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: $N_A = 6.02 \times 10^{23} mol^{-1}$

(A) 25 $g \cdot mol^{-1}$ (D) 50 $\cdot mol^{-1}$

(B) 200 $g \cdot mol^{-1}$

(C) 100 $g \cdot mol^{-1}$

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

$$4H_2O_{(g)} + 3Fe_{(s)} \rightarrow Fe_3O_{4(s)} + 4H_{2(g)}$$

(A) 30.0 mol (C) 15.0 mol

(B) 13.3 mol (D) 7.50 mol

3. What is the name of $Fe(NO_3)_2$?

(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 NH_3 are mixed, how many grams of NH_4Cl can be formed?

$$HCl_{(g)} + NH_{3(g)} \rightarrow NH_4Cl_{(s)}$$

Molar Masses	
HCl	36.5 g·mol^{-1}
NH_3	17.0 g·mol^{-1}
NH_4Cl	53.5 g·mol^{-1}

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

8. Which pair represents isotopes?

(A) $^{54}_{24}Cr$ and $^{54}_{26}Fe$

(B) $^{235}_{92}U$ and $^{238}_{92}U$

(C) $^{116}_{48}Cd$ and $^{116}_{50}Sn$

(D) $^{239}_{93}Np$ and $^{239}_{94}Pu$

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. $[Ne]3s^2 3p^4$
D. $[Ar]3s^2 3p^4$

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

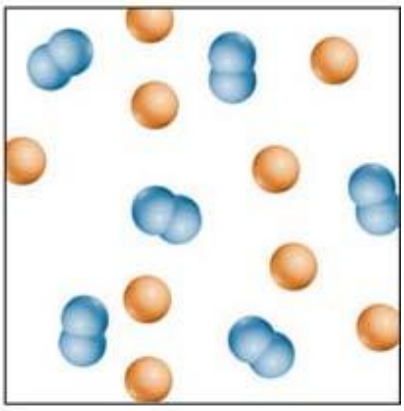
Mass number	Number of atoms
63	69.09
64	0
65	30.91

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

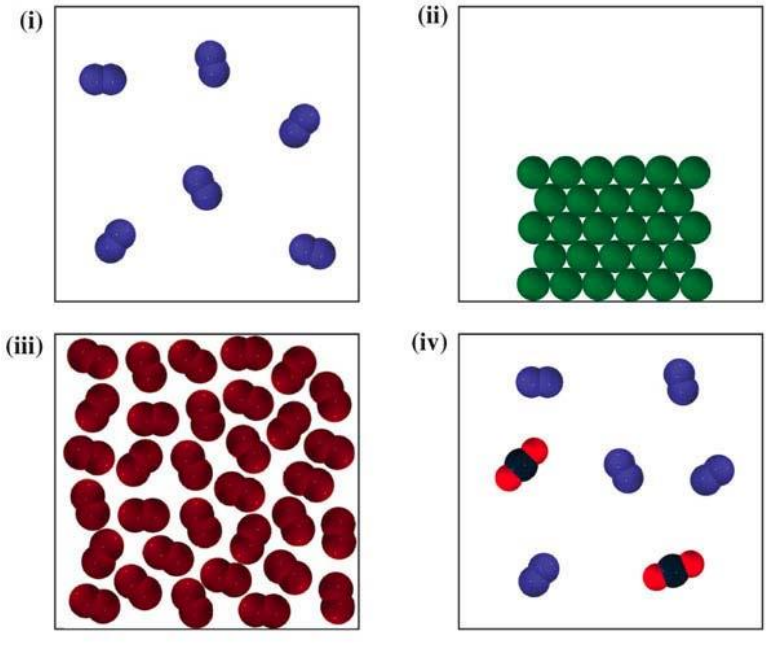
12. What does the model at right most likely represent?



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



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

$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

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.

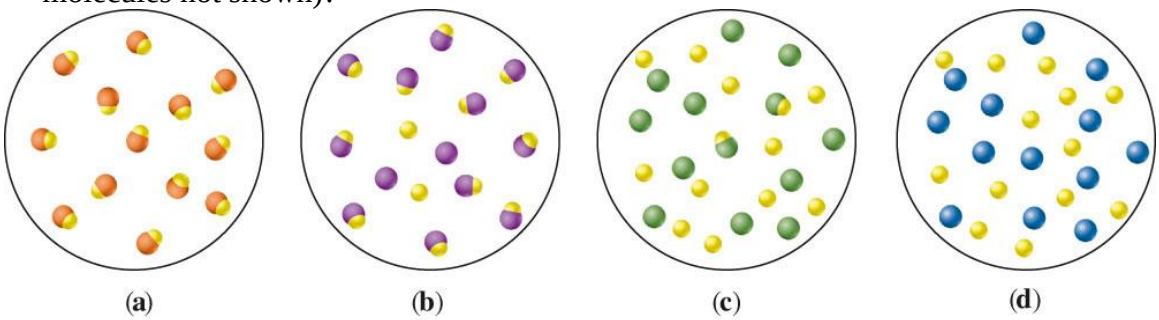
18. When a party balloon is brought outside in the winter time, it shrinks. Why does this happen?
A. The gas molecules hit the inside of the balloon less often and with less force.
B. The gas molecules combine into fewer, larger molecules.
C. The gas molecules escape to mix with the colder air.
D. The 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 densitites.

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 H_2O 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 H_2O 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)

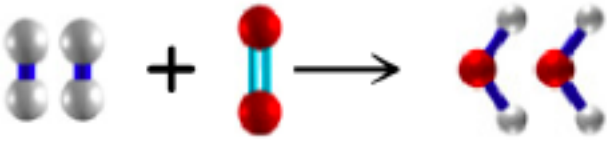
24. Which is the most soluble in water?

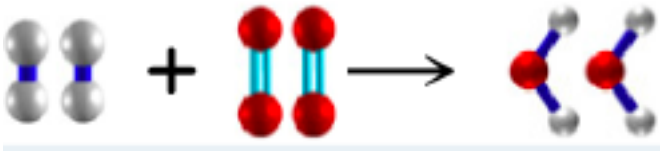
A. AgCl
B. $NaNO_3$
C. $BaSO_4$
D. $Fe(OH)_3$

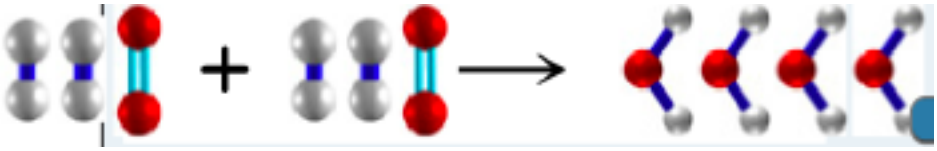
25. Given the reaction: $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$. After some time the reaction stops and the number of moles of each molecule present are 0.5 moles C_2H_5OH, 0.0 moles of O_2, 1.6 moles of CO_2, and 2.4 moles of H_2O. Which molecule was the limiting reactant?

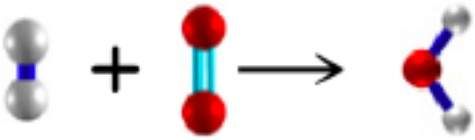
A. C_2H_5OH
B. O_2
C. CO_2
D. H_2O

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?

A. 

B. 

C. 

D. 

27. A fuel molecule made up of only hydrogen and carbon atoms is burned in oxygen. The products are H_2O and CO_2, with 3 water molecules produced for every 2 carbon dioxide molecules. What is the *empirical formula* of the original fuel?

A. CH_3
B. C_2H_6
C. C_2H_3
D. $C_2H_6O_7$

28. How many moles of CO_2 will be produced from the combustion of 2.6 moles of C_2H_5OH? Given the reaction: $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$.

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

29. Given the reaction $2PF_3 + 3Br_2 \rightarrow 2PBr_3 + 3F_2$. If 16 moles of PF_3 is combined with 21 moles of Br_2 and the reaction goes to completion, which of the following final molar amounts is *incorrect*?

A. 2 moles PF_3
B. 0 moles Br_2
C. 16 moles PBr_3
D. 21 moles F_2

30. What quantity of Cl_2 combines with 3.6 moles O_2 to form ClO_4?

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

31. Given the reaction $4NH_3 + 5O_2 \rightarrow 4NO + 6\ H_2O$. Which reactant will be in excess and how many moles will remain if 1.6 moles of NH_3 react with 2.2 moles of O_2?

A. O_2, 0.2 moles
B. O_2 0.6 moles
C. NH_3, 1.0 moles
D. NH_3, 0.6 moles

32. For the reaction T + 3U + 4V → 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.