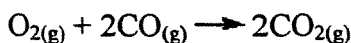# Chemistry 100 Final Exam

Fall 1995

C̲ 1. How many moles of oxygen are required to react with 3.0 moles of carbon monoxide to form carbon dioxide at STP?

$$O_{2(g)} + 2CO_{(g)} \longrightarrow 2CO_{2(g)}$$

(a) 0.50 mol
(b) 1.0 mol
(c) 1.5 mol ⟵ *(circled)*
(d) 2.0 mol
(e) 3.0 mol

STOICHIOMETRY

$$\frac{3.0 \text{ moles } CO}{} \left| \frac{1 \text{ mol } O_2}{2 \text{ mol } CO} \right. = 1.5 \text{ mol } O_2$$

B̲ 8. 8.0 grams of $CaCO_3$ is dissolved in a total volume of 500. ml. What is the molarity of the solution?

SOLUTIONS

$M = \frac{solute}{sol'n}$ convert to $\frac{mole}{L}$

(a) 0.072
(b) 0.16 ⟵ *(circled)*
(c) 0.29
(d) 0.036

$$\frac{8.0 g\ CaCO_3}{500.mL} \left| \frac{1\ mol\ CaCO_3}{100.09\ g\ CaCO_3} \right| \frac{1000mL}{1L} = .159856 = .16\ M$$

C̲ 9. How many grams of KCl are in 10. ml of a 0.10 M solution?

⟶ conversion factor

SOLUTIONS

(a) 1.0×10^{-3}g
(b) 0.013g
(c) 0.075g ⟵ *(circled)*
(d) 1.0g
(e) 75g

$$\frac{10.mL}{} \left| \frac{1L}{1000mL} \right| \frac{.10\ mol\ KCl}{1L} \left| \frac{74.55\ g\ KCl}{1\ mol\ KCl} \right. = .07455\ g = .07$$

A̲ 10. 5.0 ml of a 0.20 M solution of KI is reacted with 4.0 ml of a 0.30 M solution of $Pb(NO_3)_2$.

$$2\ KI + Pb(NO_3)_2 \longrightarrow PbI_2 + 2KNO_3$$
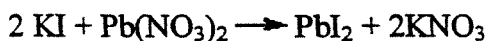
STOICHIOMETRY
LIMITING REAGENT

How many grams of solid PbI_2 will be formed?

(a) 0.23g ⟵ *(circled)*
(b) 0.35g
(c) 0.46g
(d) 0.55g
(e) 0.82g

$$\frac{5.0mL}{} \left| \frac{1L}{1000mL} \right| \frac{.20\ mol\ KI}{1L} = .001\ mol\ KI$$

$$\frac{4.0mL}{} \left| \frac{1L}{1000mL} \right| \frac{.30\ mol\ Pb(NO_3)_2}{1L} = .0012\ mol\ Pb(NO_3)_2$$

$$\frac{.001\ mol\ KI}{} \left| \frac{1\ mol\ Pb(NO_3)_2}{2\ mol\ KI} \right. = .0005\ mol\ Pb(NO_3)_2\ needed$$

∴ KI is L.R. $\frac{.001\ mol\ KI}{} \left| \frac{1\ mol\ PbI_2}{} \right| 461.09\ PbI_2 = .2305\ g\ PbI_2$

B 11. 1 ml of a 5 M solution is diluted to give 500 ml. What is the new molarity? $M_1V_1 = M_2V_2$ $M_2 = \dfrac{M_1V_1}{V_2}$

(a) 0.1
(b) 0.01
(c) 0.001
(d) 0.02

$$\dfrac{5\,M}{} \bigg| \dfrac{1\,mL}{500\,mL} \cdot .01\,mL$$

C 14. How many moles of NaCl are present in 100. ml of a 0.125 M solution?

(a) 1.25 x 10⁻³
(b) 0.0800
(c) 0.0125
(d) 12.5
(e) 800

$$100.\,mL \bigg| \dfrac{1\,L}{1000\,mL} \bigg| \dfrac{.125\,mol\,NaCl}{1\,L} = .0125\,mol$$

B 15. A solution can be described as

(a) a heterogenous mixture
(b) a homogeneous mixture
(c) a solute dissolved in solvent with fixed proportions
(d) difficult to separate its components physically
(e) having the same properties as its solvent

Pick the letter from the list below which best completes the following statements in 16-19.

(a) saturated
(b) miscible
(c) concentrated
(d) solubility
(e) concentration

B 16. Alcohol is infinitely _____ with water.

C 17. A dilute solution has fewer solute particles dissolved in it than a _____ one.

E 18. Molality, molarity and mass % are terms of _____.

D 19. The maximum amount of solute that can be dissolved in a certain amount of solvent is its_____.

C 20. An aqueous nitric acid solution that is 70.0% HNO_3 by mass contains:

(a) 70.0g HNO_3 and 100.g H_2O
(b) 70.0 mol HNO_3 1.00 L H_2O
(c) 70.0g HNO_3 and 30.0g H_2O
(d) 70.0g H_2O_3 and 30.0g HNO_3
(e) 1.11 mol HNO_3 in 1.00 L H_2O

$$70.0\% \ HNO_3 = \frac{70.0g \ HNO_3}{100.0g \ Sol'n} \quad SOLUTIONS$$

70.0g HNO_3 with 30.0g H_2O

B 21. What is the weight percent of water in a solution made by dissolving 15.6g of NaCl in 135g water?

(a) 0.104%
(b) 10.4%
(c) 11.6%
(d) 88.4%
(e) 89.6%

Solution = solute + solvent   SOLUTIONS
= 15.6g + 135 g
= 150.6g solution.

$$\frac{15.6g \ NaCl}{150.6g \ sol'n} = .10358565 \times 100\% = 10.358 \%$$

A 22. The molecular geometry of the CO_2 molecule is:

(a) linear
(b) bent
(c) pyramidal
(d) trigonal planar
(e) tetrahedral

VSEPR

Ö=C=Ö

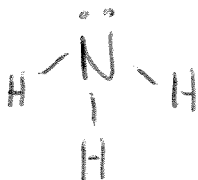B 23. The molecular geometry of the H_2O molecule is:

(a) linear
(b) bent
(c) pyramidal
(d) trigonal planar
(e) tetrahedral

VSEPR

H Ö H

C 24. The <u>electron pair arrangement</u> around the N atom in the ammonia molecule NH_3 is:
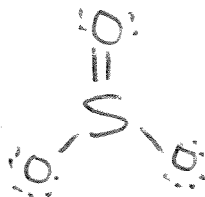
(a) linear
(b) bent
(c) pyramidal
(d) trigonal planar
(e) tetrahedral

VSEPR

H N H
H

D 25. The electron pair arrangement and the molecular geometry of SO_3 are:

(a) linear
(b) bent
(c) pyramidal
(d) trigonal planar
(e) tetrahedral

VSEPR

PART II

C 26. Which is not a chemical change?

(a) A firefly lights up
(b) Tobacco is smoked in a pipe
(c) Moth balls sublime at room temperature
(d) A leaf turns color in autumn
(e) Butter left out at room temperature turns rancid

VOCABULARY

Sublimation is physical change from solid to gas

A 27. By what process is a gas converted to a liquid?

(a) condensation
(b) evaporation
(c) sublimation
(d) melting

VOCABULARY

C 28. Which of the following is not a diatomic gas?

(a) nitrogen
(b) hydrogen
(c) helium
(d) oxygen
(e) fluorine

Cl I F Br O H N

FORMULA

D 29. 425°C is how many degrees Fahrenheit?

(a) 218
(b) 425
(c) 765
(d) 797
(e) 823

ENERGY

$$°F = 1.8 (°C) + 32$$
$$= 1.8 (425) + 32$$
$$= 765 + 32$$
$$= 797$$

B

____ 30. 0.05070 has _____ significant figures

MEASUREMENT

(a) 3
(b) 4
(c) 5
(d) 6
(e) 7

E

____ 31. The way to write the number of lead atoms in one million moles in scientific notation is:

MOLE

(a) 1×10^6 Pb atoms
(b) 1×10^{29} Pb atoms
(c) 6.022×10^6 Pb atoms
(d) 6.022×10^{23} Pb atoms
(e) 6.022×10^{29} Pb atoms

$$\frac{1,000,000 \text{ moles}}{} \left| \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mole}} \right| = 6.022 \times 10^{29}$$

D

____ 32. How many significant figures in the answer to:

$$6799.5 + 25 =$$

MEASUREMENT

(a) 1 (b) 2 (c) 3 (d) 4 (e) 5

$$\begin{array}{r} 6799.5 \\ + 25 \\ \hline 6824.5 \end{array} = 6825$$

A

____ 33. Calculate the mass of a plastic brick measuring 2.00cm by 3.00cm by 1.50cm and having a density of 1.26g/cm³.

MEASUREMENT

(a) 11.3 g
(b) 9.00 g
(c) 7.14 g
(d) 0.140 g
(e) 0.0882 g

$$D = \frac{m}{V} \qquad m = DV$$

$$\frac{1.26 \text{ g}}{cm^3} \left| \frac{2.00 cm}{} \right| \frac{3.00 cm}{} \left| \frac{1.50 cm}{} \right| = 11.34 = 11.3 \text{ g}$$

C

____ 34. The element found in Period 4 Group VI A is:

PERIODIC TABLE

(a) Cr
(b) Sn
(c) Se
(d) Te
(e) S

_D_ 35. Pick the wrong statement.

(a) A large majority of the mass of the atom is in the nucleus.
(b) Electrons are in constant motion.
(c) Atoms that have lost electrons will be positively charged.
(d) The masses of the elements give in the periodic table are the actual masses of the elements.
(e) An atom is neutral when the number of protons is equal to the number of electrons.

ATOMIC STRUCTURE

└──→ AVERAGE OF ALL NATURALLY OCCURRING ISOTOPES

_B_ 36. The chemical properties of an element are determined by its:

(a) atomic mass
(b) atomic number ──→ atomic # = # p⁺ = # e⁻ ← determines chemical properties
(c) number of neutrons
(d) symbol
(e) density

PERIODIC TABLE

_A_ 37. A 5d orbital can contain a maximum of _____ electrons.

(a) 2 (b) 6 (c) 8 (d) 10 (e) 14

ELECTRON CONFIGURATION

_A_ 38. Nonmetals tend to _____ electrons when forming ionic compounds.

(a) gain
(b) lose
(c) share
(d) transfer

FORMULA

_____ 39. The I⁻ ion is _____ than the I atom.

(a) smaller than
(b) larger than
(c) the same size as
(d) not enough information given

PERIODIC TRENDS

_____ 40. N₂ has a _____ bond between the two nitrogen atoms.

(a) single
(b) double
(c) triple
(d) ionic

: N ≡ N :

BONDING

D___ 42. 40. grams of Br_2 contains how many atoms?

(a) 0.25
(b) 0.50
(c) 1.5×10^{23}
(d) 3.0×10^{23}
(e) 6.0×10^{23}

$$\frac{40. g\ Br_2}{} \left| \frac{1\ mol\ Br_2}{157.8\ g\ Br_2} \right| \frac{6.022 \times 10^{33}\ molical\ Br_2}{1\ mol\ Br_2} \left| \frac{2\ atoms\ Br}{1\ molecul\ Br_2} \right.$$

MOLE

$= 3.0476846 \times 10^{23}$

C___ 43. An atom is composed mostly of:

(a) protons
(b) electrons
(c) empty space
(d) neutrons
(e) nuclei

ATOMIC STRUCTURE

B___ 44. An ion with atomic number 50 and 46 electrons is:

(a) Pd^{4+}
(b) Sn^{4+}
(c) Pd^{4-}
(d) Sn^{4-}
(e) unlikely to exist

Sn   +4
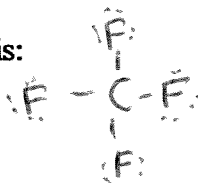
ATOMIC STRUCTURE

D___ 45. The number of valence electrons in CF_4 is:

(a) 5 (b) 9 (c) 23 (d) 32 (e) 40

$4 + 4(7) = 32$

VSEPR

D___ 46. The number of bonds is CF_4 is:

(a) 1 (b) 2 (c) 3 (d) 4 (e) 5

$\ddot{F} - \overset{\ddot{F}}{\underset{\ddot{F}}{C}} - \ddot{F}$

VSEPR

E___ 47. The oxidation number of C in CF_4 is:

(a) 0 (b) -1 (c) +1 (d) -4 (e) +4

$+4$ $-1 \times 4 = -4$

FORMULA

A___ 48. Each C-F bond in CF_4 can be described as:

(a) polar (b) non-polar (c) ionic (d) coordinate

VSEPR
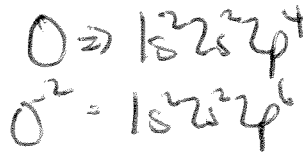
B 49. The compound CaF_2 is called:

(a) Difluorocalcium
(b) Calcium fluoride
(c) Calcium fluorine
(d) Calcium difluoride
(e) monocalcium difluoride

FORMULA

C 51. The electron configuration of the O^{2-} ion is:

(a) $1s^2 2s^2 2p^2$
(b) $1s^2 2s^2 2p^4$
(c) $1s^2 2s^2 2p^6$
(d) $2p^4$
(e) $2p^6$

ELECTRON
CONFIGURATION

$O \Rightarrow 1s^2 2s^2 2p^4$

$O^{2-} = 1s^2 2s^2 2p^6$

52. Molality is defined as:

(a) grams of solute per kilogram of solvent.
(b) moles of solute per kilograms of solution.
(c) moles of solute per kilograms of solvent.
(d) moles of solute per liter of solution.
(e) grams of solute per 100 grams of solution.

E 54. The empirical formula for a compound with the composition 37.2%C, 7.82%H, and 55.0%Cl is:

(a) HCCl
(b) H_2C_3Cl
(c) HC_5Cl_7
(d) H_3CCl_3
(e) H_5C_2Cl

MOLE

$\dfrac{37.2g\ C}{} \bigg| \dfrac{1\ mol\ C}{12.01 g\ C}$

$= \dfrac{3.0974\ mol\ C}{1.55\ldots}$

$= 2$

$\dfrac{7.82 g\ H}{} \bigg| \dfrac{1\ mol\ H}{1.01 g}$

$= \dfrac{7.7425\ mol}{1.55\ldots}$

≈ 5

$\dfrac{55.0 g\ Cl}{} \bigg| \dfrac{1\ mol\ Cl}{35.45 g}$

$= \dfrac{1.5514809\ mol\ Cl}{1.55\ldots}$

$= 1$

C_2H_5Cl

D 55. How many moles of nitrate ions are in 1.1×10^{-3} mol of $Ca(NO_3)_2$?

(a) 1
(b) 2
(c) 1.1×10^{-3}
(d) 2.2×10^{-3}
(e) 3.3×10^{-3}

MOLE

$\dfrac{1.1 \times 10^{-3}\ mol\ Ca(NO_3)_2}{} \bigg| \dfrac{2\ mol\ NO_3^{-1}}{1\ mol\ Ca(NO_3)_2}$

from formula

$Ca(NO_3)_2 \Rightarrow 1\ Ca\ x2$
$2\ NO_3^-\ x$
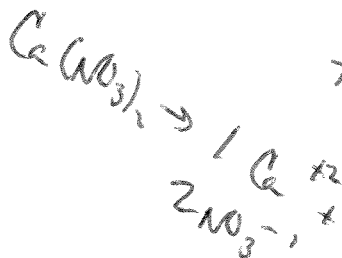
$= 2.2 \times 10^{-3}$

_C_ 56. Balance the following equation and report the number of moles of O_2 that can be formed starting with 5.0 moles of NaClO.

$$2 \text{ NaClO}_{(aq)} \longrightarrow 2 \text{ NaCl}_{(aq)} + \text{___} O_{2(g)}$$

STOICHIOMETRY

(a) 1.0
(b) 2.0
(c) 2.5
(d) 4.0
(e) 5.0

$$\frac{5.0 \text{ mol NaClO} \mid 1 \text{ mol } O_2}{2 \text{ mol NaClO}} = 2.5 \text{ mol } O_2$$

_B_ 57. The reaction in problem 54 is a/n:

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

REACTIONS

ONE REACTANT → MULTIPLE PRODUCTS

_D_ 58. Oxidation-reduction reactions are those that always involve:

(a) formation of a precipitate
(b) decomposition of reactants
(c) transfer of cations and anions
(d) transfer of electrons
(e) production of gas

REACTIONS

_B_ 59. Given the equation:

$$\text{MnO}_2 + 4\text{HCl} \longrightarrow \text{MnCl}_2 + \text{Cl}_2 + 2\text{H}_2\text{O}$$

How many grams of HCl are needed to make 3.00 grams of $MnCl_2$?

(a) 12.0 g
(b) 3.48 g
(c) 0.750 g
(d) 0.0952 g

STOICHIOMETRY

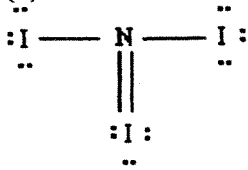$$\frac{3.00 \text{ g MnCl}_2 \mid 1 \text{ mol MnCl}_2 \mid 4 \text{ mol HCl} \mid 36.46 \text{ g HCl}}{125.84 \text{ g} \mid 1 \text{ mol MnCl}_2 \mid 1 \text{ mol HCl}}$$

$= 3.476795$

_____ 62. The Lewis structure for the NI_3 molecule is:

VSEPR

(a)

:I —— N —— I :

‖

:I :

(b)

I —— N —— I

|

I

(c)

:I —— N —— I :

‖

:I :

(d)

:I —— N —— I :

|

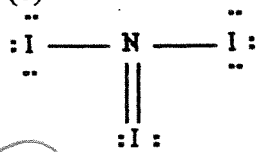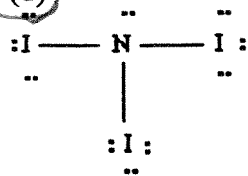:I :
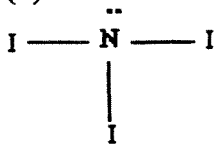
In this segment of the periodic table, several items are labeled. Use this to answer questions 63-65.

I A

	1 H 1.00797	

#2

II A

#1

(2)

3 Li 6.939	4 Be 9.0122

#3

#5

11 (Na) 22.9898	(12) Mg 24.312	III B	IV B

3

19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90

4

#4

_C_ 63. The labeled item which identifies the number of protons in the nucleus of an atom is:

(a) #1 (b) #2 (c) #3 (d) #4 (e) #5

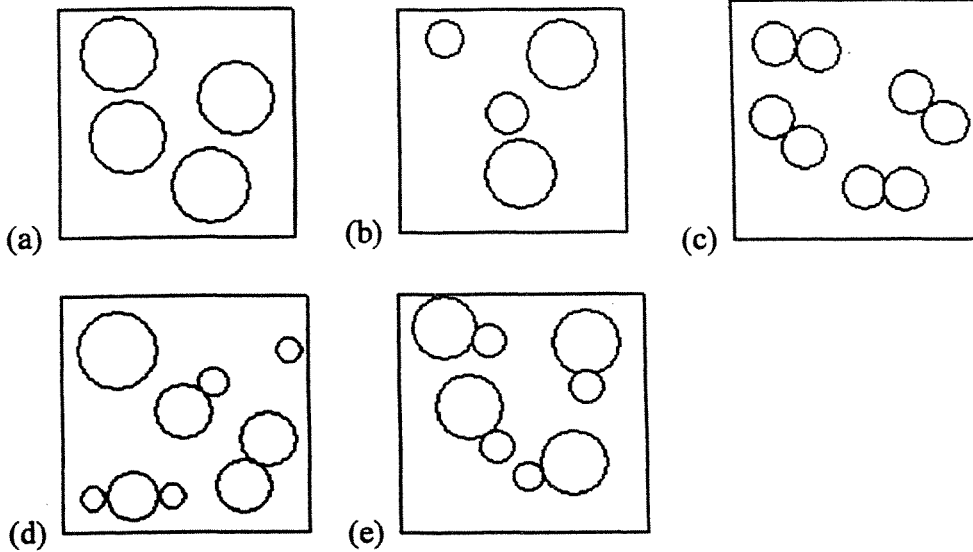_B_ 64. The labeled item that identifies the group number is:

(a) #1 (b) #2 (c) #3 (d) #4 (e) #5

_D_ 65. The labeled item that identifies the relative mass of an element is:

(a) #1 (b) #2 (c) #3 (d) #4 (e) #5

PERIODIC
TABLE

(a) (b) (c)

(d) (e)

VOCABULARY

→ DIATOMIC

C 66. Which of the figures above best represent hydrogen gas?

D 67. Which of the above figures represents a mixture of compounds and elements?