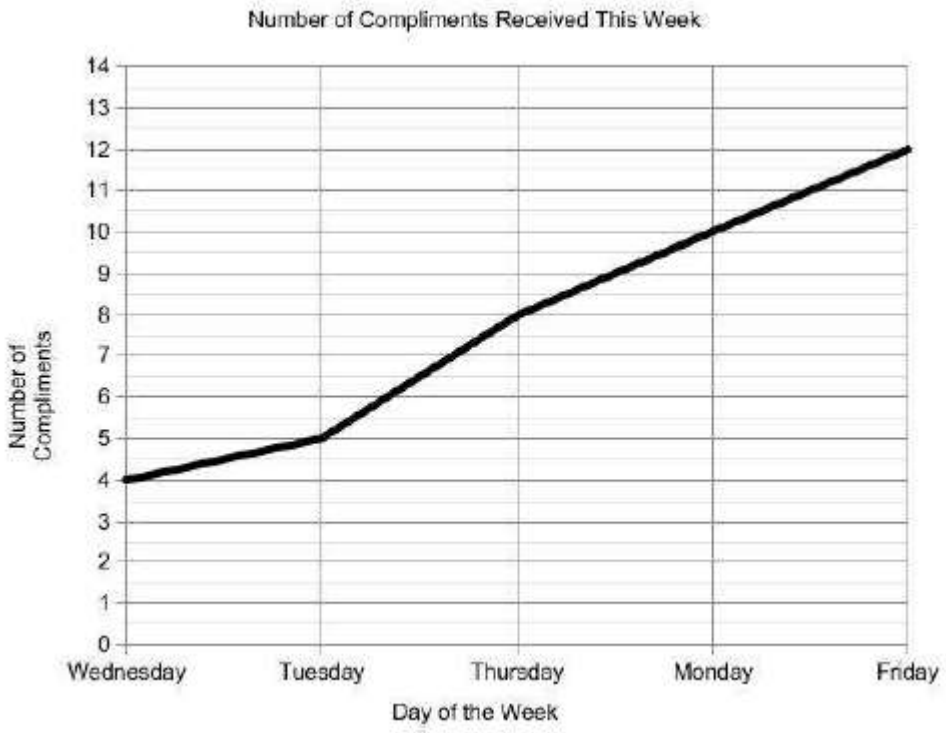
    a. A continuous data axis scaled from 0 to 260
    b. A continuous data axis scaled from 180 to 260
    c. A continuous data axis scaled from 30 to 45
    d. A discrete data axis labeled with the days of the week

Use the following information and data table to answer question 27.

Roberta's class keeps a record of the number of compliments they receive from other teacher's throughout the week. The chart below is the data that was collected.

Number of Compliments Received This Week					
Day of The Week	Monday	Tuesday	Wednesday	Thursday	Friday
Number of Compliments	10	5	4	8	12

Roberta used the chart to make the following graph.



27. Roberta made an error when plotting her graph, where was the error made?

    a. In the type of graph chosen to be plotted.
    b. In how the line was plotted on the graph.
    c. On the dependent variable axis.
    d. On the independent variable axis.

The following are 25 final exam average scores in a math class. Use this information to answer questions 28-30.

46	64	72	79	89
49	66	74	79	91
53	66	75	80	94
60	67	76	83	95
61	71	79	88	98

28. What was the mean score?

    a. 74.2
    b. 72.4
    c. 74.0
    d. 1855

29. What was the mode score?

    a. 75
    b. 74
    c. 79
    d. 91

30. What was the median score?

    a. 75
    b. 74
    c. 79
    d. 91

31. A student made 65, 78, and 85 on three tests. What must she make on the fourth test in order to have an average of 80

    a. 12
    b. 80
    c. 82
    d. 92

32. In a certain English class, quizzes make up 15% of the final average, major tests make up 35%, papers make up 20%, and the final exam makes up 30%. If a student has an average of 90 on quizzes, 80 on major tests, 75 on papers, and 85 on the final exam, what is his final average?

    a. 80
    b. 82
    c. 84
    d. 86

33. A line up for tickets to a local concert had an average (mean) waiting time of 20 minutes with a standard deviation of 4 minutes. If 2000 ticket buyers were in line, how many of them would expect to wait for less than 16 minutes?

    a. 1000
    b. 100
    c. 680
    d. 320

34. Using the correct rules for significant figures solve: 334.54 grams + 198 grams =

    a. 532.54 grams
    b. 532.5 grams
    c. 533 grams
    d. 530 grams

35. Using the correct rules for significant figures solve: 34.1 grams / 1.1 mL =

    a. 30 gmL
    b. 30 g/mL
    c. 31 gmL
    d. 31 g/mL

36. Using the correct rules for significant figures solve: 2.11×10^3 joules / 34 seconds =

    a. 6.21×10^1 joule seconds
    b. 6.21×10^1 joule/seconds
    c. 6.2×10^1 joule seconds
    d. 6.2×10^1 joule/seconds

37. Using the correct rules for significant figures solve: 0.0010 meters – 0.11 meters =

    a. -0.11
    b. -0.11 meters
    c. -0.11 meters/meters
    d. -0.11 $meters^2$

38. Using the correct rules for significant figures solve: 349 cm + 1.10 cm + 100.0 cm =

    a. 450. cm
    b. 450. cm^3
    c. 450.1 cm
    d. 450.1 cm^3

39. Using the correct rules for significant figures solve: 450 meters / 114 seconds =

    a. 3.9 m.s
    b. 3.95 m.s
    c. 3.9 m/s
    d. 3.95 m/s

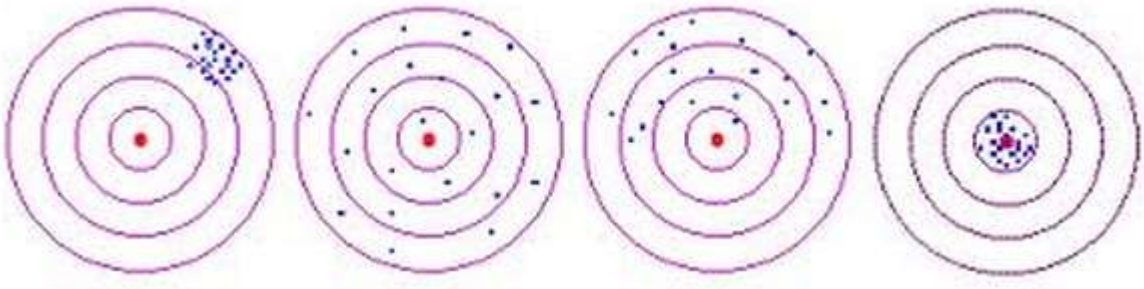
40. Using the correct rules for significant figures solve: 298.01 kilograms + 34.112 kilograms =

    a. 332.122 kg
    b. 332.122 kg^2
    c. 332.12 kg
    d. 332.12 kg^2

41. Using the correct rules for significant figures solve: 84 m/s x 31.221 s =

    a. 2,600 m
    b. 2,600 m/s^2
    c. 2,700 m
    d. 2,700 m/s^2

Use the following diagram to answer questions 42-45



A **B** **C** **D**

42. Which target represents good precision and good accuracy?

    a. TARGET A
    b. TARGET B
    c. TARGET C
    d. TARGET D

43. Which target represents poor precision and good accuracy?

a. TARGET A
b. TARGET B
c. TARGET C
d. TARGET D

44. Which target represents poor precision and poor accuracy?

a. TARGET A
b. TARGET B
c. TARGET C
d. TARGET D

45. Which target represents good precision and poor accuracy?

a. TARGET A
b. TARGET B
c. TARGET C
d. TARGET D

Use the following Information and data table to answer questions 43-44

Three students used a balance to determine the mass of the same piece of charcoal. Each student made three measurements and the results are tabulated below.

	Student A	Student B	Student C
Trial 1	14.92 g	12.67 g	12.80 g
Trial 2	14.94 g	13.73 g	12.77 g
Trial 3	14.93 g	11.98 g	12.80 g

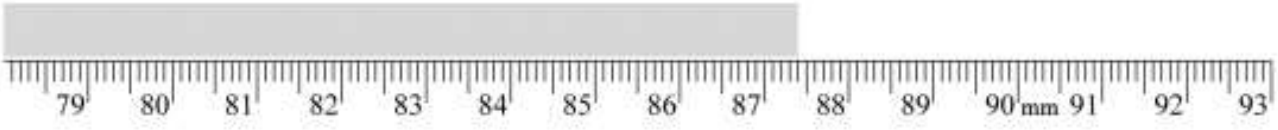
46. Which student(s) were precise in their measurements

a. Students A and B
b. Students B and C
c. Students A and C
d. Student C

47. If the true (accepted) mass of the piece of charcoal is 12.80 g, which student(s) were accurate in their measurements?

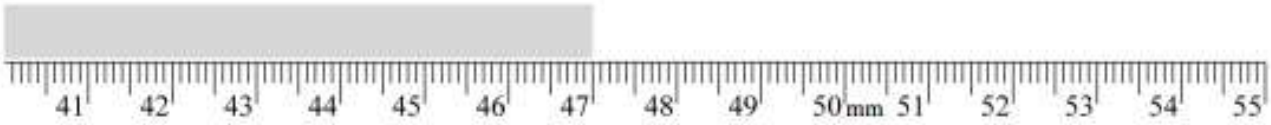
    a. Students A and B
    b. Students B and C
    c. Students A and C
    d. Student C

48. What would be an acceptable value to report for the measurement shown below?



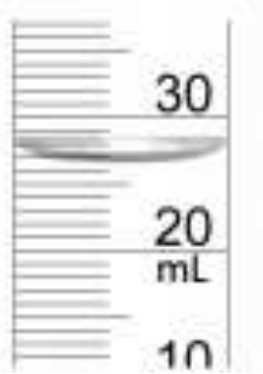
    a. 87 mm
    b. 87.4 mm
    c. 87.40 mm
    d. 87.400 mm

49. What would be an acceptable value to report for the measurement shown below?



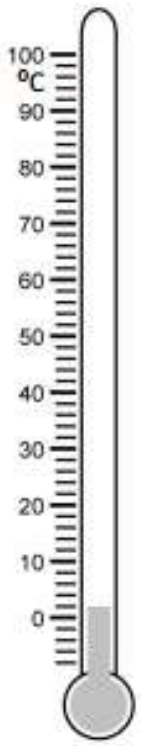
    a. 47 mm
    b. 47.0 mm
    c. 47.00 mm
    d. 47.000 mm

50. What would be an acceptable value to report for the measurement shown to the right?



    a. 26 mL
    b. 26.7 mL
    c. 33 mL
    d. 33.3 mL

51. What would be an acceptable value to report for the measurement shown to the right?



a. 2 °C
b. 2.0 °C
c. 5 °C
d. 5.0 °C

52. A teacher calculates the molar mass of sodium hydroxide as 37.0 g/mol. The true molar mass of sodium hydroxide is 40.0 g/mol. Find the teacher's percent error.

a. 3.0 %
b. 7.5 %
c. 8.1 %
d. Insufficient information provided.

Use the conversion factors provided below to answer questions 53-56

Length	Volume	Mass
1 inch = 2.54 cm	1 quart = 0.9463 L	1 ounce = 28.35 g
5280 feet = 1 mile	4 quarts = 1 gallon	1 pound = 0.454 Kg
1 yard = 3 feet = 36 inches	32 ounces = 1 quart	16 ounces = 1 pound

53. Which of the following is/are true about the unit conversion shown below?

$$\frac{10.0 \text{ inches}}{1} \times \frac{2.54 \text{ cm}}{1 \text{ inch}} \times \frac{1 \text{ meter}}{100 \text{ cm}} =$$

a. 100 cm = 1 meter
b. The numerical answer is 0.254 m
c. All the units cancel out except for meters
d. All of the above are correct

54. A mass of 0.15 ounces is equal to how many grams?

a. 0.2352 g
b. 0.24 g
c. 4.25 g
d. 4.3 g

55. 2.00 gallons is equal to how many liters

a. 0.1321 L
b. 0.528 L
c. 7.57 L
d. 8.45 L

56. 200 g is equivalent to how many pounds?

a. 0.00001 lbs
b. 0.4 lbs
c. 100 lbs
d. 400 lbs

57. Express 0.000840 in scientific notation

a. 8.40×10^{-3}
b. 8.40×10^{4}
c. 8.40×10^{-4}
d. 8.4×10^{4}

58. Which of the following is an exact number?

a. 10.25 g
b. 4.000 kg
c. 7 bananas
d. 60 seconds

59. What is the mass of 20.0 mL solution if it's density is 1.84 g/mL?

a. 10.8 g
b. 21.8 g
c. 10.9 g
d. 36.8 g

60. 44 cm is how many km?

    a. 0.00044 km
    b. 0.044 km
    c. 44000 km
    d. 4400000 km

61. 0.90 mA is how many nA?

    a. 0.000009 nA
    b. 0.009 nA
    c. 900000 nA
    d. 90000 nA

62. Newton's Law of Universal Gravitation states that a particle attracts every other particle in the universe using a force (Fg) that is directly proportional to the product of their masses (m1 and m2) and inversely proportional to the square of the distance (r) between them.

$$Fg \propto \frac{m1.m2}{r^2}$$

    Given this, if the mass of one particle remains constant but the mass of the other particle is doubled and the distance between the particles is doubled then the new force is:

    a. Half of the original force
    b. Double the original force
    c. A quarter of the original force
    d. Four times the original force

STEM UNIT 03 – INTRODUCTION TO CHEMISTRY

63. You go to the beach and dig up some wet sand. Which method would be best for determining the amount of salt present in your sample.

    a. Put the wet sand in filter paper, wash three times, evaporate out all the collected water, then mass the residue
    b. Dry the wet sand in an oven and then sift out the salt
    c. Melt the entire sample. The sand will melt and the salt won't
    d. Use a separatory funnel to separate the sand and salt

64. How many protons, electrons, and neutrons exist in a Lithium-7 atom?

a. 3 protons; 4 electrons; 3 neutrons
b. 3 protons; 3 electrons; 4 neutrons
c. 4 protons; 3 electrons; 3 neutrons
d. 3 protons; 2 electrons; 4 neutrons

65. What type of matter has an indefinite shape and a definite volume?

a. Solid
b. Liquid
c. Gas
d. Plasma

66. Which sample of aluminum has the highest density?

a. Solid aluminum rod: 1m long; 1cm diameter
b. Hollow aluminum rod: 1m long; 1cm diameter
c. Piece of aluminum foil: $2cm^2$
d. They are all the same

67. Which of the following is an inorganic compound?

a. C_3H_6
b. CO_2
c. C_2H_6O
d. CH_4

68. Which of the following is a homogeneous mixture?

a. Melted gold
b. Melted brass
c. Melted zinc
d. Melted copper

69. How would you separate a miscible mixture of ethanol alcohol and water?

a. Separatory funnel
b. Distillation
c. Filtration
d. Chromatography

70. Which of the following is a physical change?

a. A leaf changing color
b. A nail rusting
c. A pond freezing
d. A candle burning

71. Which of the following is a homogeneous mixture?

a. Water
b. Carbon dioxide
c. Air
d. soil

72. Which of the following is a heterogeneous mixture?

a. Sugar dissolved in alcohol
b. Bronze alloy
c. Rusty pipe
d. Air

73. An element has a mass number of 50 and an atomic number of 23. Which of the following is an isotope of this element?

a. $^{50}_{24}X$
b. $^{60}_{23}X$
c. $^{50}_{23}X$
d. $^{23}_{50}X$

74. Which of the following is an intensive property?

a. Mass
b. Volume
c. Density
d. Heat given off by a combustion reaction

75. The chemical symbol for strontium is?

a. St
b. Sn
c. Sr
d. W

76. Which of the following is not indicative of a chemical reaction?

a. Color change
b. Formation of a precipitate
c. Substances dissolving
d. Gas is produced

77. In the reaction: $2H_2O_2 \rightarrow 2H_2O + O_2$
The diatomic oxygen molecule on the right is a _____.

a. Reactant
b. Product
c. Catalyst
d. All the above

78. You mass an empty beaker and find its mass to be 22.575 g.
You add some copper (II) chloride to this empty beaker until the mass reads 22.985 g.
The mass of the copper (II) chloride sample is:

a. 0.41 g
b. 0.410 g
c. 0.4100 g
d. 0.41000 g

79. Europium has two isotopes. One is ^{153}Eu with an abundance of 52.23%. Which is the other isotope?

a. ^{149}Eu
b. ^{150}Eu
c. ^{151}Eu
d. ^{152}Eu

80. According to the kinetic-molecular theory, which substances are made of particles?

a. Gasses only
b. Liquids only
c. All matter
d. All matter except solids

81. According to the kinetic-molecular theory, particles of matter are in motion in

a. Gases only
b. Gases and liquids only
c. Solids, liquids, and gases
d. Solids only

82. The particles in a liquid are usually

a. closer together and lower in energy than those in a solid
b. farther apart and higher in energy than those in a gas
c. closer together and lower in energy than those in a gas
d. farther apart and lower in energy than those in a solid

83. Sucrose is another name for table sugar. Sucrose is a compound made from the elements carbon, hydrogen, and oxygen. Sucrose has the formula $C_{12}H_{22}O_{11}$ Which statement best describes the properties of sucrose?

a. They are most like the properties of carbon because both sucrose and carbon are solids at room temperature.
b. They are most like the properties of hydrogen because there is more hydrogen in sucrose than carbon or oxygen.
c. They are most like the properties of oxygen because there is more mass of oxygen in sucrose than carbon or hydrogen.
d. They are different from the propertied of the elements in sucrose.

84. Which of the following is an inorganic compound?

a. rust
b. carbohydrates
c. lipids
d. nucleic acids

85. Bohr's theory helped explain why

a. Electrons have negative charge
b. Most of the mass of the atom is in the nucleus
c. Excited hydrogen gas gives off certain colors of light
d. Atoms combine to form molecules

86. Most of the volume of an atom is occupied by the _____ whereas most of the mass is in the _____.

a. Protons, Neutrons
b. Protons, Electrons
c. Nucleus, Electron cloud
d. Electron cloud, Nucleus

87. Which one of the following species has the least number of neutrons?

A $^{35}_{17}Cl$

B $^{39}_{18}Ar$

C $^{40}_{18}Ar$

D $^{40}_{20}Ca^{2+}$

88. Copper has two isotopes, ^{63}Cu and ^{65}Cu. If the average atomic mass of copper is 63.5 amu, what is the % of each isotope

a. 25.0 % ^{63}Cu and 75.0 % ^{65}Cu
b. 33.0 % ^{63}Cu and 66.0 % ^{65}Cu
c. 66.0 % ^{63}Cu and 33.0 % ^{65}Cu
d. 75.0 % ^{63}Cu and 25.0 % ^{65}Cu

The remainder of this study packet covers topics that should be considered *enrichment* in preparation for your upcoming Honors Chemistry course. As such you will *not* be held accountable for completing this material by your Honors Chemistry teacher in regards to the assessments you *will* be receiving based on your completion of the earlier questions in this packet.

However, any independent research you elect to do towards understanding the following concepts will be extremely beneficial as you encounter these topics in your upcoming Honors Chemistry course.

Topic 1: ***Ions***

Core Concept/Application: *Understanding the development of the atomic structure throughout history and the development of using information regarding properties of subatomic particles to solve questions regarding attraction, charge, and atomic size.*

"Big Idea": What is an atom? What are the pieces that make up an atom?

Recommended reading:

https://tinyurl.com/yaslnb3w

https://tinyurl.com/yahbdmbc

Topic 2: ***Bonding***

Core Concept/Application: *Understanding the difference between metals and nonmetals and why they are classified as such. Identifying metalloids. The difference in bonding types dependent on ion and element interactions. Sharing electrons vs transfer of electrons and different bond nomenclature and diagrams dependent upon compound type.*

"Big Idea": What is the difference between metals and nonmetals? How do bonds between metals and nonmetals (covalent vs ionic) differ?

Recommended reading:

https://tinyurl.com/ybftjqcg

https://tinyurl.com/y8xsytux

https://tinyurl.com/y9h6o3ar

https://tinyurl.com/yat3knnk

Topic 3: ***Chemical Formula Naming & Writing***

Core Concept/Application: *How to name molecular vs ionic compounds. Uses of suffixes, prefixes and roman numerals. Identifying binary compounds vs tertiary compounds and identifying polyatomic ions.*

"Big Idea": What is the naming differences between ionic and covalent compounds? When to use prefixes for compounds? What is the correct ion suffix? How to identify and name polyatomic ions and write compounds containing polyatomics? When are charges used to determine compound names?

Recommended reading:

https://tinyurl.com/yc7kbd5s

https://tinyurl.com/ybjte2nu

https://tinyurl.com/y7lwx4xw

https://tinyurl.com/yczhlgln

Topic 4: ***Writing and Balancing Chemical Equations***

Core Concept/Application: *How to write balanced chemical equations as a decription of a chemical reaction. Application of the Law of the Conservation of Mass and Matter.*

"Big Idea": How to write chemical formulas? How to write formulas as short hand notation for chemical reactions? What is the Conservation of Mass and Matter and how is it applicable here?

Recommended reading:

https://tinyurl.com/yancnkeq

https://tinyurl.com/v7ezx9f

https://tinyurl.com/y8zdv7zy

Topic 5: ***The Mole and Molar Mass***

Core Concept/Application: *How do you measure something you cannot see? How do we use the mole as a quantity and unit of measure? What does that mean when balancing equations?*

"Big Idea": How much is a mole? How is Molar Mass related to the mole? How do you calculate through Mole-town using dimensional analysis?

Recommended reading:

https://tinyurl.com/y8y56hut

https://tinyurl.com/y8e842m6

Topic 6 : ***Molar Conversions***

Core Concept/Application: *How do you measure something you cannot see? How do we use the mole as a quantity and unit of measure? What does that mean when balancing equations?*

"Big Idea": What is Avogadro's Number? How is Molar Mass and Molar Volume calculated? How do you calculate through Mole-town using dimensional analysis?

Recommended reading:

https://tinyurl.com/ybb465n4

https://tinyurl.com/y825jeqh

https://tinyurl.com/y7eheabz

https://tinyurl.com/y88e8dpk

Topic 7: ***Stoichiometry***

Core Concept/Application: *How to determine what you need or what you use based on a given value and a chemical equation? How to use chemical equations as recipes?*

"Big Idea": What is the mole ratio? How do you use a mole ratio as conversion factor?

Recommended reading:

https://tinyurl.com/ybdglo92

https://tinyurl.com/y8hc4b57

https://tinyurl.com/y9p5hd7k

https://tinyurl.com/yau4dspz

https://tinyurl.com/y85h39k2

https://tinyurl.com/ybdrnf8v