Chemistry A: Form TR2-18A Name _____

REVIEW Date _____ Period _____

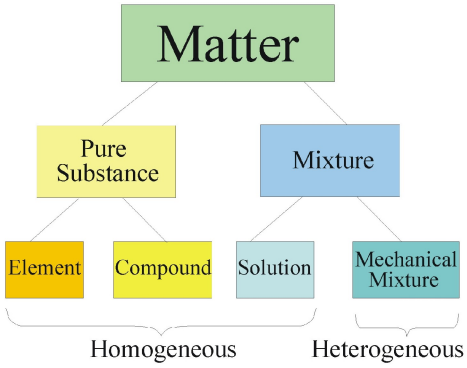
# Test Review № 2

**Skills**

- Know how to calculate percent error
- Contrast Democritus and Aristotle's ideas
- Understand the Law of Conservation Matter, Law of Constant Composition (also known as Law of Definite Proportions) and Law of Multiple Proportions
- Understand the postulates of Dalton's Atomic Theory
- Be able to explain J.J. Thomson's experiment, his results and his conclusions
- Be able to explain J.J. Thomson's Plum Pudding Model
- Be able to explain Rutherford's Gold Foil Experiment, results and conclusions
- Contrast J.J. Thomson's Plum Pudding Model with Rutherford's nuclear model

**Percentage Error.** The actual size of the error – the difference between the observed value and the true value – is known as the **absolute error**. The sign of the absolute error is not important. The size of the error is more important than whether the value is over or under. The real measure of how far off a value is, is the percentage error. It is the size of the error, the absolute error, compared to the true value.

**Matter.** Matter is anything that has mass and takes up space. Pure matter can be classified as elements or compounds. Elements are simple substances that can't be broken down by chemical means. Gold is an example. Compounds are composed of two or more elements chemically combined. The properties of elements are not retained when they combine to form a compound. Mixtures are composed of two or more substances blended together. A solution is a homogeneous mixture. A mechanical mixture has two or more phases. The properties of the substances in a mixture are retained. This fact is useful for separating a mixture. For example, a mixture of iron and sand can be separated using a magnet, because the iron is still magnetic. A solution is a homogeneous mixture. It consists of a solute and a solvent. The solvent is the continuous phase. A mechanical mixture is a heterogeneous mixture. It has two or more phases. Solutions in water appear clear, while mechanical mixtures in water often appear cloudy. Suspensions are mechanical mixtures in which the particles settle over time. Colloidal dispersions are mechanical mixtures that don't settle over time. They have smaller particles than suspensions, but larger particles than solutions. Mechanical mixtures can scatter a beam of light making it look like headlights in fog. This is called the tyndal effect.

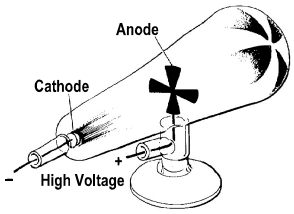



**Element Symbols.** In 1814 Jöns Berzelius, a Swedish chemist, devised the system of symbols used by scientists. The goal of his symbols was to make it easy to write chemical observations in shorthand that could be easily understood. Many symbols are just the first letter of the element's name, upper case. Carbon, for example is C. Other symbols have two letters from the element's name, with the first being upper case and the second being lower case. Examples include calcium, Ca, and cadmium, Cd. Some element's symbols are based on the Latin name such as copper (Cu = cuprum) and lead (Pb = plumbum)

**Early Theories of Matter. Democritus (Greek Philosopher ~460 BC)** proposed all that matter is composed of particles called atoms (Greek for "uncuttable"). He envisioned atoms of different substances as having different geometric shapes. The idea did not gain acceptance. **Aristotle** proposed that there were four elements: earth; air; fire; and water. This idea gained acceptance because substances appeared to have different degrees of each of these building blocks. For example, a burning, green stick releases smoke (air), water, and ash (earth), and since it burns, it obviously contains fire. The Aristotelian view lasted for almost 2,000 years.

**Dalton's Atomic Theory.** Dalton proposed atomic theory in 1803 to explain his observations about the relative masses of elements in a compound. Dalton's Postulates say: [1] Matter is made of small particles called atoms; [2] Atoms are indestructible. They cannot be created or destroyed during chemical or physical changes; [3] Atoms of an element are identical. They have the same mass; [4] Atoms of different elements have different masses; [5] Compounds are formed by combining atoms of different elements. The Dalton model of the atom is a solid, indivisible sphere.

**Thomson's Model.** Thomson showed that the beam of light in a Crookes tube was actually composed of negatively charged particles he called electrons. In order to account for the negatively charged particles in neutral matter, he assumed the rest of the atom was positively charged. Thomson's model of the atom was a positively charged cloud with the negative electrons scattered evenly throughout.




**Rutherford's Model.** Ernest Rutherford performed the alpha scattering experiment in 1911. He probed the inside of the atom by aiming small, positively charged particles called alpha particles at gold foil. Only 1 in 8,000 alpha particles bounced straight back or were deflected greatly. The rest went straight through the gold foil Based on these observations, Rutherford suggested that the atom is mostly empty space with a small, positively charged center and negatively charged electrons revolving around the outside like planets around the sun.

**Answer the questions below by circling the number of the correct response**

1. According to an accepted chemistry reference. the heat of vaporization of water is 540. calories per gram. A student determined in the laboratory that the heat of vaporization of water was 620. calories per gram. The student's results had a percent error of (1) 12.9, (2) 80.0, (3) 14.8, (4) 87.1

2. In an experiment the gram atomic mass of magnesium was determined to be 24.7. Compared to the accepted value 24.3, the percent error for this determination was (1) 0. 400, (2) 2, (3) 24.7, (4) 98.4

3. A student determined the melting point of a substance to be 55.2 °C. If the accepted value is 50.1 °C the percent error in her determination is (1) 5.10, (2) 10.2, (3) 9.24, (4) 12.0

4. In an experiment, a student found that the percent of oxygen in a sample of $KClO_3$ was 42.3%. If the accepted value is 39.3%, the experimental percent error is

$$(1)\ \frac{42.3}{39.3}\times 100\% \qquad (3)\ \frac{3.0}{42.3}\times 100\%$$
$$(2)\ \frac{39.3}{42.3}\times 100\% \qquad (4)\ \frac{3.0}{39.3}\times 100\%$$

5. Which of the following is NOT matter? (1) a chair (2) air (3) light (4) water
6. Which of the following is NOT a property of matter? (1) inertia (2) occupies space (3) composed of elements (4) weightlessness

7. Which of the following may be heterogeneous? (1) elements only (2) compounds only (3) mixtures only (4) elements or compounds

8. Which of the following is pure? (1) elements only (2) compounds only (3) mixtures only (4) both elements and compounds

9. Which of the following consists of more than one substance? (1) elements only (2) compounds only (3) mixtures only (4) either elements or compounds

10. Which of the following are types of matter? (1) elements only (2) compounds only (3) mixtures only (4) all of these
11. Which of the following is a type of mixture? (1) elements only (2) compounds only (3) solutions only (4) elements or compounds

12. Which of the following is matter? (1) love (2) ideas (3) rock (4) heat

13. The tendency of matter to maintain its state of motion is known as (1) density, (2) inertia, (3) mass, (4) volume.

14. Which of the following is NOT composed of two or more types of atoms? (1) element (2) compound (3) solution (4) mechanical mixture
15. Which substance can be decomposed by a chemical change? (1) ammonia (2) iron (3) argon (4) helium

16. The symbol for potassium is (1) P, (2) K, (3) Sn, (4) Po.

17. The symbol for gold is (1) Ag, (2) Au, (3) Ga, (4) Na.

18. Sb is the symbol for (1) antimony, (2) sulfur, (3) mercury, (4) tin.

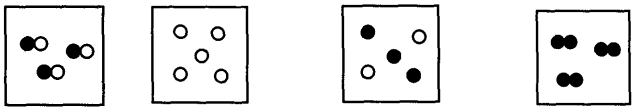
19. The matter in a container is composed of hydrogen and oxygen. When the contents of the container are added to a fire, the fire goes out. This shows that the hydrogen and oxygen in the container are (1) mixed to form a solution, (2) mixed to form an emulsion, (3) chemically combined to form a compound, (4) separate elements.

20. A bottle of green food coloring, which was left standing on a shelf for a long time, separated into distinct blue and yellow layers. The food coloring was most likely (1) an element, (2) a compound, (3) a mixture, (4) changing phase.

21. A light that is shined through the material in a container is reflected in such a way that it forms a visible ray or beam. The material in the container could be (1) an element, (2) a compound, (3) a solution (4) a mechanical mixture

22. Material left in a container separates into two phases. The material in the container could be a (1) compound, (2) solution, (3) element, (4) mechanical mixture.

23. Given: ● = particle X
O = particle Y
Which diagram represents a mixture?



(1) (2) (3) (4)

24. The *Tyndall Effect* in colloidal dispersions is due to (1) absorption of light (2) merging of light rays (3) scattering of light (4) convergence of light rays

25. Which of the following will show the *Tyndall Effect*? (1) element (2) compound (3) solution (4) suspension

26. Which statement does not describe a compound? (1) It is a pure substance. (2) Its components are mixed in any proportion by mass. (3) It cannot be separated into constituents by physical means. (4) It is composed of two or more elements.

27. Which of the following is not a mixture? (1) blood (2) pennies (3) saliva (4) calcium

28. Which mixture can be separated by filtration? (1) water and sand (2) salt and sugar (3) salt and carbon dioxide (4) sugar and carbon dioxide

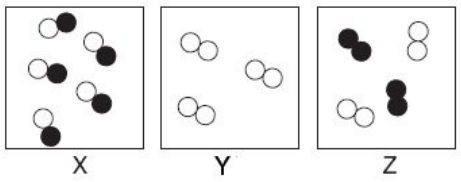
29. When a mixture of water, sand, and salt is filtered, what passes through the filter paper? (1) water, only (2) water and sand, only (3) water and salt, only (4) water, sand, and salt

30. Which of the following has the smallest particles? (1) a mechanical mixture (2) a solution (3) a suspension (4) a colloidal dispersion

31. Which must be a mixture of substances? (1) solid (2) liquid (3) gas (4) solution

32. A bottle of rubbing alcohol contains both 2-propanol and water. These liquids can be separated by the process of distillation because the 2-propanol and water (1) have combined chemically and retain their different boiling points. (2) have combined chemically and have the same boiling point. (3) have combined physically and retain their different boiling points. (4) have combined physically and have the same boiling point.

33. Given the diagrams X, Y, and Z below:

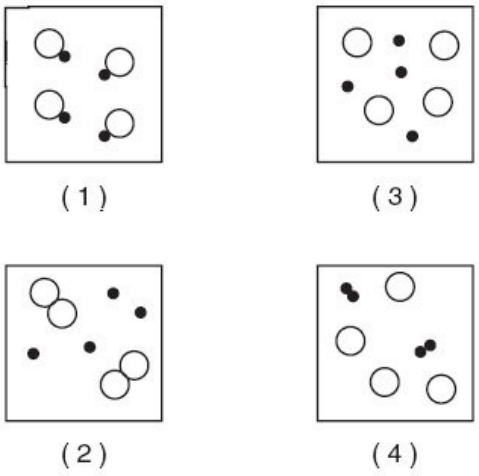


X Y Z

| Key |
| --- |
| Atom of element A = ○ |
| Atom of element B = ● |

Which diagram or diagrams represent a mixture of elements A and B? (1) X, only (2) Z, only (3) X and Y (4) X and Z

34. Which particle diagram represents one pure substance, only?



(1) (3)

(2) (4)

35. In which type of mixture will the particles settle over time? (1) solution (2) suspension (3) colloidal dispersion (4) homogeneous

36. In 1661, Robert Boyle proposed that matter is composed of simple substances called elements that cannot be broken down by chemical means. His theory was not accepted for over 100 years because (1) he lacked qualitative evidence, (2) he lacked quantitative evidence, (3) he lacked both qualitative and quantitative evidence, (4) he was a philosopher rather than a scientist.

37. Boyle proposed that matter is composed of simple substances called elements that cannot be further decomposed or broken down. Aristotle's idea that air was an element did not fit Boyle's definition because air (1) cannot be seen, (2) cannot be broken down, (3) can be decomposed, (4) can react with other substances.

38. Antoine Lavoisier measured the mass of some mercury. Then he heated it in air. The mercury turned into a red substance as it was heated. The mass of the red substance was greater than the mass of the mercury. The best explanation for this observation is that (1) matter was created, (2) a new element formed, (3) the mercury combined with something in the air, (4) hot mercury is heavier than cold mercury.

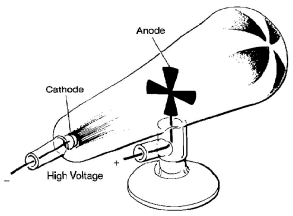
39. Lavoisier heated mercury until a red substance formed. Then he heated the red substance and it broke down into mercury and oxygen. From his observations it is reasonable to conclude (1) mercury and oxygen are elements and the red substance is a compound composed of mercury and oxygen, (2) mercury, oxygen, and the red substance are elements, (3) the red substance is an element, and mercury and oxygen are compounds composed from it, (4) mercury, oxygen, and the red substance are compounds.

40. When Lavoisier heated mercury II oxide, it decomposed into mercury and oxygen. The mass of the mercury II oxide was equal to the mass of the mercury plus the mass of the oxygen. This shows that during the chemical reaction (1) matter was not created but it was destroyed, (2) matter was created but it was not destroyed, (3) mater was both created and destroyed, (4) matter was neither created nor destroyed.

41. An 18 kg sample of water is decomposed by electrolysis, releasing 16 kg of oxygen. How much hydrogen was released? (1) 34 kg (2) 2 kg (3) 16 kg (4) 1.125 kg

42. If 46 g of X combines with 16 g of Y to form Z, how much Z is formed? (1) 30 g (2) 2.9 g (3) 724 g (4) 62 g

43. When William Crookes passed current through a cathode (negative electrode) in a glass vacuum tube, the tube glowed casting a shadow of the anode at the opposite end as shown in the diagram at the right. This showed Crookes that the source of the light was the (1) anode, (2) cathode, (3) protons, (4) neutrons.




44. Modern atomic theory is based on the work of (1) Kepler, (2) Aristotle, (3) Dalton, (4) Leeuwenhoek.

45. The law of conservation of mass follows from the concept that (1) atoms are indivisible. (2) atoms of different elements have different properties. (3) matter is composed of atoms. (4) atoms can be destroyed in chemical reactions.

46. In water, $H_2O$, the ratio of the masses of oxygen to hydrogen is 8:1. What is the ratio of the masses of oxygen to hydrogen in hydrogen peroxide, $H_2O_2$? (1) 1:1 (2) 8:1 (3) 16:1 (4) 32:1

47. According to Dalton's atomic theory, atoms (1) are destroyed in chemical reactions. (2) can be divided. (3) of each element are identical in size, mass, and other properties. (4) of different elements cannot combine.

48. Which of the following is NOT part of Dalton's atomic theory? (1) Atoms cannot be divided, created, or destroyed. (2) The number of protons in an atom is its atomic number. (3) In chemical reactions, atoms are combined, separated, or rearranged. (4) All matter is composed of extremely small particles called atoms.

49. According to Dalton's atomic theory, atoms (1) of different elements combine in simple whole-number ratios to form compounds. (2) can be divided into protons, neutrons, and electrons. (3) of all elements are identical in size and mass. (4) can be destroyed in chemical reactions.

50. Dalton's atomic theory helped to explain the law of conservation of mass because it stated that atoms (1) could not combine. (2) could not be created or destroyed. (3) all had the same mass. (4) were invisible.

51. Which concept in Dalton's atomic theory has been modified? (1) All matter is composed of atoms. (2) Atoms of different elements have different properties and masses. (3) Atoms can combine in chemical reactions. (4) Atoms cannot be divided

52. Dalton's model of the atom was (1) a solid sphere, (2) a positive cloud with scattered electrons, (3) the "solar system" model, (4) based on electrons moving in fixed circular pathways around the nucleus

53. Who made the discovery that cathode rays were actually negatively charged particles called electrons? (1) Thomson, (2) Bohr, (3) Rutherford, (4) Dalton

54. In early experiments on electricity and matter, an electrical current was passed through a glass tube containing (1) water. (2) gas under high pressure. (3) liquid oxygen. (4) gas under low pressure.

55. In a glass tube, electrical current passes from the negative electrode, called the -?- to the other electrode. (1) cathode (2) anode (3) electron (4) millikan

56. The rays produced in a cathode tube in early experiments were (1) unaffected by a magnetic field. (2) deflected away from a negative plate. (3) found to carry a positive charge. (4) striking the cathode.

57. The behavior of cathode rays produced in a glass tube containing gas at low pressure led scientists to conclude that the rays (1) were not composed of matter. (2) were composed of positively charged particles. (3) were composed of negatively charged particles. (4) were composed of uncharged particles.

58. Experiments with cathode rays led to the discovery of the (1) proton. (2) nucleus. (3) neutron. (4) electron.

59. After measuring the ratio of the charge of a cathode-ray particle to its mass, Thomson concluded that the particles (1) had no mass. (2) had a very small mass. (3) had a very large mass. (4) carried a positive charge.

60. Whose model of the atom could be represented by a solid, indivisible sphere with a characteristic mass? (1) Dalton (2) Thomson (3) Rutherford (4) Bohr

61. Whose model of the atom could be represented by a positively charged cloud with electrons distributed through it? (1) Dalton (2) Thomson (3) Rutherford (4) Bohr

62. The nucleus of the atom was discovered by (1) Thomson, (2) Bohr, (3) Rutherford, (4) Dalton

63. In Rutherford's experiments, most of the alpha particles aimed at gold foil (1) bounced back. (2) passed through the foil. (3) were absorbed by the foil. (4) combined with the foil.

64. Because most particles fired at metal foil passed straight through, Rutherford concluded that (1) atoms were mostly empty space. (2) atoms contained no charged particles. (3) electrons formed the nucleus. (4) atoms were indivisible.

65. Because a few positively charged particles bounced back from the foil, Rutherford concluded that such particles were (1) striking electrons. (2) indivisible. (3) repelled by densely packed regions of positive charge. (4) magnetic.

66. Rutherford's experiments led to the discovery of the (1) electron. (2) nucleus. (3) cathode ray. (4) neutron.

67. Rutherford's experimental results led him to conclude that atoms contain massive central regions that have (1) a positive charge. (2) a negative charge. (3) no charge. (4) both protons and electrons.

68. Which of the following particles is negatively charged? (1) electron (2) proton (3) neutron (4) cation

69. A mine in Pennsylvania produces 200 kg of the compound, consisting of 140 kg of iron and 60 kg of oxygen. A small sample of the compound is obtained from Brazil, which consists of 70 kg of iron and 30 kg of oxygen. Which law associated with Dalton's Atomic Theory that supports this data

70. Which aspect of Thomson's model is still true? Which aspect of this model is false?

71. In the gold foil experiment, the alpha particles mainly traveled through the foil with only occasional reflection and deflection. This data lead to the nuclear model. If the results were reversed, where alpha particles mainly deflected and reflected and only an occasional alpha particle passed through, what would have been a logical deduction regarding the atomic model?

**Answers**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 3 | 18. | 1 | 35. | 2 | 52. | 1 | 69. | Law of Definite proportions |
| 2. | 2 | 19. | 3 | 36. | 2 | 53. | 1 | 70. | There are electrons, but |
| 3. | 2 | 20. | 3 | 37. | 3 | 54. | 4 | | rather than a chloud of |
| 4. | 4 | 21. | 4 | 38. | 3 | 55. | 1 | | positive charge there is a |
| 5. | 3 | 22. | 4 | 39. | 1 | 56. | 2 | | nucleus. |
| 6. | 4 | 23. | 3 | 40. | 4 | 57. | 3 | 71. | In the gold foil experiment, |
| 7. | 3 | 24. | 3 | 41. | 2 | 58. | 4 | | the alpha particles mainly |
| 8. | 4 | 25. | 4 | 42. | 4 | 59. | 2 | | traveled through the foil with |
| 9. | 3 | 26. | 2 | 43. | 2 | 60. | 1 | | only occasional reflection |
| 10. | 4 | 27. | 4 | 44. | 3 | 61. | 2 | | and deflection. This data |
| 11. | 3 | 28. | 1 | 45. | 1 | 62. | 3 | | lead to the nuclear model. If |
| 12. | 3 | 29. | 3 | 46. | 3 | 63. | 2 | | the results were reversed, it |
| 13. | 2 | 30. | 2 | 47. | 3 | 64. | 1 | | would imply that the atom is |
| 14. | 1 | 31. | 4 | 48. | 2 | 65. | 3 | | mostly a positive solid |
| 15. | 1 | 32. | 3 | 49. | 1 | 66. | 2 | | instead of empty space with |
| 16. | 2 | 33. | 2 | 50. | 2 | 67. | 1 | | a small space for electrons |
| 17. | 2 | 34. | 1 | 51. | 4 | 68. | 1 | | close by. |