

ANSWERS ARE IN RED

1. 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, ionic compound**
- (D) SrCl₂, covalent compound
- (E) Sr₂Cl₂, ionic compound

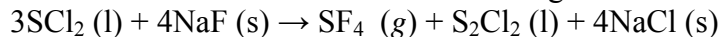
2. Which of the following ions occurs commonly?

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

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

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

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



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

5. Calculate the molar mass of (NH₄)₃AsO₄.

- (A) 417.80 g/mol
- (B) 193.03 g/mol**
- (C) 165.02 g/mol
- (D) 156.96 g/mol
- (E) 108.96 g/mol

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



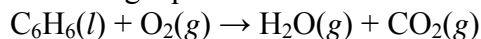
Which two are isotopes?

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

7. 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) 1.06 g/cm^3
- (B) 1.32 g/cm^3
- (C) 0.84 g/cm^3
- (D) 1.19 g/cm^3
- (E) 0.76 g/cm^3

8. 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) $2\text{C}_6\text{H}_6(l) + 15\text{O}_2(g) \rightarrow 6\text{H}_2\text{O}(g) + 12\text{CO}_2(g)$
- (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) $2\text{C}_6\text{H}_6(l) + 9\text{O}_2(g) \rightarrow 6\text{H}_2\text{O}(g) + 12\text{CO}_2(g)$

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

- (A) Al_2Br_3 is formed, but the relative amounts of Al, Br_2 and Al_2Br_3 involved in the reaction are a function of reaction conditions.
- (B) only under special conditions will 4 mole of Al and 3 moles of Br_2 yield 2 mole of Al_2Br_3 .
- (C) the tendency of Al and Br_2 to combine is equal to the tendency of Al_2Br_3 to decompose.
- (D) regardless of conditions, 2 mole of Al_2Br_3 is formed by the combination of 4 moles of Al and 3 moles of Br_2 .
- (E) less than 2 mole of Al_2Br_3 will form from the combination of 4 moles of Al and 3 moles of Br_2 .

10. Sorbitol is a sugar substitute with the molecular formula $C_6H_{14}O_6$. What is the percent of oxygen in sorbitol by mass?

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

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

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

12. 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) 75.76%
- (B) 36.97%
- (C) 95.91%
- (D) 24.24%
- (E) 87.62%

13. 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 mass is not always true.
- (B) the mass of the enclosed mixture does not change.
- (C) the mass of the enclosed mixture remains constant within the experimental error of the measurement.
- (D) the mass of the enclosed mixture increased.
- (E) the law of conservation of matter is not always true.

14. 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) 28.8 L
- (B) 3.03 L
- (C) 34.8 L
- (D) 30.3 L
- (E) 2.34 L

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

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

16. A scientist must determine the density of a mineral sample. Her five trials yield densities of $5.10 \text{ g}/\text{cm}^3$, $5.09 \text{ g}/\text{cm}^3$, $5.08 \text{ g}/\text{cm}^3$, $5.10 \text{ g}/\text{cm}^3$, and $5.11 \text{ g}/\text{cm}^3$. Independent studies found the correct density to be $5.16 \text{ g}/\text{cm}^3$. Which of the following statements represents the best analysis of the data?

- (A) The scientist's results have much greater accuracy than precision.
- (B) The scientist's results have much greater precision than accuracy.
- (C) The scientist's results have high accuracy and high precision.
- (D) The scientist's results have low accuracy and low precision.

17. Select the best statement.

- (A) Physical changes may be reversed by changing the temperature.
- (B) Physical changes alter the composition of the substances involved.
- (C) Physical properties are mostly extensive in nature.
- (D) Physical changes are not valid characteristics for identifying a substance.
- (E) Physical properties are usually accompanied by chemical changes.

18. 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) 1.31 g
- (B) 13.0 g
- (C) 266 g
- (D) 58.7 g
- (E) 24.4 g

19. Which of the following compounds is covalent?

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

20. Which of the following properties of nitrogen gas is an extensive property?

- (A) Density
- (B) Temperature
- (C) Average speed of molecules in sample
- (D) The number of molecules present
- (E) None of the above are extensive properties.

21. 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

22. 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) 0.090 L
- (B) 2.6 L
- (C) 11.1 L
- (D) 17.1 L
- (E) not possible, since the volume would have to be negative

23. 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 scientific theory, which while it cannot be directly measured or observed, is in accord with and explains the results of experiments.
- (B) a scientific law expressing the directly observable results of many different experiments.
- (C) a correct definition of a chemical term or expression, either in terms of experimental behavior or of sound scientific theory.
- (D) a specific experimental fact that is not related to any scientific law.
- (E) a false statement of a law, theory, or definition.

24. 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, 124
- (C) 82, 206, 124
- (D) 82, 124, 206
- (E) 206, 82, 288

25. Which of the following is a chemical change?

- (A) melting wax
- (B) condensing water vapor into rainfall
- (C) alcohol evaporating
- (D) pulling a piece of copper into a thin wire
- (E) the souring of milk