

# Chemistry 100

## Final 1997

3. Avogadro's Law states: equal volumes of all gases, at the same temperature and pressure, contain \_\_\_\_\_.

GAS

- a) the same mass in grams
- b) the same number of moles
- c) a number of moles proportional to the molar mass of the gas.
- d) all of the above
- e) none of the above

$$PV = nRT$$

constant

$$\frac{PV}{T} = n$$

# of moles

THEY ALSO  
CONTAIN SAME # OF MOLECULES

8. Coca-Cola® is carbonated by injecting the liquid with carbon dioxide gas. Under what conditions is the solubility of carbon dioxide gas the greatest?

SOLUTIONS

- a) low temperature, low pressure
- b) low temperature, high pressure
- c) low temperature, pressure is not a factor
- d) high pressure, temperature is not a factor
- e) high temperature, high pressure

HENRY'S LAW  
GAS DISSOLVE BETTER

- UNDER PRESSURE
- ↓ TEMPERATURE

9. Which of the following increases the rate of dissolving for a solid solute in a solvent?

- a) grinding the solute ✓
- b) heating the solution ✓
- c) stirring the solution ✓
- d) all of the above
- e) none of the above

SOLUTIONS

10. A saturated solution is a solution where more solute will \_\_\_\_\_ in a given amount of solvent at a given temperature.

- a) rapidly dissolve
- b) slowly dissolve
- c) not dissolve
- d) none of the above

MAXIMUM DISSOLVED

SOLUTIONS

11. What is the mass of a 10.0% sodium hydroxide solution that contains 2.50 g of dissolved solute? (molar mass NaOH = 40.0 g/mole)

- a) 0.250 g
- b) 0.278 g
- c) 22.5 g
- d) 25.0 g
- e) 250. g

$$10.0\% = \frac{10.0 \text{ g NaOH}}{100 \text{ g sol'n}} = \frac{2.50 \text{ g}}{X}$$

SOLUTIONS

$$X = 25 \text{ g sol'n}$$

SOLUTIONS

12. What is the mass of water need to prepare 5.00 kg of a 40.0% antifreeze solution?

- a) 2.00 kg
- b) 3.00 kg
- c) 3.33 kg
- d) 12.5 kg
- e) 200 kg

$$40.0\% = \frac{40.0 \text{ g antifreeze}}{100.0 \text{ g sol'n}} \therefore \frac{60.0 \text{ g H}_2\text{O}}{100.0 \text{ g sol'n}}$$

$$\frac{5.00 \text{ kg sol'n} \mid 1000 \text{ g} \mid 60.0 \text{ g H}_2\text{O}}{1 \text{ kg} \mid 100.0 \text{ g sol'n}} = 3000 \text{ g} = 3.00 \text{ kg}$$

13. What volume of 6.00 M sulfuric acid contains 0.100 mol of H<sub>2</sub>SO<sub>4</sub> (98.03 g/mol)?

- a) 0.600 mL
- b) 16.7 mL
- c) 60.6 mL
- d) 167 mL
- e) 1670 mL

SOLUTIONS

$$\frac{100 \text{ mL H}_2\text{SO}_4 \mid 1 \text{ L} \mid 1000 \text{ mL}}{6.00 \text{ mol H}_2\text{SO}_4 \mid 1 \text{ L}} = 16.6667 \text{ mL}$$

14. What is the mass of barium hydroxide dissolved in 250. mL of 0.200M Ba(OH)<sub>2</sub> solution? (molar mass Ba(OH)<sub>2</sub> = 171.35 g/mole)

- a) 0.05 mole
- b) 8.57 g
- c) 17.1 g
- d) 171 g
- e) 8570 g

SOLUTIONS

$$\frac{250. \text{ mL} \mid 1 \text{ L} \mid 0.200 \text{ mol Ba(OH)}_2 \mid 171.35 \text{ g}}{1000 \text{ mL} \mid 1 \text{ L} \mid 1 \text{ mol Ba(OH)}_2}$$

$$= 8.5675 \text{ g Ba(OH)}_2$$

15. To what volume must you dilute 80.0 mL of 3.0 M CuSO<sub>4</sub> to have a 0.50 M solution?  
(molar mass CuSO<sub>4</sub> = 159.56)

- a) 190 mL
- b) 480 mL
- c) 1.3 L
- d) 190 L
- e) 480 L

$$M_1 V_1 = M_2 V_2$$

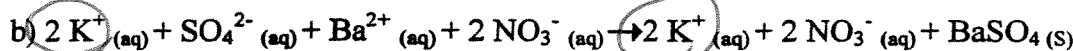
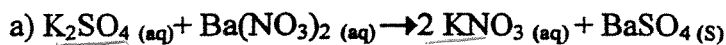
$$V_2 = \frac{M_1 V_1}{M_2}$$

SOLUTIONS

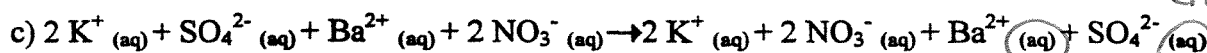
$$\frac{3.0 M}{0.50 M} \cdot 80.0 mL = 480 mL$$

16. Which of the following is the best net ionic equation? (Assume that BaSO<sub>4</sub> forms an insoluble precipitate)

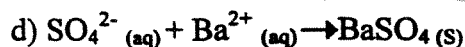
REACTIONS



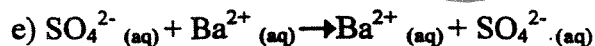
THESE CANCEL



INSOLUBLE = SOLID



NET IONIC DISSOCIATES AQUEOUS IONIC COMPOUNDS.



17. Using the solubility table given with this exam, determine which compound is insoluble in water.

REACTIONS/



- ALL ALKALI METAL IONS ARE SOLUBLE

- ALL NITRATES ARE SOLUBLE.

- MOST CHLORIDES ARE SOLUBLE

SOLUTIONS

19. The polarity of a molecule depends on what factor(s)?

- a) polarity of the bonds in the molecule
- b) shape of the molecule
- c) size of the molecule
- d) both a and b**
- e) a, b, and c

VSEPR

20. Which of the following illustrates the bond polarity of one <sup>O-H</sup>~~OH~~ bond in a water molecule?

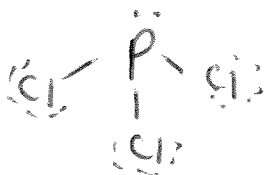
- a) ( $\delta^-$ ) O-H ( $\delta^+$ )**
- b) ( $\delta^-$ ) O-H ( $\delta^-$ )
- c) ( $\delta^+$ ) O-H ( $\delta^+$ )
- d) ( $\delta^+$ ) O-H ( $\delta^-$ )
- e) ( $\delta$ ) O-H ( $\delta$ )

VSEPR

OXYGEN IS MORE ELECTRONEGATIVE

21. Is  $\text{PCl}_3$  polar?

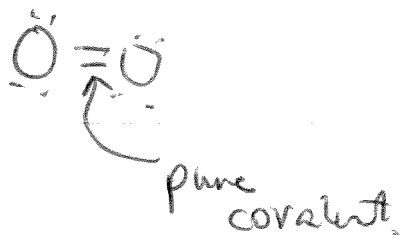
- a) yes**
- b) no



VSEPR

22. Is  $\text{O}_2$  polar?

- a) yes
- b) no**



pure covalent.

VSEPR

24. One milliliter equals

MEASUREMENT

a) 1000 L

b) 1/1000 L

c) 100 L

d) 1/100 L

e) 1 L

25. 0.0023010 has \_\_\_ significant figures.

MEASUREMENT

a) 3

b) 4

c) 5

d) 6

e) 7

26. Multiply 2.505 m times 1.75 m and round off the product to the proper number of significant digits.

MEASUREMENT

a) 4.0 m<sup>2</sup>

b) 4.00 m<sup>2</sup>

c) 4.38 m<sup>2</sup>

d) 4.384 m<sup>2</sup>

e) 4.40 m<sup>2</sup>

$$\begin{array}{r} 2.505 \text{ m} \\ \times 1.75 \text{ m} \\ \hline 4.38375 \\ \approx 4.38 \text{ m}^2 \end{array}$$

27. If the density of ethyl alcohol is 0.789 g/mL, what is the volume of 35.5 g of ethyl alcohol?

- a) 2.80 mL
- b) 4.50 mL
- c) 28.0 mL
- d) 45.0 mL
- e) 280 mL

$$D = \frac{m}{V} \quad V = \frac{m}{D}$$

$$\frac{35.5 \text{ g}}{0.789 \text{ g/mL}} = 44.99366 \text{ mL}$$

MEASUREMENT

28. Elements on the right side of the periodic table are

- a) metals
- b) metalloids
- c) semimetals
- d) non-metals

PERIODIC TABLE

29. A horizontal row in the periodic table is called a

- a) group
- b) row
- c) family
- d) period

PERIODIC TABLE

30. Which of the following examples of matter can only be separated into two or more substances by chemical methods?

- a) compound
- b) element
- c) heterogeneous mixture
- d) homogeneous mixture
- e) none of the above

VOCABULARY

31. Ammonium phosphate is used in fertilizer to replenish nitrogen to the soil. If the formula is  $(\text{NH}_4)_3\text{PO}_4$ , what is the total number of atoms in one molecule?

- a) 13
- b) 16
- c) 18
- d) 20
- e) none of the above

$$\begin{array}{r} 3\text{N} \\ 12\text{H} \\ 1\text{P} \\ 4\text{O} \\ \hline 20 \text{ atoms} \end{array}$$

FORMULA

32. Which of the following observations is not evidence for a chemical change?

- a) producing bubbles after mixing solutions
- b) giving a precipitate after mixing solutions
- c) liberation of heat after mixing solutions
- d) changing color after mixing solutions
- e) adding water to dilute a solution

VOCABULARY



33. Two atoms are walking down the street and they run into each other.

One says to the other, "Are you all right?" "No, I lost an electron!"

"Are you sure?" "Yeah, I'm positive!"

The atom that lost an electron is a(n):

- a) isotope
- b) cation
- c) anion
- d) isoelectronic
- e) neutral

ATOMIC  
STRUCTURE

34. State the subatomic particle having a relative charge of zero and an approximate mass of one atomic mass unit.

- a) neutron
- b) electron
- c) proton
- d) isotope
- e) isoelectronic

ATOMIC  
STRUCTURE

35. Refer to the periodic table and determine the atomic mass of barium.

- a) 25 amu
- b) 56 amu
- c) 81 amu
- d) 137.33 amu
- e) 193.33 amu

PERIODIC  
TABLE

36.  $^{18}\text{O}^{2-}$  has \_\_\_ protons, \_\_\_ electrons, and \_\_\_ neutrons

- a) 8, 8, 18     8     10     10  
b) 8, 6, 10  
c) 8, 10, 6  
d) 8, 10, 10  
e) 16, 16, 18

ATOMIC  
STRUCTURE

37. What is the maximum number of electrons that can occupy the 2nd energy level?

- a) 2  
b) 6  
c) 8  
d) 10  
e) 18

↓  
 $2n^2$   
 $= 2(2)^2$   
 $= 8$

ELECTRON  
CONFIGURATION

38. What is the shape of a 2p orbital?

- a) cloverleaf  
b) dumbbell  
c) sphere  
d) circle

ELECTRON  
CONFIGURATION

39. Which element has the following electron configuration:  $1s^2 2s^2 2p^6 3s^2 3p^3$

- a) N
- b) Al
- c) P
- d) K
- e) Sc

ELECTRON  
CONFIGURATION

40. Predict which of the following elements has the largest atomic radius.

- a) F
- b) Cl
- c) O
- d) S
- e) Se

PERIODIC  
TRENDS

42. Which of the following is not isoelectronic with argon?

- a)  $S^{2-}$
- b) Cl
- c)  $K^+$
- d)  $Mg^{2+}$
- e) all are isoelectronic with argon

PERIODIC  
TABLE

43. The ammonium ion,  $\text{NH}_4^+$ , is classified as which of the following?

a) monoatomic cation

b) monoatomic anion

c) polyatomic cation

d) polyatomic anion

e) none of the above

FORMULA

44. What is the formula for the ionic compound composed of the bismuth ion,  $\text{Bi}^{3+}$ , and the cyanide ion,  $\text{CN}^-$ ?

a)  $\text{Bi}_2\text{CN}_2$

b)  $\text{BiCN}_3$

c)  $\text{Bi}_3\text{CN}$

d)  $\text{Bi}(\text{CN})_3$

e)  $\text{Bi}_3(\text{CN})_3$

FORMULA



45. What is the systematic name for  $\text{Co}_2\text{S}_3$ ?

a) dicobalt trisulfur

b) cobalt (II) sulfide

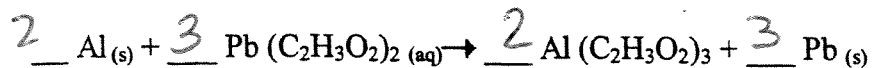
c) cobalt (II) sulfate

d) cobalt (III) sulfide

e) cobalt (III) sulfate

FORMULA

46. What is the coefficient of lead metal after balancing the following equation?



REACTIONS

- a) 1
- b) 2
- c) 3
- d) 4
- e) 6

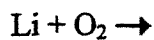
47. Classify the type of chemical reaction illustrated in question #46

- a) combination
- b) decomposition
- c) single replacement
- d) double replacement
- e) acid/base

REACTIONS

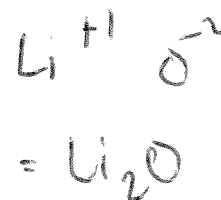
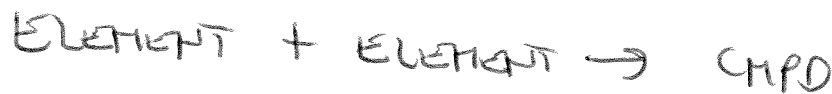


48. What is the predicted product from the following combination reaction?



REACTIONS

- a) LiO
- b) Li<sub>2</sub>O
- c) LiO<sub>2</sub>
- d) Li<sub>2</sub>O<sub>3</sub>
- e) Li<sub>3</sub>O<sub>2</sub>



49. How many moles of Br<sub>2</sub> are in 65.0 g?

- a) 1.23 mol
- b) 0.813 mol
- c) 0.407 mol
- d) 2.44 x 10<sup>23</sup> mol
- e) 4.88 x 10<sup>23</sup> mol

MOLE

$$\frac{65.0 \text{ g Br}_2}{159.80 \text{ g Br}_2} \times \frac{1 \text{ mole Br}_2}{1} = .406758$$

50. Calculate the empirical formula of the compound that consists of 53.73% iron and 46.27% sulfur. (molar mass: Fe=55.85 g/mole; S=32.06 g/mole)

- a) FeS
- b) Fe<sub>2</sub>S
- c) Fe<sub>2</sub>S<sub>3</sub>
- d) Fe<sub>3</sub>S<sub>2</sub>
- e) Fe<sub>3</sub>S<sub>4</sub>

$$\frac{53.73 \text{ g Fe}}{55.85 \text{ g}} \times \frac{1 \text{ mole}}{1} = .962399 \text{ mole Fe}$$

$$\frac{.962399 \text{ mole Fe}}{.962} = 1 \times 2 = 2$$

$$= 1 \times 2 = 2$$



MOLE

$$\frac{46.27 \text{ g}}{32.06 \text{ g}} \times \frac{1 \text{ mole}}{1} = 1.44323144 \text{ mole}$$

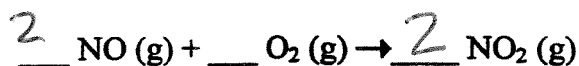
$$\frac{1.44323144 \text{ mole}}{.962} = 1.5 \times 2 = 3$$

$$= 1.5 \times 2 = 3$$

51. How many moles of oxygen gas, O<sub>2</sub>, will react with 2 moles of nitrogen monoxide gas, NO, according to the following equation?

(molar mass: O<sub>2</sub> = 32.00 g/mol; NO = 30.01; NO<sub>2</sub> = 46.01)

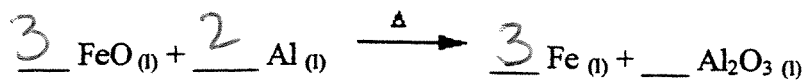
STOICHIOMETRY



- a) 1 mol
- b) 2 mol
- c) 3 mol
- d) 4 mol
- e) none of the above

$$\frac{2 \text{ mole NO}}{2 \text{ mole NO}} \times \frac{1 \text{ mole O}_2}{1} = 1$$

52. How many grams of iron are produced for the reaction of 500. g of aluminum metal?  
 (molar mass: FeO = 71.85; Al = 26.98; Fe = 55.85; Al<sub>2</sub>O<sub>3</sub> = 101.096)



- a) 345 g
- b) 689 g
- c) 1030 g
- d) 1550 g**
- e) 3100 g

STOICHIOMETRY

$$\begin{array}{l|l|l|l} 500. \text{ g Al} & 1 \text{ mole Al} & 3 \text{ mole Fe} & 55.85 \text{ g Fe} \\ \hline & 26.98 \text{ g Al} & 2 \text{ mole Al} & 1 \text{ mole Fe} \end{array}$$

$$= 1552.5389177 \text{ g Fe}$$

53. Which of the following compounds is held together by covalent bonds.

- a) CO<sub>2</sub>**
- b) HgO
- c) PbO
- d) MgO
- e) all of the above

BONDING

54. What is the number of valence electrons (v) in CO<sub>3</sub><sup>2-</sup>?

- a) 18
- b) 20
- c) 22
- d) 24**
- e) 28

VSEPR

$$\begin{array}{l} \downarrow \\ 4 + 3(6) + 2 \\ 4 + 18 + 2 \\ = 24 \end{array}$$

$$\begin{array}{l} +12 \\ \hline 2 \\ = +6 \end{array} \quad \begin{array}{l} -2 \times 7 = -14 \\ \uparrow \\ \text{FORMULA} \end{array}$$

56. What is the oxidation number of chromium in the dichromate ion,  $\text{Cr}_2\text{O}_7^{2-}$ ?

a) + 6

b) + 7

c) + 12

d) + 14

e) - 14

57. The change of  $\text{Al}^{3+}$  to Al is:

a) redox

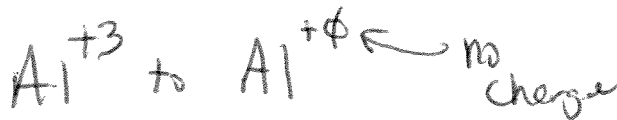
b) reduction

c) oxidation

d) electronegativity

e) electron affinity

REACTIONS



the charge was reduced.