

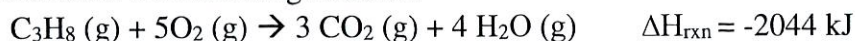
CHEM 101

Make-up Exam 4:

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

- Which of the following does not involve a chemical reaction?
  - Iron rusting when left outside.
  - Dew condensing on grass during the night.
  - Copper turns green on exposure to air.
  - A pure copper penny forms bubbles of a dark brown gas when dropped into nitric acid. The nitric acid solution turns blue.
- By balancing chemical equations what law is being demonstrated?
  - Law of conservation of energy
  - Bohr's model
  - Quantum-mechanical model
  - Law of conservation of mass
- What is an aqueous solution?
  - Heterogenous mixture of a substance with water
  - Heterogenous mixture of a substance with any liquid
  - Homogeneous mixture of a substance with water
  - Homogeneous mixture of a substance with any liquid
- Which of the following does not describe a base?
  - Bitter taste
  - Slippery feel
  - Ability to dissolve metals
  - Tendency to form  $\text{OH}^-$  in solution
- Is the following statement True or False? "The water formed in combustion reactions may be gaseous (g) or liquid (l) depending on the reaction conditions."
  - True
  - False
- Is the following statement True or False? "All combustion reactions are also oxidation-reduction reactions?"
  - True
  - False

7. What is the most significant greenhouse gas in terms of its contribution to climate?
- CO
  - SO<sub>2</sub>
  - NO<sub>2</sub>
  - CO<sub>2</sub>
8. Fill in the blanks with correct words: "If we consider baking pancakes as an analogy for chemical reactions, ingredients would be our \_\_\_\_\_, pancakes would be our \_\_\_\_\_, and the recipe would be \_\_\_\_\_."
- Products, reactants, stoichiometry
  - Reactants, products, stoichiometry
  - Products, reactants, chemical formula
  - Reactants, products, chemical formula
9. What is limiting reagent?
- The reactant that makes the most amount of product
  - The product that makes the most amount of reactant
  - The reactant that makes the least amount of product
  - The product that makes the least amount of reactant
10. Fill in the blanks with correct words: "The amount of \_\_\_\_\_ emitted or absorbed by a chemical reaction, under conditions of constant \_\_\_\_\_, can be quantified with a function called enthalpy."
- Internal energy, pressure
  - Thermal energy, pressure
  - Internal energy, temperature
  - Thermal energy, temperature
11. Consider the following reaction:



Which conversion factor does not correspond to the above chemical equation?

- $\frac{1 \text{ mol C}_3\text{H}_8}{5 \text{ mol O}_2}$
- $\frac{1 \text{ mol C}_3\text{H}_8}{3 \text{ mol CO}_2}$
- $\frac{1 \text{ mol C}_3\text{H}_8}{-2044 \text{ kJ}}$
- $\frac{5 \text{ mol O}}{-2044 \text{ kJ}}$

12. What is the periodic law?
- When the mixtures are arranged on order of increasing acharges, certain sets of properties recur periodically.
  - When the mixtures are arranged in order of increasing atomic number, certain sets of properties recur periodically.
  - When the elements are arranged in order of increasing charges, certain sets of properties recur periodically.
  - When the elements are arranged in order of increasing atomic number, certain sets of properties recur periodically.
13. Is the following statement True or False: “orange light has a shorter wavelength than blue light.”
- True
  - False
14. Which of the following does the Bohr model explain?
- Why do atoms, when excited with energy emit light at a continuous spectrum?
  - Why do atoms, when excited with energy, emit light only at particular wavelengths
  - Predict the emission spectra of helium
  - Predict the emission spectra of lithium
15. What is the ground state of hydrogen atom?
- The single electron of undisturbed hydrogen atom at room temperature is in the 1s orbital. This is the ground state, or lowest energy state, of the hydrogen atom.
  - The single electron of undisturbed hydrogen atom at room temperature is in the 2s orbital. This is the ground state, or lowest energy state, of the hydrogen atom.
  - The two electrons of undisturbed hydrogen atom at room temperature are in the 1s orbital. This is the ground state, or lowest energy state, of the hydrogen atom.
  - The two electrons of undisturbed hydrogen atom at room temperature are in the 2s orbital. This is the ground state, or lowest energy state, of the hydrogen atom.
16. Is the following statement True or False? “ The 2s orbital is similar to 1s orbital, but smaller in size.”
- True
  - False
17. What does the following explanation represent? “When filling orbitals of equal energy, electrons fill them singly first, with parallel spin.”
- Pauli exclusion principle
  - Hund’s rule
  - Bohr’s model
  - Quantum mechanical model



18. Which of the following statements is True?
- a. The s subshell can hold maximum 1 electron.
  - b. The p subshell can hold maximum 3 electrons.
  - c.** The d subshell can hold maximum 10 electrons.
  - d. The f subshell can hold maximum 7 electrons.

19. How many valence and core electrons silicon has?

- a.** Valence = 4, core = 10
- b. Valence = 4, core = 14
- c. Valence = 10, core = 4
- d. Valence = 14, core = 4

20. Consider the equation for combustion of methane (CH<sub>4</sub>). If ΔH<sub>rxn</sub> = -802.3 kJ when 1 mol CH<sub>4</sub> is burned, how much heat is produced by the combustion of 237 g of CH<sub>4</sub>?

- a.** -11847 kJ
- b. -4320 kJ
- c. -5924 kJ
- d. -8640 kJ

$$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$$

$$? \text{ kJ} = 237 \text{ g CH}_4 \times \frac{1 \text{ mol CH}_4}{12.01 + (1.01 \times 4)} \times \frac{-802.3 \text{ kJ}}{1 \text{ mol CH}_4} = -11847 \text{ kJ}$$

Actual yield

21. A reaction has a theoretical yield of 22.8 g. When the reaction is carried out, 15.1 g of the product is obtained. What is the percent yield?

- a. 151 %
- b.** 66 %
- c. 51 %
- d. 196 %

$$\text{Percent yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100\%$$

$$= \frac{15.1 \text{ g}}{22.8 \text{ g}} \times 100\% = 66.23\%$$

Theoretical yield  
↑↑  
Smallest number

22. Consider the generic reaction: 2A + 3B + 4C → D

A reaction mixture contains 6 mol A; 8 mol B; and 12 mol C. What is the limiting reactant?

- a.** B
- b. A
- c. C
- d. A and C are both limiting reactants

$$? \text{ mol D} = 6 \text{ mol A} \times \frac{1 \text{ mol D}}{2 \text{ mol A}} = 3 \text{ mol D}$$

$$? \text{ mol D} = 8 \text{ mol B} \times \frac{1 \text{ mol D}}{3 \text{ mol B}} = \frac{8}{3} = 2.67 \text{ mol D}$$

limiting reactant ← B

$$? \text{ mol D} = 12 \text{ mol C} \times \frac{1 \text{ mol D}}{4 \text{ mol C}} = 3 \text{ mol D}$$

23. What is the maximum number of electrons that can occupy the n=3 quantum shell?

- a.** 18
- b. 4
- c. 9
- d. 8

$$1s^2 2s^2 2p^6 \quad 3s^2 3p^6 \quad 4s^2 \quad 3d^{10}$$

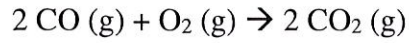
$$2 + 6 + 10 = 18$$

24. What element has the following electron configuration? "1s<sup>2</sup>2s<sup>2</sup>2p<sup>6</sup>3s<sup>2</sup>3p<sup>6</sup>3d<sup>10</sup>"

- a. Ni
- b. Si
- c. Na
- d. No element has the above electron configuration**

1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup> (4s<sup>2</sup>) 3d<sup>10</sup>  
 First we should fill out 4s<sup>2</sup>

25. Consider the reaction:



If a reaction mixture contains 28 g of CO and 32 g of O<sub>2</sub>, what is the theoretical yield?

- a. 34516 g
- b. 88 g
- c. 44 g**
- d. 90132 g

? g CO<sub>2</sub> = 28 g CO ×  $\frac{1 \text{ mol CO}}{12.01 + 16 \text{ g CO}}$  ×  $\frac{2 \text{ mol CO}_2}{2 \text{ mol CO}}$  ×  $\frac{12.01 + (16 \times 2) \text{ g CO}_2}{1 \text{ mol CO}_2}$   
 Theoretical yield ← Smaller number ← = 43.99 g CO<sub>2</sub>

? g CO<sub>2</sub> = 32 g O<sub>2</sub> ×  $\frac{1 \text{ mol O}_2}{(16 \times 2) \text{ g O}_2}$  ×  $\frac{2 \text{ mol CO}_2}{1 \text{ mol O}_2}$  ×  $\frac{12.01 + 32 \text{ g CO}_2}{1 \text{ mol CO}_2}$   
 = 88.02 g CO<sub>2</sub>

**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											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

