

Directions: Choose the letter that corresponds to the correct answer.

1. In which of the following reactions is water considered to be acting as an acid?

- A. $\text{Zn (s)} + 2\text{H}_3\text{O}^+ \rightarrow \text{Zn}^{2+} + \text{H}_2 \text{ (g)} + \text{H}_2\text{O}$
- B. $\text{HCl (g)} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$
- C. $\text{HC}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{C}_2\text{H}_3\text{O}_2^-$
- D. $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$
- E. $\text{NH}_3 + \text{H}_3\text{O}^+ \rightarrow \text{NH}_4^+ + \text{H}_2\text{O}$

2. A 2135 cm³ sample of dry air has a pressure of 98.4 kPa at 127 degrees Celsius. What is the volume of the sample if the temperature is increased to 206 degrees Celsius when the pressure is kept constant?

- A. 1320 cm³
- B. 1780 cm³
- C. 2560 cm³
- D. 3460 cm³

3. Which of these represents a release of energy?

- A. $\text{H}_2\text{O(l)} \rightarrow \text{H}_2\text{O(g)}$
- B. $\text{H}_2\text{O(s)} \rightarrow \text{H}_2\text{O(l)}$
- C. $\text{H}_2\text{O(g)} \rightarrow \text{H}_2\text{O(l)}$
- D. $\text{H}_2\text{O(s)} \rightarrow \text{H}_2\text{O(g)}$

4. During the production of aspirin, 2.6 g of aspirin can be formed from 2.0 g of salicylic acid. What is the percent yield if only 1.7 g of aspirin is produced?

- A. 35%
- B. 65%
- C. 77%
- D. 85%

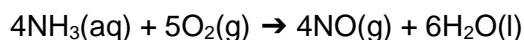
5. Analysis by mass of a certain compound shows that it contains 14 percent hydrogen and 86 percent carbon. Which of the following is the most informative statement that can properly be made about the compound based on these data?

- A. It is a hydrocarbon.
- B. Its empirical formula is CH_2
- C. Its molecular formula is C_2H_4
- D. Its molar mass is 28 g/mol
- E. It contains a triple bond

6. Which characteristic is more similar in liquids and solids as compared to gases?

- A. the masses of particles.
- B. the distance between particles.
- C. the degree to which particles are organized.
- J. the strength of chemical bonds within particles.

7. The reaction shown below represents the oxidation of ammonia (NH_3).



How many grams of water (H_2O) will be formed when 34 grams of ammonia reacts with an excess of oxygen (O_2)?

- A. 51 grams

- B. 54 grams
- C. 64 grams
- D. 110 grams

8. Which of these describes how gallium forms a 3+ ion?

- A. The gallium loses 3 electrons.
- B. The gallium loses 3 protons.
- C. The gallium gains 3 electrons.
- D. The gallium gains 3 protons.

9. In which two compounds does nitrogen have the same oxidation number?

- A. N_2O_3 and HNO_3
- B. N_2O_5 and HNO_3
- C. NO_2 and N_2O_3
- D. N_2O_4 and HNO_2
- E. HNO_2 and NH_3

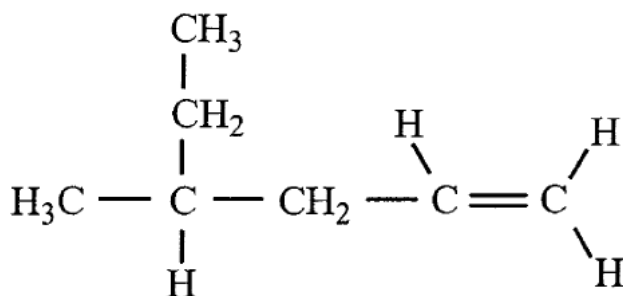
10. A student fills a flask with 5.0 moles of nitrogen gas and then seals the flask. Which change will happen when the student warms the flask?

- A. The temperature of the nitrogen gas will decrease.
- B. The pressure inside the flask will increase.
- C. The volume inside the flask will decrease.
- D. The molar mass of the nitrogen gas will increase.

11. How many atoms are in 3.50 moles of calcium (Ca)?

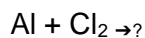
- A. 4.00×10^1
- B. 1.40×10^2
- C. 6.02×10^{23}
- D. 2.10×10^{24}

12. Which of the following is the IUPAC name for this compound?



- A. 4-methyl-1-hexene
- B. 4-ethyl-1-pentene
- C. 2-ethyl-4-pentene
- D. sec-butyl propylene
- E. 3-methyl-5-hexene

13. The equation below represents an incomplete chemical reaction.



What is the product of the chemical reaction?

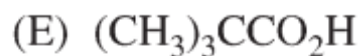
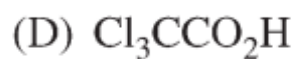
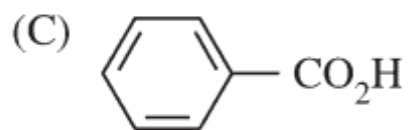
- A. Al_2Cl_3

- B. AlCl
- C. AlCl_2
- D. AlCl_3

14. Which information about a solution is required to calculate its molarity?

- A. number of moles of solute and atomic mass of solute
- B. number of moles of solvent and atomic mass of solute
- C. number of particles of solvent and the volume of solvent
- D. number of moles of solute and number of liters of solution.

15. Of the following carboxylic acids, which is the most acidic?



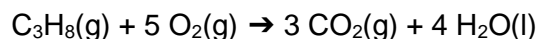
16. Which one of the following processes is accompanied by a decrease in entropy?

- A. Sublimation of carbon dioxide.
- B. Evaporation of water.
- C. Freezing of water.
- D. Shuffling a deck of cards.
- E. Heating a balloon filled with a gas.

17. Which of the following is the pH of a solution obtained by mixing 50.0 mL of 0.100 *M* HA and 50.0 mL of 0.100 *M* NaOH?

- I. Neutral if HA is a strong acid
 - II. Basic if HA is a weak acid
 - III. Neutral if HA is a weak acid
- A. I only
 - B. II only
 - C. III only
 - D. I and II
 - E. I and III

18. The combustion of propane, C₃H₈(g), proceeds according to the equation below:



How many grams of water will be formed in the complete combustion of 44.0 grams of propane?

- A. 4.50 g
- B. 18.0 g
- C. 44.0 g
- D. 72.0 g
- E. 176 g

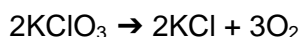
19. Which of the following is NOT accompanied by an increase in the entropy of the system?

- A. Discharging a battery
- B. Boiling water at atmospheric pressure
- C. Very slow mixing of hot and cold water in a well-insulated container
- D. Very slow expansion of a gas into an evacuated flask
- E. Rapid expansion of a gas and recompression to its original temperature, pressure, and volume

20. A student sets up an experiment to investigate the effect of temperature on the volume of 50 grams of gas inside a balloon. Which statement correctly describes the design of the experiment?

- A. The temperature is an experimental control, and the volume is the independent variable.
- B. The volume is an experimental control, and the temperature is the dependent variable.
- C. The mass of the gas is an experimental control, and the temperature is the independent variable.
- D. The temperature is an experimental control, and the mass of the gas is the dependent variable.

21. The equation below represents the breakdown of potassium chlorate (KClO_3).

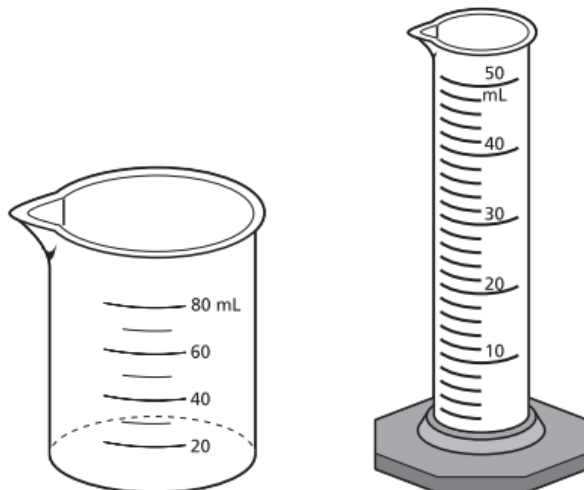


What volume of oxygen gas (O_2) does 20.0 grams of potassium chlorate (KClO_3) produce at STP based on the equation shown?

- A. 5.48 liters
- B. 7.80 liters
- C. 67.3 liters
- D. 72.9 liters

22. Two measuring tools are shown.

Measuring Tools



What is the most appropriate tool for measuring 30.0 mL of a sodium chloride solution?

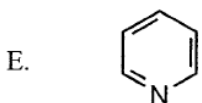
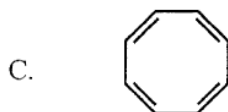
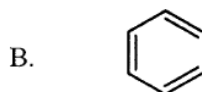
- A. the beaker because it is more stable, and the liquid is less likely to spill.
- B. the beaker because it is calibrated to hold large amounts of liquid
- C. the graduated cylinder because it is calibrated to measure the liquid more precisely.
- D. the graduated cylinder because it will be nearly filled with liquid.

23. Which of the following compounds produces H_2 gas when added to water?

- A. LiH
- B. CH_4
- C. NH_3
- D. PH_3

E. H₂S

24. Which of the following is aromatic?



25. An engine cylinder contains 250 mL of gas at a pressure of 1.0 atm. As the engine runs, it compresses the cylinder, reducing the volume of the gas to 25 mL. What is the new pressure of the gas at this volume?

- A. 0.10 atm
- B. 10.0 atm
- C. 25 atm
- D. 250 atm