

1. Consider the stable isotope of lead, lead-206, $^{206}_{82}\text{Pb}$. Select the combination which lists the correct mass number, atomic number, and neutron number, respectively.
 - (A) 124, 82, 206
 - (B) 206, 82, 288
 - (C) 82, 206, 124
 - (D) 82, 124, 206
 - (E) 206, 82, 124
2. Select the best statement.
 - (A) Physical changes are not valid characteristics for identifying a substance.
 - (B) Physical changes alter the composition of the substances involved.
 - (C) Physical properties are usually accompanied by chemical changes.
 - (D) Physical changes may be reversed by changing the temperature.
 - (E) Physical properties are mostly extensive in nature.
3. An enclosed mixture has a mass of 7.51076 ± 0.00003 g, and after a chemical change occurs the mixture has a mass of 7.51078 ± 0.00003 g. These results show that
 - (A) the law of conservation of matter is not always true.
 - (B) the mass of the enclosed mixture remains constant within the experimental error of the measurement.
 - (C) the mass of the enclosed mixture increased
 - (D) the mass of the enclosed mixture does not change.
 - (E) the law of conservation of mass is not always true.
4. Which of the following is a chemical change?
 - (A) melting wax
 - (B) the souring of milk
 - (C) alcohol evaporating
 - (D) condensing water vapor into rainfall
 - (E) pulling a piece of copper into a thin wire
5. A flask has a mass of 59.20 g when empty and 524.68 g when filled with water. When the same flask is filled with concentrated hydrochloric acid, HCl, its mass is 613.12 g. What is the density of concentrated hydrochloric acid? (Assume that water has a density of 1.00 g/cm^3 at the temperature of the measurement.)
 - (A) 1.19 g/cm^3
 - (B) 1.06 g/cm^3
 - (C) 0.76 g/cm^3
 - (D) 1.32 g/cm^3
 - (E) 0.84 g/cm^3

6. A sample of ammonia gas at 53.4 °C and 0.537 atm has a volume of 13.78 L. What is its volume when the temperature is -10.2 °C and its pressure is 0.537 atm?

(R = 0.08206 L·atm/mol·K)

- (A) 2.6 L
- (B) 0.090 L
- (C) 17.1 L
- (D) 11.1 L
- (E) not possible, since the volume would have to be negative

7. Which of the following ions occurs commonly?

- (A) O²⁻
- (B) Cl⁺
- (C) N²⁺
- (D) Ca⁺
- (E) S⁶⁺

8. The chemical equation $4\text{Al (s)} + 3\text{Br}_2\text{ (l)} \rightarrow 2\text{Al}_2\text{Br}_3\text{ (s)}$ informs us that

- (A) less than 2 mole of Al₂Br₃ will form from the combination of 4 moles of Al and 3 moles of Br₂.
- (B) regardless of conditions, 2 mole of Al₂Br₃ is formed by the combination of 4 moles of Al and 3 moles of Br₂.
- (C) the tendency of Al and Br₂ to combine is equal to the tendency of Al₂Br₃ to decompose.
- (D) only under special conditions will 4 mole of Al and 3 moles of Br₂ yield 2 mole of Al₂Br₃.
- (E) Al₂Br₃ is formed, but the relative amounts of Al, Br₂ and Al₂Br₃ involved in the reaction are a function of reaction conditions.

9. Strontium chloride is used as a red coloring in fireworks. Which of the following gives the correct formula and bonding for strontium chloride?

- (A) SrCl, ionic compound
- (B) SrCl, covalent compound
- (C) SrCl₂, covalent compound
- (D) SrCl₂, ionic compound
- (E) Sr₂Cl₂, ionic compound

10. Atoms A, R, X and Z have the following nuclear compositions:



Which two are isotopes?

- (A) A & Z
- (B) A & R
- (C) A & X
- (D) X & Z
- (E) R & Z

11. Which of the following compounds is covalent?

- (A) PF_3
- (B) MgCl_2
- (C) RbBr
- (D) CaO
- (E) K_2S

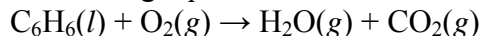
12. A 0.425 mol sample of neon gas is confined to a container at 0.370 atm and 32.1°C. What is the volume of the gas? ($R = 0.08206 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$)

- (A) 3.03 L
- (B) 2.34 L
- (C) 30.3 L
- (D) 28.8 L
- (E) 34.8 L

13. Express 72,041 m using three significant figures.

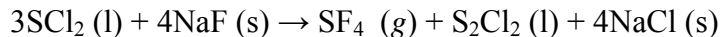
- (A) $7.204 \times 10^4 \text{ m}$
- (B) $7.20 \times 10^4 \text{ m}$
- (C) $7.20 \times 10^4 \text{ m}$
- (D) 72000. m
- (E) $7.2 \times 10^4 \text{ m}$

14. Balance the following equation for the combustion of benzene:



- (A) $\text{C}_6\text{H}_6(l) + 9\text{O}_2(g) \rightarrow 3\text{H}_2\text{O}(g) + 6\text{CO}_2(g)$
- (B) $\text{C}_6\text{H}_6(l) + 9\text{O}_2(g) \rightarrow 6\text{H}_2\text{O}(g) + 6\text{CO}_2(g)$
- (C) $2\text{C}_6\text{H}_6(l) + 9\text{O}_2(g) \rightarrow 6\text{H}_2\text{O}(g) + 12\text{CO}_2(g)$
- (D) $\text{C}_6\text{H}_6(l) + 15\text{O}_2(g) \rightarrow 3\text{H}_2\text{O}(g) + 6\text{CO}_2(g)$
- (E) $2\text{C}_6\text{H}_6(l) + 15\text{O}_2(g) \rightarrow 6\text{H}_2\text{O}(g) + 12\text{CO}_2(g)$

15. How many grams of sodium fluoride are needed to form 485 g of sulfur tetrafluoride?



- (A) 754 g
- (B) 51.3 g
- (C) 1940 g
- (D) 205 g
- (E) 1510 g

16. Chlorine has two stable, naturally occurring isotopes, ^{35}Cl (isotopic mass = 34.968853 amu) and ^{37}Cl (isotopic mass = 36.965903 amu). Chlorine has an atomic mass of 35.453 amu. What is the percent abundance of chlorine-37?

- (A) 24.24%
- (B) 36.97%
- (C) 75.76%
- (D) 95.91%
- (E) 87.62%

17. Select the answer that expresses the result of $(3.8621 \times 1.5630) - 5.98$ with the correct number of significant figures.

- (A) 0.056462
- (B) 0.05646
- (C) 0.0565
- (D) 0.056
- (E) 0.06

18. Sorbitol is a sugar substitute with the molecular formula $\text{C}_6\text{H}_{14}\text{O}_6$. What is the percent of oxygen in sorbitol by mass?

- (A) 42.0 %
- (B) 8.79 %
- (C) 52.7 %
- (D) 3.30 %
- (E) 39.6 %

19. Calculate the molar mass of $(\text{NH}_4)_3\text{AsO}_4$.
- (A) 417.80 g/mol
 - (B) 165.02 g/mol
 - (C) 156.96 g/mol
 - (D) 193.05 g/mol
 - (E) 108.96 g/mol
20. Which of the following properties of nitrogen gas is an extensive property?
- (A) Average speed of molecules in sample
 - (B) The number of molecules present
 - (C) Density
 - (D) Temperature
 - (E) None of the above are extensive properties.
21. A scientist must determine the density of a mineral sample. Her five trials yield densities of 5.10 g/cm^3 , 5.09 g/cm^3 , 5.08 g/cm^3 , 5.10 g/cm^3 , and 5.11 g/cm^3 . Independent studies found the correct density to be 5.16 g/cm^3 . Which of the following statements represents the best analysis of the data?
- (A) The scientist's results have much greater precision than accuracy.
 - (B) The scientist's results have much greater accuracy than precision.
 - (C) The scientist's results have low accuracy and low precision.
 - (D) The scientist's results have high accuracy and high precision.
22. Chemical reactions occur through the tendency of elements with less stable electronic structure to attain a more stable structure by the gain, loss, or sharing of electrons. This statement is
- (A) a false statement of a law, theory, or definition.
 - (B) a scientific experimental fact that is not related to any scientific law.
 - (C) a correct definition of a chemical term or expression, either in terms of experimental behavior or of sound scientific theory.
 - (D) a specific law expressing the directly observable results of many different experiments.
 - (E) a scientific theory, which while it cannot be directly measured or observed, is in accord with and explains the results of experiments.

23. Which of the following elements are the least reactive?

- (A) halogens
- (B) alkaline earth metals
- (C) metalloids
- (D) noble gases
- (E) alkali metals

24. How many grams of NH_3 gas occupy 32.1L at STP?
($R = 0.08206 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$)

- (A) 266 g
- (B) 24.4 g
- (C) 13.0 g
- (D) 58.7 g
- (E) 1.31 g

25. Which assumption of Dalton's atomic theory had to be revised or discarded because of the existence of stable isotopes?

Dalton's Original Atomic Theory

1. The ultimate particles of matter are the atoms of elements, which are indivisible and indestructible.
2. All the atoms of a given element are alike in all respects.
3. The atoms of different elements differ in one or more properties.
4. Compounds are formed by combination of different kinds of atoms.

- (A) 1 (B) 2 (C) 3 (D) 4