

CHEM 101
 Exam 4:
 December 3, 2021
 Instructor: Lida Farsi

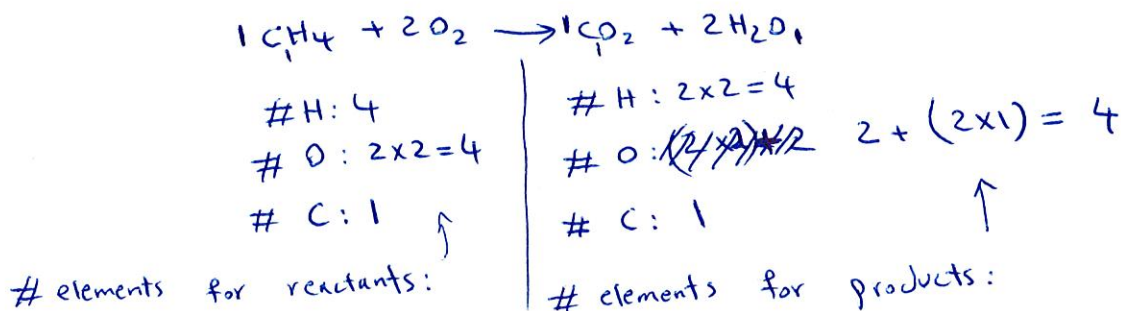
Clearly print your name in the name section of the Scantron answer sheet.

There is only one most correct response to each of the multiple-choice questions. Each question is worth 4 points.

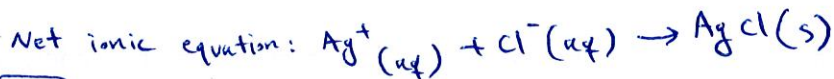
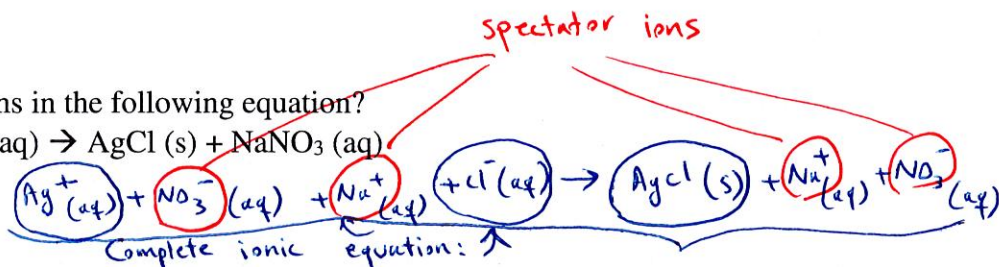
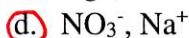
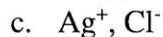
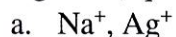
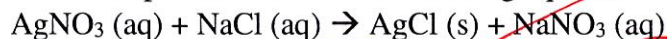
- Which of the following is NOT a combustion reaction?
 - $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$
 - $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
 - $2\text{HCl}(\text{aq}) + \text{K}_2\text{S}(\text{aq}) \rightarrow \text{H}_2\text{S}(\text{g}) + 2\text{KCl}(\text{aq})$ \Rightarrow No oxygen \Rightarrow Not a combustion reaction
 - $\text{CH}_3\text{OH}(\text{l}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$
- Is the following statement True or False? "All acid-base reactions are gas evolution reactions"

Many gas evolution reactions are also acid-base reactions.

 - True
 - False
- Which changes involve a chemical reaction?
 - Ice melting upon warming
 - Bubbles forming when a soda can is opened
 - An electric current passing through water, resulting in the formation of hydrogen and oxygen gas
 - Dry ice subliming
- Which of the following does NOT provide evidence of a chemical reaction?
 - A color change
 - The formation of a solid in a previously clear solution
 - The emission or absorption of heat
 - All of the above provide evidence of a chemical reaction
- Which equation is balanced?
 - $\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
 - $\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
 - $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
 - $2\text{CH}_4(\text{g}) + 25\text{O}_2(\text{g}) \rightarrow 16\text{CO}_2(\text{g}) + 18\text{H}_2\text{O}(\text{g})$



6. What are the spectator ions in the following equation?



7. Which of the following is **NOT** a gas evolution reaction?

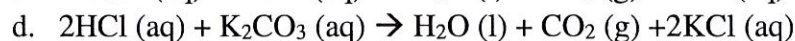
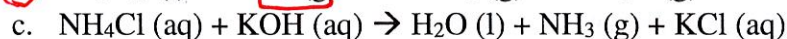
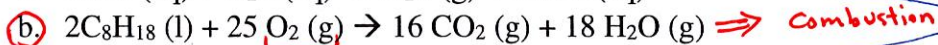
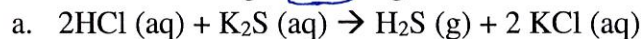


table 7.4

8. Is the following statement True or False? "Reactions involving the transfer of electrons are called oxidation-reduction reactions or redox reaction."

a. True

b. False

9. Which of the following compounds are insoluble in water?



$\Rightarrow \text{Li}^+, \text{NH}_4^+, \text{K}^+$ form compounds that are ALWAYS Soluble.

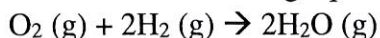
Table 7.2

10. Is the following statement True or False? "Greenhouse gases act like glass in a greenhouse, allowing visible-light energy to enter the atmosphere but preventing heat energy from escaping."

a. True

b. False

11. Consider the following equation:



How many moles of H_2O result from the complete reaction of 20 mol of H_2 ? Assume that there is more than enough O_2 .

a. 40

b. 10

c. 18

d. 20

$$? \text{ mol H}_2\text{O} = 20 \text{ mol H}_2 \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol H}_2} = 20 \text{ mol H}_2\text{O}$$

12. Excessive exposure to which of the following electromagnetic radiation is NOT harmful to humans?

- a. Gamma rays
- b. Visible light
- c. X-rays
- d. Ultraviolet

13. Which of the following has the shortest wavelength?

- a. Radio waves
- b. X-rays
- c. Infrared
- d. Microwaves

Figure 9.4

14. Is the following statement True or False?

In the Bohr model of the atom, ~~several numbers~~ are used to specify each ~~orbital~~.

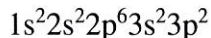
- a. True
- b. False

a single quantum number

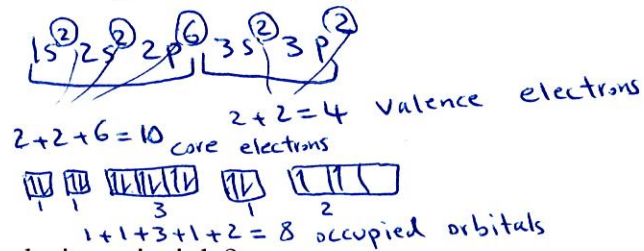
15. What is the shape of "s" and "p" orbitals?

- a. s: dumbbell, p: sphere
- b. s: sphere, p: dumbbell
- c. s: donut, p: clover
- d. s: clover, p: donut

16. What information cannot be inferred from the following electronic configuration?



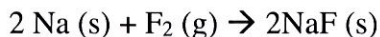
- a. This element has 14 electrons
- b. This element has 4 valence electrons
- c. This element has 10 core electrons
- d. This element has 2 orbitals overall



17. Which of the following represents the Pauli exclusion principle?

- a. ~~Orbits~~ may hold no more than two electrons in the first shell, no more than eight electrons in the second shell, and no more than 18 electrons in the third shell.
- b. ~~Orbits~~ may hold no more than two electrons with opposing spins.
- c. Orbitals may hold no more than two electrons in the first shell, no more than eight electrons in the second shell, and no more than 18 electrons in the third shell.
- d. Orbitals may hold no more than two electrons with opposing spins.

18. Consider the reaction:

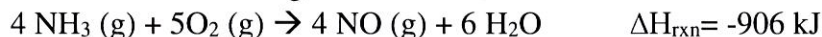


If you begin with 10 mol of sodium (Na) and 6 mol of fluorine (F₂), what is the limiting reactant and theoretical yield of NaF in moles?

- a. Na, 10 mol
 b. F₂, 10 mol
 c. Na, 12 mol
 d. F₂, 12 mol

? mol NaF = 10 mol ~~Na~~ $\times \frac{2 \text{ mol NaF}}{2 \text{ mol Na}} = 10 \text{ mol NaF}$ *Limiting reactant*
 ? mol NaF = 6 mol ~~F₂~~ $\times \frac{2 \text{ mol NaF}}{1 \text{ mol F}_2} = 12 \text{ mol NaF}$ *Theoretical yield*

19. Consider the following reaction:



Calculate the heat (in kJ) associated with the complete reaction of 25 g of NH₃.

- a. -22650
 b. -1329.2
 c. -0.003
 d. -332.3

? kJ = 25 g NH₃ $\times \frac{1 \text{ mol NH}_3}{17.04 \text{ g NH}_3} \times \frac{-906 \text{ kJ}}{4 \text{ mol NH}_3} = -332.3 \text{ kJ}$

$\text{NH}_3 = (14.01 \times 1) + (1.01 \times 3) = 17.04$

20. Write the electron configuration for vanadium:

- a. 1s²2s²2p⁶3s²3p⁶3d⁵
 b. 1s²2s²2p¹⁰3s²3p⁶3d³
 c. 1s²2s²2p⁶3s²3d⁶4s²3p³
 d. 1s²2s²2p⁶3s²3p⁶4s²3d³

This is how we fill orbitals:
 1s 2s 2p 3s 3p 4s 3d 4p
 - So a and b are wrong.
 - c is also wrong

21. Is the following statement True or False? "As we move to the right across a period, or row, in the periodic table, atomic size increases"

- a. True
 b. False

22. Is the following statement True or False: "As we move down a column (or family) in the periodic table, ionization energy increases"

- a. True
 b. False

23. Is the following statement True or False? "To balance a chemical equation, we should insert coefficients in front of the chemical formulas. But if the equation is difficult to balance, we are allowed to ~~also~~ ~~change~~ the ~~subscripts~~ of some elements to make sure the number of each type of atom in the reactants equals the number of each type of atom in the products."

- a. True
 b. False

~~N~~
~~14.01~~

N
 14.01

H
 1.01

24. Fill in the blank with the correct word: “The quantitative relationship between reactants and products in a chemical reaction is reaction _____.”

- a. Limiting reactant
- b. Molar mass
- c. Theoretical yield
- d. Stoichiometry

25. What does the following definition represent? “The amount of thermal energy emitted or absorbed by a chemical reaction, under conditions of constant pressure.”

- a. Entropy
- b. Internal energy
- c. Work
- d. Enthalpy

Appendix 1: Periodic Table of the Elements

Periodic Table of the Elements

1 H Hydrogen 1.01																	2 He Helium 4.00
3 Li Lithium 6.94	4 Be Beryllium 9.01											5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18
11 Na Sodium 22.99	12 Mg Magnesium 24.31	3	4	5	6	7	8	9	10	11	12	13 Al Aluminum 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.95
19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.88	23 V Vanadium 50.94	24 Cr Chromium 51.99	25 Mn Manganese 54.94	26 Fe Iron 55.85	27 Co Cobalt 58.93	28 Ni Nickel 58.69	29 Cu Copper 63.55	30 Zn Zinc 65.38	31 Ga Gallium 69.72	32 Ge Germanium 72.63	33 As Arsenic 74.92	34 Se Selenium 78.97	35 Br Bromine 79.90	36 Kr Krypton 84.80
37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.95	43 Tc Technetium 98.91	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.6	53 I Iodine 126.90	54 Xe Xenon 131.29
55 Cs Cesium 132.91	56 Ba Barium 137.33	57-71 Lanthanides	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.85	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.20	83 Bi Bismuth 208.98	84 Po Polonium [209]	85 At Astatine [209]	86 Rn Radon 222.02
87 Fr Francium 223.02	88 Ra Radium 226.03	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 [278]	110 Ds Darmstadtium [281]	111 Rg Roentgenium [280]	112 Cn Copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [289]	116 Lv Livermorium [293]	117 Ts Tennessine [294]	118 Og Oganesson [294]
57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium 144.91	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.06	71 Lu Lutetium 174.97			
89 Ac Actinium 227.03	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium 237.05	94 Pu Plutonium 244.06	95 Am Americium 243.06	96 Cm Curium 247.07	97 Bk Berkelium 247.07	98 Cf Californium 251.08	99 Es Einsteinium [254]	100 Fm Fermium 257.10	101 Md Mendelevium 258.10	102 No Nobelium 259.10	103 Lr Lawrencium [262]			

Alkali Metal
Alkaline Earth
Transition Metal
Basic Metal
Metalloid
Nonmetal
Halogen
Noble Gas
Lanthanide
Actinide