

NUCLEAR

VOCAB:

* **Transmutation**: an atom of an element is converted to an atom of a different element

natural
(spontaneous)
* by itself (#8)

artificial
(bombaraded)

ex: ${}_{92}^{235}\text{U} + {}_0^1\text{n} \rightarrow \text{products}$
not by itself

* **Fusion** ("union") : 2 H's unite to form 1 He

* **Fission** ("division") : uranium splits into lighter nuclei : neutrons

small amounts of energy converted to LARGE amounts of energy

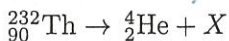
| * Radioisotopes | Uses |
|-----------------|----------------------|
| I - 131 | thyroid disorders |
| C - 14 | fossils |
| Co - 60 | treat cancer |
| U - 238 | rocks / age of Earth |

IMPORTANT REF TABLES: D & N

1. A sample of which radioisotope emits particles having the greatest mass?

- A) ^{137}Cs B) ^{53}Fe C) ^{220}Fr D) ^3H

2. Given the equation representing a nuclear reaction in which X represents a nuclide:



$228 + 4 = 232 \checkmark$
 $88 + 2 = 90 \checkmark$

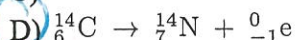
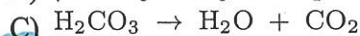
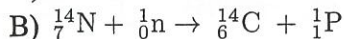
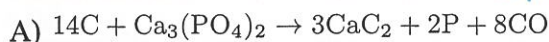
Which nuclide is represented by X ?

- A) $^{236}_{92}\text{Ra}$ B) $^{228}_{88}\text{Ra}$ C) $^{236}_{92}\text{U}$ D) $^{228}_{88}\text{U}$

3. Which nuclear emission is negatively charged?

- A) an alpha particle B) a beta particle
 C) a neutron D) a positron

4. Which balanced equation represents a spontaneous radioactive decay?



by itself

5. What is the decay mode of ^{37}K ?

- A) β^- B) β^+ C) γ D) α

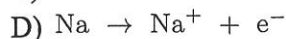
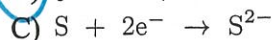
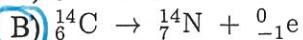
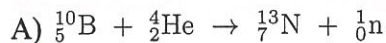
6. A carbon-14 atom spontaneously decayed to form a nitrogen-14 atom. This change took place because

- A) a transmutation occurred without particle emission
 B) a transmutation occurred with particle emission
 C) nitrogen-14 has an unstable nucleus
 D) carbon-14 has a stable nucleus

7. Which term identifies a type of nuclear reaction?

- A) transmutation B) neutralization
 C) deposition D) reduction

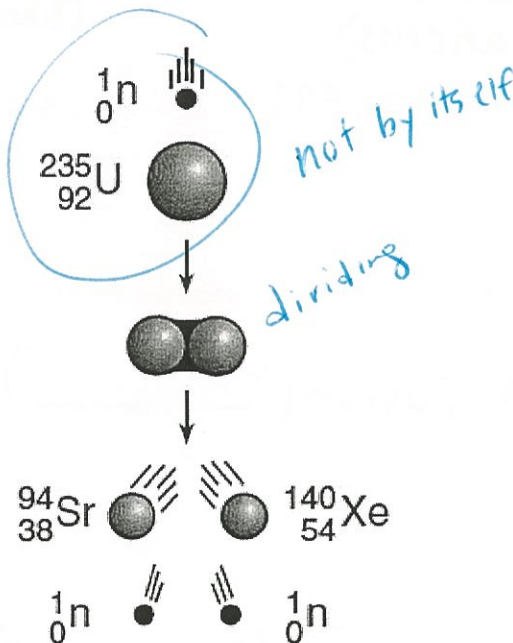
8. Which equation represents natural transmutation?



9. What occurs in both fusion and fission reactions?

- A) Small amounts of energy are converted into large amounts of matter.
 B) Small amounts of matter are converted into large amounts of energy.
 C) Heavy nuclei are split into lighter nuclei.
 D) Light nuclei are combined into heavier nuclei.

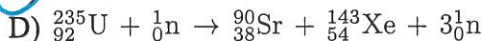
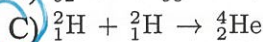
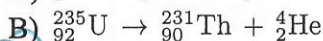
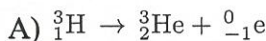
10. Given the diagram representing a reaction:



Which type of change is represented?

- A) fission B) fusion
 C) deposition D) evaporation

11. Which balanced equation represents nuclear fusion?



12. Which radioisotope is used in dating geological formations?

- A) I-131 B) U-238
 C) Ca-37 D) Fr-220

13. Which radioisotope is used for diagnosing thyroid disorders?

A) U-238

B) Pb-206

C) I-131

D) Co-60

Base your answers to questions 14 and 15 on the information below and on your knowledge of chemistry.

The radioisotope Mo-99 naturally decays to produce the metastable isotope Tc-99m, which is used in medical diagnosis. A doctor can obtain images of organs and bones by injecting a patient with a solution of Tc-99m. The half-life of the metastable Tc-99m is six hours.

14. State *both* the number of protons and the number of neutrons in a Tc-99 nuclide.

43 protons
56 neutrons

15. Complete the nuclear equation below for the nuclear decay of Mo-99.



PERIODIC TABLE

* elements are arranged in order of increasing atomic number

Groups all ↓ have the same # of valence electrons (so they have similar chemical properties)

metalloids
nonmetals
metals

Noble Gases (stable unreactive)

Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | |
|----------------------------------|---------------------------------|-------------------------------------|-------------------------------------|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|----------------------------------|------------------------------------|-----------------------------------|------------------------------------|-----------------------------------|
| 1 H Hydrogen 1.008 | 2 He Helium 4.003 | | | | | | | | | | | 18 | | | | | |
| 3 Li Lithium 6.941 | 4 Be Beryllium 9.012 | | | | | | | | | | | 13 B Boron 10.811 | 14 C Carbon 12.011 | 15 N Nitrogen 14.007 | 16 O Oxygen 15.999 | 17 F Fluorine 18.998 | 18 Ne Neon 20.180 |
| 11 Na Sodium 22.990 | 12 Mg Magnesium 24.305 | | | | | | | | | | | 13 Al Aluminum 26.982 | 14 Si Silicon 28.086 | 15 P Phosphorus 30.974 | 16 S Sulfur 32.066 | 17 Cl Chlorine 35.453 | 18 Ar Argon 39.948 |
| 19 K Potassium 39.098 | 20 Ca Calcium 40.078 | 21 Sc Scandium 44.956 | 22 Ti Titanium 47.867 | 23 V Vanadium 50.942 | 24 Cr Chromium 51.996 | 25 Mn Manganese 54.938 | 26 Fe Iron 55.845 | 27 Co Cobalt 58.933 | 28 Ni Nickel 58.693 | 29 Cu Copper 63.546 | 30 Zn Zinc 65.38 | 31 Ga Gallium 69.723 | 32 Ge Germanium 72.631 | 33 As Arsenic 74.922 | 34 Se Selenium 78.971 | 35 Br Bromine 79.904 | 36 Kr Krypton 84.738 |
| 37 Rb Rubidium 84.468 | 38 Sr Strontium 87.62 | 39 Y Yttrium 88.906 | 40 Zr Zirconium 91.224 | 41 Nb Niobium 92.906 | 42 Mo Molybdenum 95.95 | 43 Tc Technetium 98.907 | 44 Ru Ruthenium 101.07 | 45 Rh Rhodium 102.906 | 46 Pd Palladium 106.42 | 47 Ag Silver 107.868 | 48 Cd Cadmium 112.414 | 49 In Indium 114.818 | 50 Sn Tin 118.711 | 51 Sb Antimony 121.760 | 52 Te Tellurium 127.4 | 53 I Iodine 126.904 | 54 Xe Xenon 131.29 |
| 55 Cs Cesium 132.905 | 56 Ba Barium 137.327 | 57-71 Lanthanides | 72 Hf Hafnium 178.49 | 73 Ta Tantalum 180.948 | 74 W Tungsten 183.84 | 75 Re Rhenium 186.207 | 76 Os Osmium 190.23 | 77 Ir Iridium 192.227 | 78 Pt Platinum 195.085 | 79 Au Gold 196.967 | 80 Hg Mercury 200.592 | 81 Tl Thallium 204.383 | 82 Pb Lead 207.2 | 83 Bi Bismuth 208.980 | 84 Po Polonium [209] | 85 At Astatine [209] | 86 Rn Radon 222.018 |
| 87 Fr Francium [223] | 88 Ra Radium 226.025 | 89-103 Actinides | 104 Rf Rutherfordium [261] | 105 Db Dubnium [262] | 106 Sg Seaborgium [266] | 107 Bh Bohrium [264] | 108 Hs Hassium [269] | 109 Mt Meitnerium [268] | 110 Ds Darmstadtium [269] | 111 Rg Roentgenium [272] | 112 Cn Copernicium [277] | 113 Uut Ununtrium [278] | 114 Fl Flerovium [289] | 115 Uup Ununpentium [288] | 116 Lv Livermorium [293] | 117 Uus Ununseptium [294] | 118 Uuo Ununoctium [294] |
| 57 La Lanthanum 138.905 | 58 Ce Cerium 140.116 | 59 Pr Praseodymium 140.908 | 60 Nd Neodymium 144.242 | 61 Pm Promethium 144.913 | 62 Sm Samarium 150.36 | 63 Eu Europium 151.964 | 64 Gd Gadolinium 157.25 | 65 Tb Terbium 158.925 | 66 Dy Dysprosium 162.500 | 67 Ho Holmium 164.930 | 68 Er Erbium 167.259 | 69 Tm Thulium 168.934 | 70 Yb Ytterbium 173.055 | 71 Lu Lutetium 174.967 | | | |
| 89 Ac Actinium 227.028 | 90 Th Thorium 232.038 | 91 Pa Protactinium 231.036 | 92 U Uranium 238.029 | 93 Np Neptunium 237.048 | 94 Pu Plutonium 244.064 | 95 Am Americium 243.061 | 96 Cm Curium 247.070 | 97 Bk Berkelium 247.070 | 98 Cf Californium 251.080 | 99 Es Einsteinium [252] | 100 Fm Fermium 257.095 | 101 Md Mendelevium 258.1 | 102 No Nobelium 259.101 | 103 Lr Lawrencium [262] | | | |

Ref Table S : USE IT when you are asked about :
atomic radius, electronegativity,
ionization energy (trends)

1. The arrangement of the elements from left to right in Period 4 on the Periodic Table is based on
- A) atomic mass
 B) atomic number
 C) the number of electron shells
 D) the number of oxidation states
2. Which list of elements consists of a metal, a metalloid, and a nonmetal?
- A) Li, Na, Rb
 B) Cr, Mo, W
 C) Sn, Si, C ✓
 D) O, S, Te
3. Which list includes elements with the most similar chemical properties? *same group, same # of valence e⁻*
- A) Br, Ga, Hg
 B) Cr, Pb, Xe
 C) O, S, Se
 D) N, O, F
4. Which statement explains why sulfur is classified as a Group 16 element?
- A) A sulfur atom has 6 valence electrons.
 B) A sulfur atom has 16 neutrons.
 C) Sulfur is a yellow solid at STP.
 D) Sulfur reacts with most metals.
5. What is the charge of the nucleus of a copper atom?
- A) +1 B) +2 C) +29 D) +64
6. At STP, which element is a good conductor of electricity? *metal*
- A) chlorine B) iodine
 C) silver *Ag* D) sulfur
7. A solid element that is malleable, a good conductor of electricity, and reacts with oxygen is classified as a
- A) metal B) metalloid
 C) noble gas D) nonmetal
8. At STP, graphite and diamond are two solid forms of carbon. Which statement explains why these two forms of carbon differ in hardness?
- A) Graphite and diamond have different ionic radii.
 B) Graphite and diamond have different molecular structures.
 C) Graphite is a metal, but diamond is a nonmetal.
 D) Graphite is a good conductor of electricity, but diamond is a poor conductor of electricity.
9. Which element is *least* likely to undergo a chemical reaction?
- A) lithium B) carbon
 C) fluorine D) neon *Noble Gas*
10. Which phrase describes two forms of solid carbon, diamond and graphite, at STP?
- A) the same crystal structure and the same properties
 B) the same crystal structure and different properties
 C) different crystal structures and the same properties
 D) different crystal structures and different properties
11. Which general trends in atomic radius and electronegativity are observed as the elements in Period 3 are considered in order of increasing atomic number? *.9 Na 1.3 Mg 1.0 Al 1.6 Si 1.9 P 2.1 S 2.5 Cl 3.0 Ar*
- A) Atomic radius decreases and electronegativity increases.
 B) Atomic radius increases and electronegativity decreases.
 C) Both atomic radius and electronegativity increase.
 D) Both atomic radius and electronegativity decrease.
12. Which atom has the largest atomic radius?
- A) potassium *200* B) rubidium *215*
 C) francium *242* D) cesium *238*
13. Which list of elements is arranged in order of increasing electronegativity? *1.6, 1.3, 1.0, 4, 3.2, 3*
- A) Be, Mg, Ca B) F, Cl, Br
 C) K, Ca, Sc D) Li, Na, K
0.8, 1.0, 1.4 1.0, 0.9, 0.8

14. Which statement describes the general trends in electronegativity and atomic radius as the elements in Period 2 are considered in order from left to right?

- A) Both electronegativity and atomic radius increase.
- B) Both electronegativity and atomic radius decrease.
- C) Electronegativity increases and atomic radius decreases.
- D) Electronegativity decreases and atomic radius increases.

| | | | |
|-----|-----|-----|------|
| Li | Be | B | |
| 1.0 | 1.6 | 2.0 | EN ↑ |
| 130 | 99 | 84 | AR ↓ |

15. Which statement describes the general trends in electronegativity and first ionization energy as the elements in Period 3 are considered in order from Na to Cl?

- A) Electronegativity increases, and first ionization energy decreases.
- B) Electronegativity decreases, and first ionization energy increases.
- C) Electronegativity and first ionization energy both increase.
- D) Electronegativity and first ionization energy both decrease.

| | | | |
|-----|-----|-----|------|
| Na | Mg | Al | |
| 0.9 | 1.3 | 1.6 | EN ↑ |
| 496 | 738 | 578 | ↑ |

BONDING \rightarrow Stability

(making bonds releases energy,
breaking bonds absorbs energy)

IONIC

COVALENT

metal $\ddot{}$ nonmetal

* TRANSFER of electrons

nonmetal $\ddot{}$ nonmetal

* SHARING of electrons

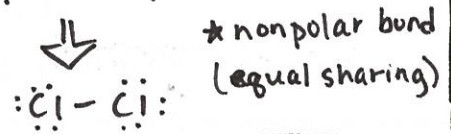
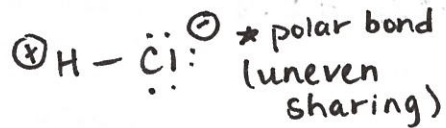
EXAMPLE:



strong attraction due to opposite charges

* ionic compounds have high BP

EXAMPLE:





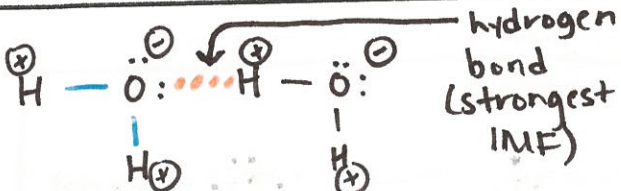
* POLAR vs NONPOLAR

covalent bond

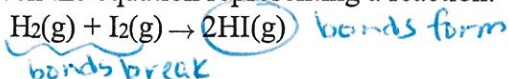
$\Delta \text{EN} \neq 0$
uneven distribution of charge

$\Delta \text{EN} = 0$
even distribution of charge

Let's compare 2 molecules: CO_2 and H_2O

| CO_2 | MOLECULE | H_2O |
|--|--------------------------------------|--|
| covalent | covalent or ionic? | covalent |
|  | Lewis Dot Diagram of each ATOM |  |
| $:\ddot{\text{O}} = \text{C} = \ddot{\text{O}}:$ | Diagram of MOLECULE |  hydrogen bond (strongest IMF) |
| $3.4 - 2.6 = 0.8$ | Δ EN between atoms | $3.4 - 2.2 = 1.2$ |
| polar | polar or nonpolar BONDS? | polar |
| YES - Symmetrical | Is the molecule symmetrical? | NO - asymmetrical |
| NONPOLAR * even distribution of charge | POLAR or NONPOLAR <u>MOLECULES</u> ? | POLAR * uneven distribution of charge |

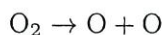
1. Given the equation representing a reaction:



Which statement describes the energy changes that occur in this reaction?

- A) Energy is absorbed as bonds are formed, only.
- B) Energy is released as bonds are broken, only.
- C) Energy is absorbed as bonds are formed, and energy is released as bonds are broken.
- D) Energy is absorbed as bonds are broken, and energy is released as bonds are formed.

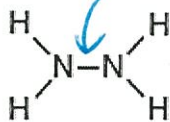
2. Given the balanced equation representing a reaction:



What occurs during this reaction?

- A) Energy is absorbed as bonds are broken.
- B) Energy is absorbed as bonds are formed.
- C) Energy is released as bonds are broken.
- D) Energy is released as bonds are formed.

3. Given the formula for hydrazine:



How many pairs of electrons are shared between the two nitrogen atoms?

- A) 1
- B) 2
- C) 3
- D) 4

4. Which atom in the ground state has a stable valence electron configuration? *Noble gas*

- A) Ar
- B) Al
- C) Si
- D) Na

5. Which term refers to how strongly an atom of an element attracts electrons in a chemical bond with an atom of a different element?

- A) entropy
- B) electronegativity
- C) activation energy
- D) first ionization energy

6. What occurs when *metal* potassium reacts with *nonmetal* chlorine to form potassium chloride?

- A) Electrons are shared and the bonding is ionic.
- B) Electrons are shared and the bonding is covalent.
- C) Electrons are transferred and the bonding is ionic.
- D) Electrons are transferred and the bonding is covalent.

7. Which formulas represent one ionic compound and one molecular compound?

- A) N_2 and SO_2
- B) Cl_2 and H_2S
- C) BaCl_2 and N_2O_4
- D) NaOH and BaSO_4

8. Element X reacts with chlorine to form an ionic compound that has the formula $X\text{Cl}_2$. To which group on the Periodic Table could element X belong?

- A) Group 1
- B) Group 2
- C) Group 13
- D) Group 15

9. A sample of a substance has these characteristics:

- melting point of 984 K
- hard, brittle solid at room temperature
- poor conductor of heat and electricity as a solid
- good conductor of electricity as a liquid or in an aqueous solution

This sample is classified as

- A) a metallic element
- B) a radioactive element
- C) a molecular compound
- D) an ionic compound



10. How many pairs of electrons are shared between the nitrogen atoms in a molecule of N_2 ?

- A) 5 B) 2 **C) 3** D) 6

11. Which compound has the strongest hydrogen bonding between its molecules? **FON**

- A) ~~HBr~~ B) ~~HCl~~ **C) HF** D) ~~HI~~

12. Which pair of atoms is held together by a covalent bond?

- A) HCl** B) LiCl C) NaCl D) KCl

13. Which pair of atoms has the most polar bond? **ΔEN**

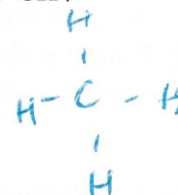
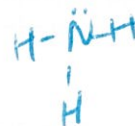
- A) H - Br B) H - Cl
C) I - Br D) I - Cl

14. A molecule must be nonpolar if the molecule

- A) is linear
B) is neutral
C) has ionic and covalent bonding
D) has a symmetrical charge distribution

15. Which formula represents a polar molecule?

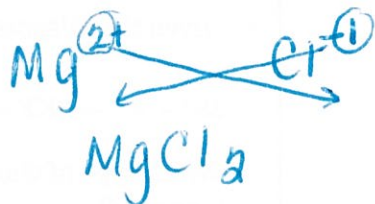
- A) O_2 B) CO_2 **C) NH_3** D) CH_4



FORMULA WRITING

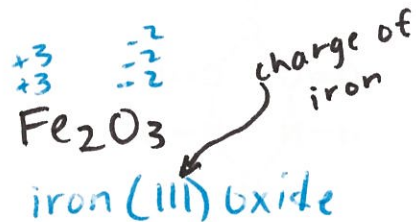
* Ionic compounds

↳ magnesium chloride



↳ Al_2O_3

aluminum oxide



iron(III) oxide

* structural formula (ex: $\begin{array}{c} \text{H} & \text{H} \\ | & | \\ \text{H}-\text{C}-\text{C}-\text{H} \\ | & | \\ \text{H} & \text{H} \end{array}$)

* molecular formula (ex: C_2H_6)

↓ ÷ by GCF

* empirical formula (ex: CH_3)

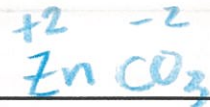
* Types of Reactions

↳ synthesis $A+B \rightarrow AB$

↳ decomposition $AB \rightarrow A+B$

↳ Single Replacement $A+BC \rightarrow AC+B$

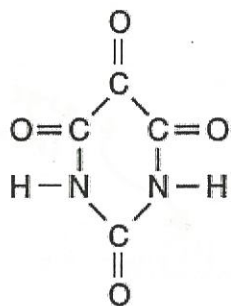
↳ Double Replacement $AB+CD \rightarrow AC+BD$



1. Which formula is an empirical formula?

- A) CH₄ B) C₂H₆
C) C₃H₆ D) C₄H₁₀

2. Given the formula for a compound:



Which molecular formula and empirical formula represent this compound?

- A) C₂HNO₂ and CHNO
B) C₂HNO₂ and C₂HNO₂
C) C₄H₂N₂O₄ and CHNO
D) C₄H₂N₂O₄ and C₂HNO₂

3. Given two formulas representing the same compound:

Formula A CH₃

Formula B C₂H₆

Which statement describes these formulas?

- A) Formulas A and B are both empirical.
B) Formulas A and B are both molecular.
C) Formula A is empirical, and formula B is molecular.
D) Formula A is molecular, and formula B is empirical.

4. Which list includes three type of chemical formulas for organic compounds?

- A) covalent, metallic, isotopic
B) covalent, metallic, molecular
C) empirical, structural, isotopic
D) empirical, structural, molecular

5. What is the chemical formula for zinc carbonate?

- A) ZnCO₃ B) Zn(CO₃)₂
C) Zn₂CO₃ D) Zn₃CO₂

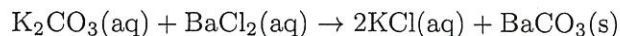
6. Given the balanced equation:



Which type of chemical reaction does this equation represent?

- A) synthesis
B) decomposition
C) single replacement
D) double replacement

7. Given the balanced equation representing a reaction:



Which type of reaction is represented by this equation?

- A) synthesis
B) decomposition
C) single replacement
D) double replacement

8. Which list includes three types of chemical reactions?

- A) decomposition, single replacement, and solidification
B) decomposition, single replacement, and double replacement
C) solidification, double replacement, and decomposition
D) solidification, double replacement, and single replacement

9. Which terms identify types of chemical reactions?

- A) decomposition and sublimation
B) decomposition and synthesis
C) deposition and sublimation
D) deposition and synthesis
- solid → gas*

10. In which type of chemical reaction do two or more reactants combine to form one product, only?

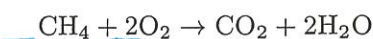
- A) synthesis
B) decomposition
C) single replacement
D) double replacement

11. Which equation represents a decomposition reaction?

- A) $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
B) $\text{Cu}(\text{s}) + 2\text{AgNO}_3(\text{aq}) \rightarrow 2\text{Ag}(\text{s}) + \text{Cu}(\text{NO}_3)_2(\text{aq})$
C) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$
D) $\text{KOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{KCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
-

MATH of CHEM

1. Given the balanced equation representing the reaction between methane and oxygen:

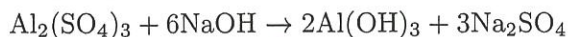


Coefficients

According to this equation, what is the mole ratio of oxygen to methane?

- A) $\frac{1 \text{ gram O}_2}{2 \text{ grams CH}_4}$ B) $\frac{1 \text{ mole O}_2}{2 \text{ moles CH}_4}$
C) $\frac{2 \text{ grams O}_2}{1 \text{ gram CH}_4}$ D) $\frac{2 \text{ moles O}_2}{1 \text{ mole CH}_4}$

2. Given the balanced equation representing a reaction:

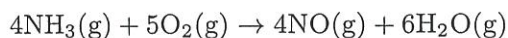


The mole ratio of NaOH to Al(OH)₃ is

- A) 1:1 B) 1:3 C) 3:1 D) 3:7

reduced form

3. Given the balanced equation representing a reaction:



What is the number of moles of H₂O(g) formed when 2.0 moles of NH₃(g) react completely?

- A) 6.0 mol B) 2.0 mol
C) 3.0 mol D) 4.0 mol

* dimensional analysis

$$2 \text{ mol NH}_3 \times \left(\frac{6 \text{ mol H}_2\text{O}}{4 \text{ mol NH}_3} \right) = 3 \text{ mol H}_2\text{O}$$

4. Given the balanced ionic equation:



What is the number of moles of electrons gained by 3.0 moles of lead ions?

- A) 5.0 mol B) 2.0 mol
C) 3.0 mol D) 6.0 mol

$$3 \text{ mol Pb}^{2+} \times \left(\frac{2 \text{ mol e}^-}{1 \text{ mol Pb}^{2+}} \right) = 6 \text{ mol}$$

5. Given the balanced equation representing a reaction:



Which mass of oxygen completely reacts with 4.0 grams of hydrogen to produce 36.0 grams of water?

- A) 8.0 g B) 16.0 g
C) 32.0 g D) 40.0 g

* conservation of mass



$$4 + x = 36$$

$$x = 32$$

P.T.

6. What is the gram-formula mass of $\text{Ca}(\text{OH})_2$?

- A) 29 g/mol B) 54 g/mol
C) 57 g/mol D) 74 g/mol

$$\begin{array}{r} \text{Ca: } 1(40.1) = 40.1 \\ \text{O: } 2(16) = 32 \\ \text{H: } 2(1) = 2 \\ \hline 74 \end{array}$$

7. The formula mass of a compound is the

- A) sum of the atomic masses of its atoms
B) sum of the atomic numbers of its atoms
C) product of the atomic masses of its atoms
D) products of the atomic numbers of its atoms

8. What is the percent composition by mass of nitrogen in $(\text{NH}_4)_2\text{CO}_3$ (gram-formula mass = 96.0 g/mol)?

- A) 14.6% B) 29.2%
C) 58.4% D) 87.5%

$$\begin{aligned} \% \text{ by mass} &= \frac{\text{mass part}}{\text{mass whole}} \times 100 \\ &= \frac{2(14)}{96} \times 100 \end{aligned}$$

Nitrogen

9. What is the percent composition by mass of sulfur in the compound MgSO_4 (gram-formula mass = 120. grams per mole)?

- A) 20% B) 27% C) 46% D) 53%

$$\% = \frac{32}{120} \times 100$$

10. A student measures the mass and volume of a sample of copper at room temperature and 101.3 kPa. The mass is 48.9 grams and the volume is 5.00 cubic centimeters. The student calculates the density of the sample. What is the percent error of the student's calculated density?

$$\begin{aligned} D &= \frac{m}{V} = \frac{48.9}{5} = 9.78 \\ \% \text{ error} &= \frac{m_v - a_v}{a_v} \times 100 \\ &= \frac{9.78 - 8.96}{8.96} \times 100 \\ &= 9.15\% \end{aligned}$$

use Tables

11. A solution is made by dissolving 70.0 grams of KNO_3 (s) in 100. grams of water at $50.^\circ\text{C}$ and standard pressure. Show a numerical setup for calculating the percent by mass of KNO_3 in the solution.

$$\% \text{ by mass} = \frac{\text{part}}{\text{whole}} \times 100$$

$$= \frac{70}{100+70} \times 100$$

whole solution = water + solute (solvent)

1. According to Table F, which ions combine with chloride ions to form an insoluble compound?

- A) Fe^{2+} ion B) Ca^{2+} ions
C) Li^{+} ions D) Ag^{+} ions

2. Which compound is insoluble in water?

- A) calcium bromide B) potassium bromide
C) silver bromide D) sodium bromide

3. Which barium salt is *insoluble* in water?

- A) BaCO_3 B) BaCl_2
C) $\text{Ba}(\text{ClO}_4)_2$ D) $\text{Ba}(\text{NO}_3)_2$

4. Which compound is insoluble in water?

- A) BaSO_4 B) CaCrO_4
C) KClO_3 D) Na_2S

5. Which ion, when combined with chloride ions, Cl^- , forms an insoluble substance in water?

- A) Fe^{2+} B) Mg^{2+} C) Pb^{2+} D) Zn^{2+}

6. According to Reference Table G, how many grams of KNO_3 would be needed to saturate 200 grams of water at 70°C ?

- A) 43 g B) 86 g C) 134 g D) 268 g

7. An unsaturated aqueous solution of NH_3 is at 90°C in 100. grams of water. According to Reference Table G, how many grams of NH_3 could this unsaturated solution contain?

- A) 5 g B) 10. g C) 15 g D) 20. g

8. According to your Reference Tables, which substance forms an unsaturated solution when 80 grams of the substance is dissolved in 100 grams of H_2O at 10°C ?

- A) KI B) KNO_3
C) NaNO_3 D) NaCl

9. At standard pressure, which substance becomes *less* soluble in water as temperature increases from 10°C to 80°C ?

- A) HCl B) KCl
C) NaCl D) NH_4Cl

10. The solubility of $\text{KCl}(s)$ in water depends on the

- A) pressure on the solution
B) rate of stirring
C) size of the KCl sample
D) temperature of the water

11. What is the total mass of KNO_3 that must be dissolved in 50. grams of H_2O at 60°C to make a saturated solution?

- A) 32 g B) 53 g C) 64 g D) 106 g

12. What is the mass of NH_4Cl that must dissolve in 200. grams of water at 50°C to make a saturated solution?

- A) 26 g B) 42 g
C) 84 g D) 104 g

13. A 2400.-gram sample of an aqueous solution contains 0.012 gram of NH_3 . What is the concentration of NH_3 in the solution, expressed as parts per million?

- A) 5.0 ppm B) 15 ppm
C) 20. ppm D) 50. ppm