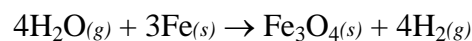


1. A single molecule of a certain compound weighs 3.4×10^{-22} g. Which figure comes nearest to the mass of a mole as ordinarily expressed? Given: $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$

- (A) $25 \text{ g} \cdot \text{mol}^{-1}$ (D) $50 \cdot \text{mol}^{-1}$
(B) $200 \text{ g} \cdot \text{mol}^{-1}$
(C) $100 \text{ g} \cdot \text{mol}^{-1}$

2. How many moles of Fe are needed to produce 10.0 mol of H_2 ?



- (A) 30.0 mol (C) 15.0 mol
(B) 13.3 mol (D) 7.50 mol

3. What is the name of $\text{Fe}(\text{NO}_3)_2$?

- (A) Iron nitrate (C) Iron dinitrate
(B) Iron (II) nitrate (D) Iron dinitrogen hexoxide

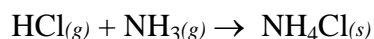
4. A stock solution of 12 M H_2SO_4 is available in the laboratory. The preparation of 200 mL of 0.20 M H_2SO_4 (dilute) solution may be accomplished by

- (A) diluting 3.3 mL of H_2SO_4 (stock) with water to 200 mL total volume.
(B) a six-to-one dilution of stock H_2SO_4 and using 200 mL of this solution.
(C) mixing 3.3 mL of H_2SO_4 with 200 mL of water.
(D) mixing 1 mL of H_2SO_4 (stock) with 600 mL of water and using 200 mL of this solution.

5. A one-liter container is filled with one mole of hydrogen at 25 °C. A second one liter container is filled with one mole of oxygen at 25 °C. Comparing the pressure of the hydrogen to the oxygen, the ratio will be

- (A) 1:16 (B) 2:1 (C) 1:1
(D) 1:8

7. If 7.30 g of HCl and 4.00 g of NH₃ are mixed, how many grams of NH₄Cl can be formed?



Molar Masses	
HCl	36.5 g·mol ⁻¹
NH ₃	17.0 g·mol ⁻¹
NH ₄ Cl	53.5 g·mol ⁻¹

- (A) 13.3 (B) 11.3 (C) 12.6
(D) 10.7

8. Which pair represents isotopes?

- (A) $^{54}_{24}\text{Cr}$ and $^{54}_{26}\text{Fe}$
(B) $^{235}_{92}\text{U}$ and $^{238}_{92}\text{U}$
(C) $^{116}_{48}\text{Cd}$ and $^{116}_{50}\text{Sn}$
(D) $^{239}_{93}\text{Np}$ and $^{239}_{94}\text{Pu}$

9. What is the groundstate electron configuration for S?

- A. $1s^2 2s^2 2p^4$
B. $1s^2 2s^2 2p^6 3s^4$
C. $[\text{Ne}]3s^2 3p^4$
D. $[\text{Ar}]3s^2 3p^4$

10. Given the table below for the isotopes of a certain element, what would you expect the mass of the element to be?

Mass number	Number of atoms
63	69.09
64	0
65	30.91

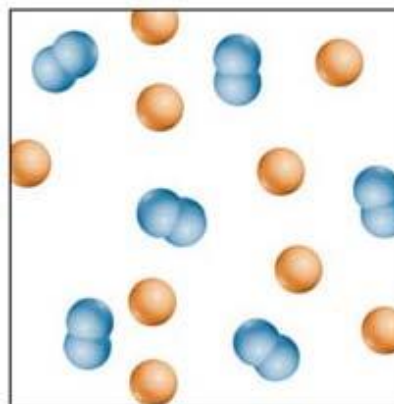
- A. 63.00 amu
- B. 64.00 amu
- C. 65.00 amu
- D. 63.62 amu

11 Given what you know about the periodic table and common ions, what compound is most likely for an ionic compound formed by Al and O?

- A. Al_2O_3
- B. AlO
- C. AlO_2
- D. Al_2O

12. What does the model at right most likely represent?

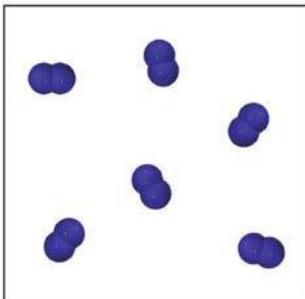
- A. Pure compound.
- B. Pure element.
- C. Homogeneous mixture.
- D. Heterogeneous mixture.



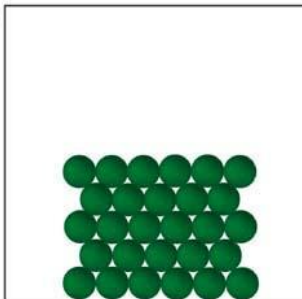
13. Of the pictures below, which represents a diatomic gas (such as H_2)?

- A. i
- B. ii
- C. iii
- D. iv

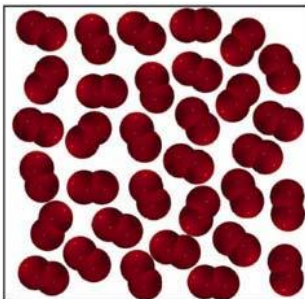
(i)



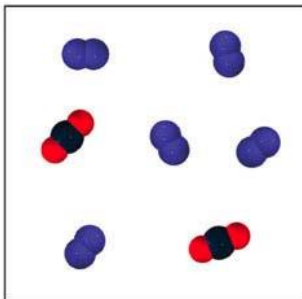
(ii)



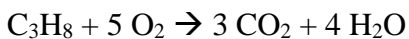
(iii)



(iv)



14. Given the reaction shown, what is the reducing agent?



- A. C_3H_8
- B. O_2
- C. CO_2
- D. H_2O

15. Which is true?

- A. Air is a pure compound.
- B. Tin is a homogeneous mixture.
- C. Water is an element.
- D. Concrete is a heterogeneous mixture.

16. A mixture of N_2 and H_2O has a total pressure of 1.2 atm at 298 K in a 19.5 L container. If the mass of H_2O is 1.7 grams, what is the mass of the N_2 ?

- A. 0.094 g
- B. 0.86 g
- C. 24 g
- D. 12 g

17. Why does methane, CH_4 , behave more like an ideal gas than ammonia, NH_3 ?

- A. NH_3 can form hydrogen bonds and CH_4 cannot.
- B. CH_4 has only weak dipole-dipole interactions.
- C. CH_4 is much smaller than NH_3 .
- D. CH_4 is moving much faster than NH_3 .

18. When a party balloon is brought outside in the winter time, it shrinks. Why does this happen?

- A. The gas molecules hit the inside of the balloon less often and with less force.
- B. The gas molecules combine into fewer, larger molecules.
- C. The gas molecules escape to mix with the colder air.
- D. The pressure on the outside of the balloon increases due to the cold air.

19. Which of the following is *not* assumed by kinetic molecular theory?

- A. Gases are infinitely small compared to the size of their container.
- B. Gases have purely elastic collisions with the sides of their container.
- C. Gases are not attracted to each other.
- D. Gases move more quickly than liquids or solids at the same temperature.

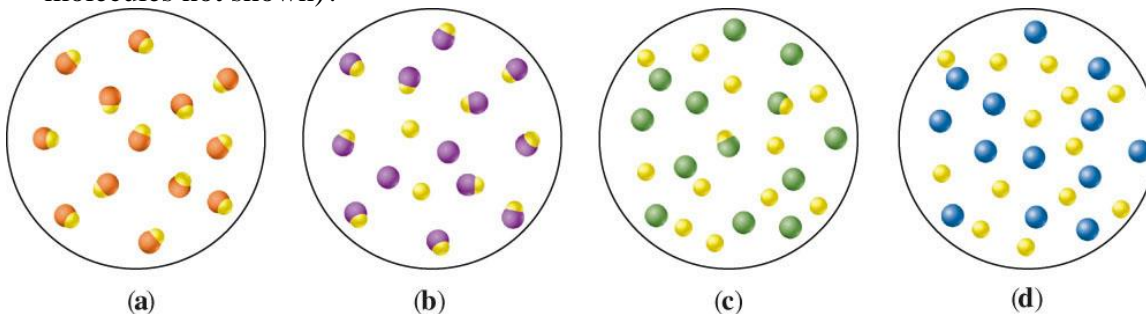
20. Which gas will deviate the most from ideal behavior?

- A. H_2
- B. N_2
- C. O_2
- D. Cl_2

21. The kinetic energies of two different gases are different when

- A. they have different molar masses.
- B. they are at different temperatures.
- C. they are at different pressures.
- D. they are at different densities.

22. Which of the following models best represents KBr in aqueous solution (water molecules not shown)?



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

23. A 45.5 gram sample of a mineral is placed in boiling water until its temperature is 100.0 °C. It is then placed in 255 grams of H₂O with a temperature of 22.5 °C. The final temperature of the system settles at 32.4°C. What is the specific heat of the mineral? Given: the specific heat of H₂O is 4.18 J/(g °C).

A. 3.43 J/(g °C)
 B. 9.90 J/(g °C)
 C. 67.6 J/(g °C)
 D. 0.82 J/(g °C)

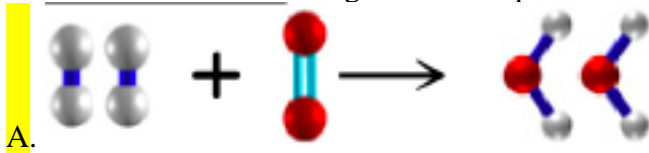
24. Which is the most soluble in water?

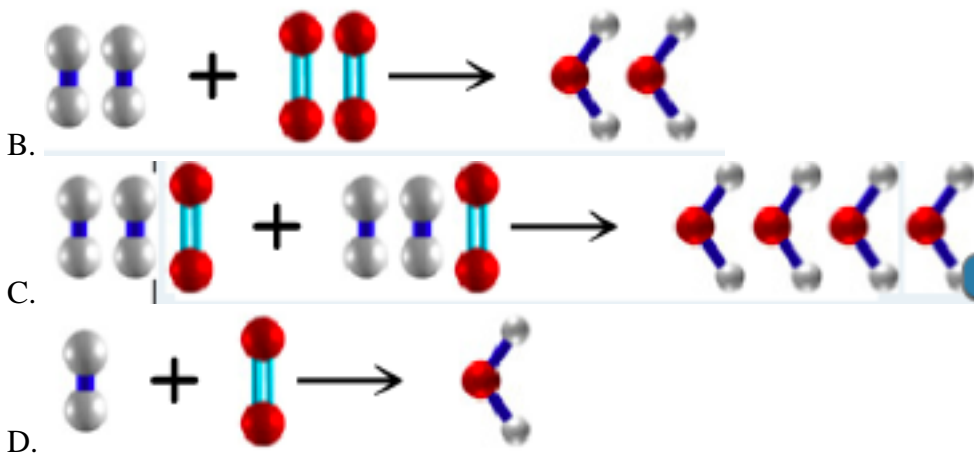
A. AgCl
B. NaNO₃
 C. BaSO₄
 D. Fe(OH)₃

25. Given the reaction: $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$. After some time the reaction stops and the number of moles of each molecule present are 0.5 moles C₂H₅OH, 0.0 moles of O₂, 1.6 moles of CO₂, and 2.4 moles of H₂O. Which molecule was the limiting reactant?

A. C₂H₅OH
B. O₂
 C. CO₂
 D. H₂O

26. Water is formed by the combustion of hydrogen gas in the presence of oxygen gas. Which of the below diagrams best represents this as a balanced reaction?





27. A fuel molecule made up of only hydrogen and carbon atoms is burned in oxygen. The products are H₂O and CO₂, with 3 water molecules produced for every 2 carbon dioxide molecules. What is the *empirical formula* of the original fuel?

- A. CH₃
- B. C₂H₆
- C. C₂H₃
- D. C₂H₆O₇

28. How many moles of CO₂ will be produced from the combustion of 2.6 moles of C₂H₅OH? Given the reaction: C₂H₅OH(l) + 3O₂(g) → 2CO₂(g) + 3H₂O(g).

- A. 5.2 moles
- B. 1.3 moles
- C. 2.6 moles
- D. 3.9 moles

29. Given the reaction 2PF₃ + 3Br₂ → 2PBr₃ + 3F₂. If 16 moles of PF₃ is combined with 21 moles of Br₂ and the reaction goes to completion, which of the following final molar amounts is *incorrect*?

- A. 2 moles PF₃
- B. 0 moles Br₂
- C. 16 moles PBr₃
- D. 21 moles F₂

30. What quantity of Cl₂ combines with 3.6 moles O₂ to form ClO₄?

- A. 3.6 moles
- B. 0.9 moles
- C. 14.4 moles
- D. 1.8 moles

31. Given the reaction 4NH₃ + 5O₂ → 4NO + 6H₂O. Which reactant will be in excess and how many moles will remain if 1.6 moles of NH₃ react with 2.2 moles of O₂?

- A. O₂, 0.2 moles
- B. O₂, 0.6 moles
- C. NH₃, 1.0 moles
- D. NH₃, 0.6 moles

32. For the reaction $T + 3U + 4V \rightarrow TUV_2 + 2UV$, what is the limiting reactant if 2 moles of T, 4 moles of U, and 6 moles of V are reacted together?
- A. T
 - B. U**
 - C. V
 - D. More than one reactant are equally limiting.
33. Consider the following species: F^- , O^{2-} , Ne, Na^+
Which statement is correct?
- A. All of the species have the same number of electrons, and therefore must have the same electronegativity.
 - B. The negative ions would be more susceptible to addition of another electron because they have fewer protons.
 - C. The positive ion is smallest because it has the most protons.**
 - D. All of the species have the same number of electrons, and therefore they are all approximately the same size.
34. Suppose 1 mole of HNO_3 is dissolved in beaker A and 1 mole of $NaCl$ is dissolved in beaker B. Which statement is true?
- A. Both beakers will contain approximately the same number of ions.**
 - B. Beaker A will contain more positive ions because HNO_3 is a strong acid.
 - C. Beaker B will contain more ions because Na^+ is soluble without exceptions.
 - D. The number of ions in each beaker cannot be determined without knowing the total volume of the solution in each case.
35. Why is the bond angle in NF_3 smaller than the bond angle in CF_4 ?
- A. N has more isotopes than C.
 - B. N has a lone pair on it and C does not.**
 - C. Because N has fewer Fs attached to it.
 - D. N has more protons than C.
36. Which of the below combinations will form the most polar bond?
- A. H-F**
 - B. Cl-Br
 - C. F-I
 - D. H-H
37. Draw a Lewis Dot structure for BF_3 . What bond angles are present?
- A. 90° only
 - B. 109.5° only
 - C. 120° only**
 - D. 90° and 180°
49. Why does NH_3 have a higher boiling point than N_2 ?
- A. NH_3 has larger dispersion forces.
 - B. N_2 cannot hydrogen bond to itself.**
 - C. NH_3 is non-polar.
 - D. N_2 has a larger molar mass.

38. Of the below comparisons of atomic/ionic radii, which statement is false?
- A. $F < Cl$
 - B. $Cl < Cl^-$
 - C. $Na < Mg$
 - D. $Na^+ < Na$
39. Draw a Lewis Dot structure for O_3 . How many lone pairs of electrons are present?
- A. 2
 - B. 4
 - C. 6
 - D. It depends on which resonance form is drawn.
40. Which molecule would be expected to have the highest melting point?
- A. H_2O
 - B. CO_2
 - C. Br_2
 - D. $NaCl$
41. A new nail is left in water until it becomes rusty. Which is true?
- A. The rusty nail will have the same mass as the new nail because the iron is changing form but not being consumed.
 - B. The rusty nail will have less mass than the new nail because some of the nail has wasted away.
 - C. The rusty nail will have more mass than the new nail because mass has been added in the rusting process.
 - D. The rusty nail will have the same mass as the new nail because of the law of conservation of mass.
42. A tin can is found to be only 78.5% tin by mass. How many moles of tin are in a 3.05-gram sample taken from the can? Given: tin = Sn
- A. 0.0202 mol
 - B. 0.0257 mol
 - C. 2.39 mol
 - D. 0.661 mol
43. A 75.0 gram sample of 22.2 °C water is added to a sample of boiling (100.0 °C) water with unknown mass. The final temperature is 50.0 °C. Which statement is true?
- A. The hot water must have had less mass than the cooler water.
 - B. The hot water must have had the same mass as the cooler water.
 - C. The hot water must have had more mass than the cooler water.
 - D. Impossible to choose between A, B, and C without more information.
44. A sample of pond water is suspected to be contaminated with Hg_2^{2+} ions and/or Pb^{2+} ions. Testing the water with NaCl yields a precipitate. Testing the water with Na_2SO_4 yields no precipitate. Which statement is true?
- A. Neither ion is present.
 - B. Hg_2^{2+} is present, but Pb^{2+} is not.

- C. Pb^{2+} is present, but Hg_2^{2+} is not.
- D. Both ions are present.

45. Which statement below is true?

- A. Melting and dissolving are different words for the same phenomenon.
- B. When a substance melts, ions always form.
- C. When a substance dissolves, ions always form.
- D. A solvent is not necessary for melting.

46. Draw a Lewis Dot structure for NF_3 . Which statement is true?

- A. The F-N-F angles will be greater than 109.5° because of the presence of a lone pair.
- B. The F-N-F angles will be 109.5° exactly because of the tetrahedral structure.
- C. The F-N-F angles will be less than 109.5° because of the presence of a lone pair.
- D. The F-N-F angles will be approximately 120° because of the three atomic groups on the N.