Dougherty Valley HS Chemistry - AP
Self-Assessment Quiz – Chapters 1-4

Chapter #1

Fill out once school starts

Name: **Period:** **Seat#:**

Directions: Show work for ANY mathematical calculations, and show annotations/explanations for any non-mathematical questions.

1) Sodium is mixed with water and a violent reaction between the metal and water is seen. This is best classified as:
- (a.) An observation
- b. A law
- c. A hypothesis
- d. A theory

2) This image represents a particulate view of a sample of matter. Classify the sample according to its composition.
- a. The sample is a pure element.
- b. The sample is a homogeneous mixture.
- (c.) The sample is a compound.
- d. The sample is a heterogeneous mixture.

3) Which change is a physical change?
- a. wood burning
- b. iron rusting
- c. dynamite exploding
- (d.) gasoline evaporating

} chemical changes

phase changes = physical

4) Which property of rubbing alcohol is a chemical property?
- a. density (0.786 g/cm³)
- b. flammability
- c. boiling point (82.5 °C)
- d. melting point (–89 °C)

↓ describes a Rxn that can happen

5) Convert 85.0 °C to K.
- a. 181.1 K
- (b.) 358 K
- c. 29.4 K
- d. 302.6 K

$K = {}^\circ C + 273$

$85 + 273 = 358$

6) Express the quantity 33.2×10^{-4} m in mm.
- a. 33.2 mm
- (b.) 3.32 mm
- c. 0.332 mm
- d. 3.32×10^{-6} mm

KHDBdcm

0.00332 = 3.32 mm

7) A 1.75 L sample has a density of 0.921 g/mL. Find the mass.
- (a.) 1.61×10^{3} g
- b. 1.61×10^{-3} g
- c. 1.90×10^{3} g
- d. 1.90×10^{-3} g

$D = m/V$

$0.921 = m/1750\,mL$

$m = 1611.75$ g

8) Perform the calculation to the correct number of significant figures. $(43.998 \times 0.00552)/2.002$
- (a.) 0.121
- b. 0.12
- c. 0.12131
- d. 0.1213

× or ÷ = limit ans based on sig figs

3 S.F

= 0.121

9) Calculate with the correct number of significant figures. $(8.01 - 7.50)/3.002$
- a. 0.1698867
- (b.) 0.17
- c. 0.170
- d. 0.1700

+ or − = limit by decimal places

(0.51)/3.002

now sig figs 2 SF

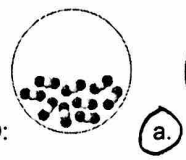
= 0.17

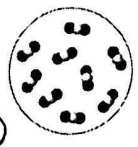
10) Convert 1285 cm² to m²
- a. 1.285×10^{7} m²
- b. 12.85 m²
- (c.) 0.1285 m²
- d. 1.285×10^{5} m²

$1285\,cm^2 \left| \frac{(1\,m)^2}{(100\,cm)^2} \right.$

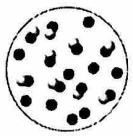
$= 0.1285\,m^2$

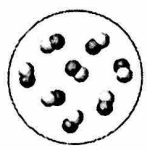
11) The first diagram depicts a compound in its liquid state. Which of the other diagrams best depicts the compound after it has evaporated into a gas?

LIQUID:  (a.)

 b.

same chemical formula after evaporating

 c.

 d.

12) Three samples, each of a different substance, are weighed and their volume is measured. The results are tabulated. List the substances in order of decreasing density.
- a. III > II > I
- b. I > II > III
- (c.) III > I > II
- d. II > I > III

	Mass	Volume
Substance I	10.0 g	10.0 mL
Substance II	10.0 kg	12.0 L
Substance III	12.0 mg	10.0 μL

$10g/0.01\,L = 1 \times 10^{3}\,g/L$

$1000g/12\,L = 83.3\,g/L$

$0.012g/(10 \times 10^{-6})L = 1.2 \times 10^{3}\,g/L$

↳ $\times 10^{-6}$ = L

13) A solid metal sphere has a radius of 3.53 cm and a mass of 1.796 kg. What is the density of the metal in g/cm³ ? (The volume of a sphere is $V = \frac{4}{3}\pi r^3$)
- a. 34.4 g/cm³
- b. 0.103 g/cm³
- c. 121 g/cm³
- (d.) 9.75 g/cm³

$V = \frac{4}{3}\pi(3.53)^3$

$= 1.84 \times 10^{2}\,cm^3$

$1796g/(1.84 \times 10^{2})$

$= 9.76\,g/cm^3$

14) The gas mileage of a certain German automobile is 22 km/L. Convert this quantity to miles per gallon.
- a. 9.4 mi/gal
- b. 1.3×10^{2} mi/gal
- (c.) 52 mi/gal
- d. 3.6 mi/gal

$\frac{22\,km}{1\,L} \left| \frac{1\,mi}{1.609\,km} \right| \frac{1\,L}{0.264\,gal}$

$= 51.8\,mi/gal$

15) A wooden block has a volume of 18.5 in³ . Express the volume of the cube in cm³.
- (a.) 303 cm³
- b. 47.0 cm³
- c. 1.13 cm³
- d. 7.28 cm³

$18.5\,in^3 \left| \frac{(2.54\,cm)^3}{(1\,in)^3} \right.$

$= 303\,cm^3$

Answers

1) A	6) B	11) A	
2) C	7) A	12) C	
3) D	8) A	13) D	
4) B	9) B	14) C	
5) B	10) C	15) A	

Chapter #2

1) Two samples of a compound containing elements A and B are decomposed. The first sample produces 15 g of A and 35 g of B. The second sample produces 25 g of A and what mass of B?

a. 11 g
b. 58 g
c. 21 g
d. 45 g

$\frac{15gA}{35gB} = \frac{25gA}{XgB}$

$XgB = 58.3g$

2) A compound containing only carbon and hydrogen has a carbon-to- hydrogen mass ratio of 11.89. Which carbon-to-hydrogen mass ratio is possible for another compound composed only of carbon and hydrogen?

a. 2.50
b. 3.97
c. 4.66
d. 7.89

12.01 : 4.04 CH_4
24.02 : 6.06 C_2H_6
3.96

3) Which idea came out of Rutherford's gold foil experiment?

a. Atoms contain protons and neutrons.
b. Matter is composed of atoms.
c. Elements have isotopes.
d. Atoms are mostly empty space.

4) A student re-creates the Millikan oil drop experiment and tabulates the relative charges of the oil drops in terms of a constant, α. What is the charge of the e⁻ in terms of α

SKIP

a. ½ α
b. α
c. 3/2 α
d. 2 α

Drop #1	α
Drop #2	$\frac{3}{2}\alpha$
Drop #3	$\frac{5}{2}\alpha$
Drop #4	3α

5) Determine the number of protons and neutrons in the isotope Fe-58.

a. 26 protons and 58 neutrons
b. 32 protons and 26 neutrons
c. 26 protons and 32 neutrons
d. 58 protons and 58 neutrons

26 Fe
58 − 26 = 32

6) An isotope of an element contains 82 protons and 122 neutrons. What is the symbol for the isotope?

a. $^{204}_{82}Pb$
b. $^{122}_{82}Pb$
c. $^{122}_{40}Zr$
d. $^{204}_{40}Zr$

$^{204}_{82}Pb$ 82 + 122 = 204

7) Determine the number of electrons in the Cr^{3+} ion.

a. 24 electrons
b. 27 electrons
c. 3 electrons
d. 21 electrons

24 − 3 = 21

8) Which pair of elements do you expect to be most similar in their chemical properties? → in same group, same # of valence e⁻

a. K and Fe
b. O and Si
c. Ne and N
d. Br and I

9) Which element is not a main-group element?

a. Se
b. Mo
c. Sr
d. Ba

↳ s & p = main group

10) What is the charge of the ion most commonly formed by S?

a. 2+
b. +
c. −
d. 2-

11) A naturally occurring sample of an element contains only two isotopes. The first isotope has a mass of 68.9255 amu and a natural abundance of 60.11%. The second isotope has a mass of 70.9247 amu. Find the atomic mass of the element.

a. 70.12 amu
b. 69.72 amu
c. 84.06 amu
d. 69.93 amu

12) Which sample contains the greatest number of atoms?

a. 14 g C
b. 49 g Cr
c. 102 g Ag
d. 202 g Pb

$\frac{14g}{12g}\left|\frac{1mol}{}\right. = 1$
$\frac{49g}{52}\left|\frac{1mol}{}\right. < 1$
$\frac{102g}{108g}\left|\frac{1mol}{}\right. < 1$
$\frac{202g}{207g}\left|\frac{1mol}{}\right. < 1$

13) Determine the number of atoms in 1.85 mL of mercury. (The density of mercury is 13.5 g/mL.)

a. 3.02×10^{27} atoms
b. 4.11×10^{20} atoms
c. 7.50×10^{22} atoms
d. 1.50×10^{25} atoms

$1.85mL\left|\frac{13.5g}{1mL}\right.\left|\frac{1mol}{201g}\right.\left|\frac{6.02\times10^{23}}{1mol}\right.$
$= 7.48 \times 10^{22}$

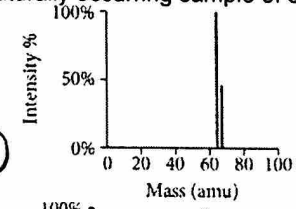
14) A 20.0 g sample of an element contains 4.95×10^{23} atoms. Identify the element.

52 a. Cr
16 b. O
24 c. Mg
56 d. Fe

$\frac{4.95\times10^{23}\ atoms}{}\left|\frac{1mol}{6.02\times10^{23}\ atoms}\right. = 0.82\ mol$
$20g / 0.82\ mol = 24$

15) Copper has two naturally occurring isotopes with masses 62.94 amu and 64.93 amu and has an atomic mass of 63.55 amu. Which mass spectrum is most likely to correspond to a naturally occurring sample of copper?

a.



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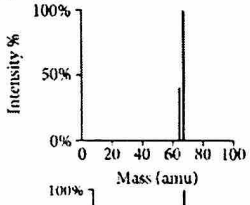
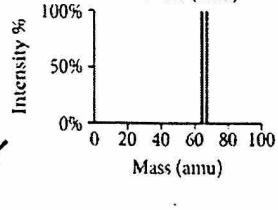
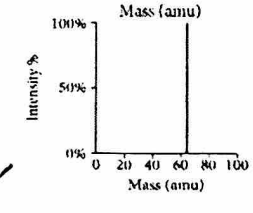


c.



d.



62.94 (Δ 0.61) 63.55 (Δ 1.38) 64.93

closer to 62.94, more abundant

Answers
1) B 6) A 11) B
2) B 7) D 12) A
3) D 8) D 13) C
4) A 9) B 14) C
5) C 10) D 15) A

1) What is the empirical formula of a compound with the molecular formula $C_{10}H_8$?

a. C_5H_3
b. C_2H_4
(c.) C_5H_4
d. CH

reduce to lowest #'s possible

10/2 8/2 → 5,4

2) Which substance is an ionic compound?

(a.) SrI_2
b. N_2O_4
c. He
d. CCl_4

metal + nonmetal
cation + anion

3) What is the correct formula for the compound formed between calcium and sulfur?

(a.) CaS
b. Ca_2S
c. CaS_2
d. CaS_3

Ca^{2+} S^{2-} reduce
2 2 2, 2
↓
1, 1

4) Name the compound SrI_2.

(a.) strontium iodide
b. strontium diiodide
c. strontium(II) iodide
d. strontium(II) diiodide

ionic, no prefixes or not variable charge, no roman numerals

5) What is the formula for manganese(IV) oxide?

a. Mn_4O
b. MnO_4
c. Mn_2O
(d.) MnO_2

Mn^{+4} O^{2-} reduce
2 4
1 2

6) Name the compound $Pb(C_2H_3O_2)_2$

a. lead(II) carbonate
(b.) lead(II) acetate
c. lead bicarbonate
d. lead diacetate

lead is variable charge, need roman numeral
ionic, no prefix
$C_2H_3O_2^{-1}$

7) Name the compound P_2I_4.

a. phosphorus iodide
b. phosphorus diiodide
c. phosphorus(II) iodide
(d.) diphosphorus tetraiodide

covalent, need prefixes

8) Name the compound HNO_2 (aq).

a. hydrogen nitrogen dioxide
b. hydrogen nitrate
c. nitric acid
(d.) nitrous acid

Acid!
NO_2^- = nitrite
-ite → -ous acid

9) Determine the number of CH_2Cl_2 molecules in 25.0 g CH_2Cl_2.

a. 0.294 molecules
(b.) 1.77×10^{23} molecules
c. 1.28×10^{27} molecules
d. 1.51×10^{25} molecules

$\frac{25\text{ g}}{84.93\text{ g}} \left| \frac{1\text{ mol}}{1\text{ mol}} \right| \frac{6.02 \times 10^{23}}{1\text{ mol}} = 1.77 \times 10^{23}$

10) List the elements in the compound CF_2Cl_2 in order of decreasing mass percent composition.

a. C > F > Cl
b. F > Cl > C
c. Cl > C > F
(d.) Cl > F > C

C = 12.01g/120.91 = 9.9%
F = 38/120.91 = 31.4%
Cl = 70.9/120.91 = 58.6%

total molar mass
=

Chapter #3

11) Determine the mass of potassium in 35.5 g of KBr.

a. 17.4 g
b. 0.298 g
c. 11.7 g
d. 32.9 g

$\frac{35.5\text{ g}}{119\text{ g}} \left| \frac{1\text{ mol}}{1\text{ mol KBr}} \right| \frac{1\text{ mol K}}{1\text{ mol}} \left| \frac{39.1\text{ g}}{1\text{ mol K}} \right. = 11.7\text{ g}$

12) A compound is 52.14% C, 13.13% H, and 34.73% O by mass. What is the empirical formula of the compound?

a. $C_2H_8O_3$
(b.) C_2H_6O
c. C_4HO_3
d. C_3HO_6

$\frac{52.14\text{ g}}{12.01\text{ g}} \left| \frac{1\text{ mol}}{1} \right. = 4.3$ C
$\frac{13.13\text{ g}}{1.01\text{ g}} \left| \frac{1\text{ mol}}{1} \right. = 13$ H
$\frac{34.73\text{ g}}{16\text{ g}} \left| \frac{1\text{ mol}}{1} \right. = 2.17$ O

(4.3/2.17) ≈ 2, 13/2.17 ≈ 6, 2.17/2.17 = 1

13) A compound has the empirical formula CH_2O and a formula mass of 120.10 amu. What is the molecular formula?

a. CH_2O
b. $C_2H_4O_2$
c. $C_3H_6O_3$
(d.) $C_4H_8O_4$

$CH_2O = 30.03$ g/mol
$\frac{120.10}{30.03} \approx 4$
$CH_2O \times 4 = C_4H_8O_4$

14) Combustion of 30.42 g of a compound containing only carbon, hydrogen, and oxygen produces 35.21 g CO_2 and 14.42 g H_2O. What is the empirical formula?

a. $C_4H_8O_6$
(b.) $C_2H_4O_3$
c. $C_2H_2O_3$
d. C_6HO_{12}

$\frac{35.21\text{ g } CO_2}{44.01\text{ g}} \left| \frac{1\text{ mol}}{1\text{ mol}} \right| \frac{1\text{ mol C}}{1\text{ mol}} = 0.80$
$\frac{14.42\text{ g } H_2O}{18.02\text{ g}} \left| \frac{1\text{ mol}}{1\text{ mol}} \right| \frac{2\text{ mol H}}{1\text{ mol}} = 1.6$

15) What are the correct coefficients (reading from left to right) when the chemical equation is balanced?

$\_PCl_3(l) + \underline{3}\ H_2O(l) \rightarrow \_H_3PO_3(aq) + \underline{3}\ HCl(aq)$

(a.) 1, 3, 1, 3
b. 1, 2, 1, 1
c. 1, 3, 2, 1
d. 3, 6, 1, 9

$\frac{0.80\text{ mol C}}{1\text{ mol}} \left| \frac{12.01\text{ g}}{1\text{ mol}} \right. = 9.608\text{ g}$

$\frac{1.6\text{ mol H}}{1\text{ mol}} \left| \frac{1.01\text{ g}}{1\text{ mol}} \right. = 1.616$

$\frac{19.2\text{ g O}}{16\text{ g}} \left| \frac{1\text{ mol}}{1} \right. = 1.2\text{ mol}$

30.42
− 9.608
− 1.616
= 19.2 g O

$\frac{0.80}{0.80} = 1$ C $\quad \frac{1.6}{0.80} = 2$ H $\quad \frac{1.2}{0.8} = 1.5$ O

× 2 2C, 4H, 3O

Answers			
1) C	6) B	11) C	
2) A	7) D	12) B	
3) A	8) D	13) D	
4) A	9) B	14) B	
5) D	10) D	15) A	

Chapter #4

1) Manganese(IV) oxide reacts with aluminum to form elemental manganese and aluminum oxide:

$3\ MnO_2 + 4\ Al \rightarrow 3\ Mn + 2\ Al_2O_3$

What mass of Al is needed to fully react with 25.0 g MnO_2 ?

a. 7.76 g Al
b. 5.82 g Al
c. 33.3 g Al
(d.) 10.3 g Al

25g | 1mol / 86.94g | 4 mol Al / 3 mol MnO_2 | 26.98g / 1mol

= 10.34 g

2) $2\ Na(s) + Cl_2(g) \rightarrow 2\ NaCl(s)$

What is the theoretical yield of sodium chloride for the reaction of 55.0 g Na with 67.2 g Cl_2?

Cl_2 = LR

a. 1.40×10^2 g NaCl
(b.) 111 g NaCl
c. 55.4 g NaCl
d. 222 g NaCl

have 2.39 mol Na, need: 1.195 mol Cl_2

55g Na | 1mol / 22.99g = 2.39 mol

67.2g | 1mol / 70.9g = 0.948 mol

0.948 mol | 2mol / 1mol | 58.4g / 1mol = 111 g

3) Sulfur and fluorine react to form sulfur hexafluoride:

$S(s) + 3\ F_2(g) \rightarrow SF_6(g)$

If 50.0 g S is allowed to react as completely as possible with 105.0 g F_2, what mass of the excess reactant is left?

(a.) 20.5 g S
b. 45.7 g F_2
c. 15.0 g S
d. 36.3 g F_2

have 1.56 mol S need 4.68 mol F_2, F_2 lim Reg

50g | 1mol / 32.07g = 1.56

105g | 1mol / 38g = 2.76

2.76 mol | 1 mol S / 3 mol F_2 | 32g / 1mol = 29.44 g used

50 - 29.44 = 20.5 g left

4) A reaction has a theoretical yield of 45.8 g. When the reaction is carried out, 37.2 g of the product is obtained. What is the percent yield?

a. 55.1%
b. 44.8%
c. 123%
(d.) 81.2%

$\frac{37.2}{45.8} \times 100 = 81.2\%$

*Careful - % yield not % error

5) What is the molarity of a solution containing 55.8 g of $MgCl_2$ dissolved in 1.00 L of solution?

a. 55.8 M
b. 1.71 M
(c.) 0.586 M
d. 0.558 M

55.8g | 1mol / 95.21g = 0.586

$\frac{0.586}{1L} = 0.586M$

6) What mass (in grams) of $Mg(NO_3)_2$ is present in 145 mL of a 0.150 M solution of $Mg(NO_3)_2$?

(a.) a. 3.23 g
b. b. 0.022 g
c. c. 1.88 g
d. d. 143 g

$0.150\ \frac{mol}{L} \times 0.145\ L =$ 0.02175 mol

0.02175 mol | 147g / 1mol = 3.2 g

7) What volume of a 1.50 M HCl solution should you use to prepare 2.00 L of a 0.100 M HCl solution?

a. 0.300 L
(b.) 0.133 L
c. 30.0 L
d. 2.00 L

$M_1V_1 = M_2V_2$

$(1.5)(x) = (0.1)(2)$

$x = 0.133$

8) $2\ KI(aq) + Pb(NO_3)_2(aq) \rightarrow 2\ KNO_3(aq) + PbI_2(s)$

What minimum volume of 0.200 M potassium iodide solution is required to completely precipitate all of the lead in 155.0 mL of a 0.112 M lead(II) nitrate solution?

a. 348 mL
b. 86.8 mL
(c.) 174 mL
d. 43.4 Ml

155mL | 0.112 mol / 1000mL = 0.01736 mol

0.01736 mol | 2 mol KI / 1 mol $Pb(NO_3)_2$ = 0.03472 mol KI needed

$0.2M = \frac{0.03472\ mol}{x\ L}$ $x = 0.174\ L$

9) Which solution forms a precipitate when mixed with a solution of aqueous Na_2CO_3 ?

a. $KNO_3(aq) \rightarrow NaNO_3 + K_2CO_3$
b. $NaBr(aq) \rightarrow$ —
c. $NH_4Cl(aq) \rightarrow NaCl + (NH_4)_2CO_3$
(d.) $CuCl_2(aq) \rightarrow NaCl + CuCO_3(s)$

Alkali metals & NH_4 always soluble

10) What is the net ionic equation for the reaction that occurs when aqueous solutions of KOH and SrCl2 are mixed?

a. $K^+(aq) + Cl^-(aq) \rightarrow KCl(s)$ KCl = aq
(b.) $Sr^{2+}(aq) + 2\ OH^-(aq) \rightarrow Sr(OH)_2(s)$
c. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
d. None of the above because no reaction occurs

insoluble ppt

$KOH + SrCl_2 \rightarrow KCl + Sr(OH)_2$

11) What is the net ionic equation for the reaction that occurs when aqueous solutions of KOH and HNO3 are mixed?

a. $K^+(aq) + NO^-(aq) \rightarrow KNO_3(s)$
b. $NO^-(aq) + OH^-(aq) \rightarrow NO_3OH(s)$
(c.) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
d. None of the above because no reaction occurs.

$KOH + HNO_3 \rightarrow KNO_3 + H_2O$

12) What is the net ionic equation for the reaction that occurs when aqueous solutions of $KHCO_3$ and HBr are mixed?

a. $K^+(aq) + C_2H_3O_2^-(aq) \rightarrow KC_2H_3O_2(s)$
(b.) $H^+(aq) + HCO_3^-(aq) \rightarrow CO_2(g) + H_2O(l)$
c. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
d. None of the above because no reaction occurs.

remember H_2CO_3 decomposes.

$KHCO_3 + HBr \rightarrow KBr + H_2CO_3 \rightarrow CO_2 + H_2O$

13) What is the oxidation state of carbon in CO_3^{2-} ?

(a.) +4
b. +3
c. -3
d. -2

$x + 3(-2) = -2$

$x = +4$

14) Sodium reacts with water according to the reaction:

$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

Identify the oxidizing agent.

a. Na (s)
(b.) H_2O (l)
c. NaOH (aq)
d. H_2 (aq)

$Na\ 0 \rightarrow +1$ loss, ox

$H_2\ +1 \rightarrow 0$ gain, Red

∴ Na = reducing agent

H_2O = oxidizing agent

15) Identify the correct balanced equation for the combustion of propane C_3H_8

a. $C_3H_8(g) \rightarrow 4\ H_2(g) + 3\ C(s)$
(b.) $C_3H_8(g) + 5\ O_2(g) \rightarrow 4\ H_2O(g) + 3\ CO_2(g)$
c. $C_3H_8(g) + 3\ O_2(g) \rightarrow 4\ H_2O(g) + 3\ CO_2(g)$
d. $2\ C_3H_8(g) + 9\ O_2(g) \rightarrow 6\ H_2CO_3(g) + 2\ H_2(g)$

Combustion results in $H_2O + CO_2$, requires $O_2(g)$

Answers

1) D	6) A	11) C
2) B	7) B	12) B
3) A	8) C	13) A
4) D	9) D	14) B
5) C	10) B	15) B