

Unless otherwise specified, each question is worth 11 points.

1. explain the difference between a hypothesis, law & theory
2. perform conversion calculations, including density, using appropriate significant figures
3. interpret molar mass, atomic mass, atomic number and charges associated with atoms and ions in terms of sub-atomic particles (protons, neutrons & electrons)
4. write names and formulas for simple inorganic compounds
5. perform mass→moles and moles→mass mole calculations for elements and/or compounds
6. balance simple chemical equations and perform stoichiometry calculations involving masses of reactants and products
7. predict products for acid-base and/or precipitation reactions; write chemical equations for these reactions, including net ionic equations
8. identify acids, bases, reducing agents, oxidizing agents, element reduced and element oxidized in acid/base and redox reactions
9. explain macroscopic properties of gases – such as pressure, temperature & volume – in terms of the Kinetic Molecular Theory
10. perform stoichiometry calculations involving gases
11. calculate enthalpies of reactions, kJ/mol (at constant pressure) from heat associated with chemical reactions (like with did in lab with masses of “surroundings”, ΔT values, and specific heat values)
12. perform reaction enthalpy calculations from standard enthalpies of formation of reactants and products
13. write balanced equations for nuclear reactions
14. predict likely modes of radioactive decay for given nuclides
15. perform calculations associated with (first-order) nuclear decay reactions including rate constants (k), half-lives ($t_{1/2}$), time, and initial/current quantities and/or rates
16. perform calculations associated with mass defects and binding energy associated with nuclear reactions
17. explain the difference between nuclear fusion and fission; identify likely reactants for these two different processes; identify products of these processes
18. explain how chemical properties of a radioactive nuclide effect its toxicity

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Abbreviated Periodic Table of the Elements

1 1A 1 H 1.01	2 2A 3 Li 6.94	4 4A 4 Be 9.01											13 3A 5 B 10.81	14 4A 6 C 12.01	15 5A 7 N 14.01	16 6A 8 O 16.00	17 7A 9 F 19.00	18 8A 10 Ne 20.18															
11 Na 22.99	12 Mg 24.31	3 3B 21 Sc 44.96	4 4B 22 Ti 47.88	5 5B 23 V 50.94	6 6B 24 Cr 52.00	7 7B 25 Mn 54.94	8 8B 26 Fe 55.85	9 8B 27 Co 58.93	10 8B 28 Ni 58.69	11 1B 29 Cu 63.55	12 2B 30 Zn 65.38	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95																
19 K 39.10	20 Ca 40.08	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3														
55 Cs 132.9	56 Ba 137.3	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	87 Fr (223)	88 Ra 226	103 Lr (262)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs (265)	109 Mt (268)	110 Ds (271)	111 Rg (272)	112 Uub	113	114	115	84 Po (209)	85 At (210)	86 Rn (222)

POSSIBLY HELPFUL INFORMATION:

$$R \text{ (gas constant)} = 0.08206 \left(\frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} \right)$$

$$K = ^\circ\text{C} + 273.15$$

$$\text{Avogadro's Number} = 6.022 \times 10^{23}$$

$$1 \text{ kg} = 6.022 \times 10^{26} \text{ amu}$$

$$1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2/\text{s}^2$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

$$\Delta E = \Delta m \cdot c^2$$

$$1 \text{ atm} = 760 \text{ mmHg} = 760 \text{ torr}$$

$$1 \text{ L} \cdot \text{atm} = 101.333 \text{ J}$$

Radioactive Decay (first-order kinetics):

$$\text{Rate} = k \cdot N$$

$$\ln(N/N_0) = -k \cdot t$$

$$t_{1/2} = \ln(2)/k$$

$$^1\text{H} \text{ (1 proton + 1 electron) mass} = 1.007825 \text{ amu}$$

$$\text{neutron mass} = 1.008665 \text{ amu}$$

$$1 \text{ mol} = 6.022 \times 10^{23}$$

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Water Solubility Rules (ref. Table 4.1, p. 144, *Chemistry, seventh edition, Zumdahl & Zumdahl*)

Note that there may be a number of exceptions to these rules, and/or there are more subtle classifications ("partially soluble", "somewhat soluble", "marginally soluble", etc.), but these are the rules that we will use in CHM 101.

0. Any ionic compound that is indicated as aqueous(aq), should be considered water soluble for CHM 101.
1. (*Required memorization*)
2. (*Required memorization*)
3. Most chloride, bromide, and iodide salts are soluble. EXCEPTIONS (for CHM 101): chloride, bromide, and iodide salts containing Ag^+ , Pb^{2+} , and Hg_2^{2+} are INSOLUBLE.
4. Most sulfate salts are soluble. EXCEPTIONS (for CHM 101): BaSO_4 , PbSO_4 , Hg_2SO_4 , and CaSO_4 , are INSOLUBLE.
5. Most hydroxide salts are insoluble, unless rule #2 applies to the compound.
6. Most sulfide (S^{2-}), carbonate (CO_3^{2-}), chromate (CrO_4^{2-}), and phosphate (PO_4^{3-}) salts are insoluble, unless rule #2 applies to the compound.

SOME of the Rules for ASSIGNING OXIDATION NUMBERS: (ref. Table 4.2, p. 156, *Chemistry, seventh edition, Zumdahl & Zumdahl*)

1. (*required memorization*)
2. (*required memorization*)
3. **fluorine = -1** (HF , CF_4 , ...)
4. **oxygen = -2** (H_2O , CO_2 , ...); except peroxide = $\text{O}_2^{2-} = -1$ (H_2O_2 , NaO ,...)
5. **hydrogen = +1** (H_2O , NH_3 ,...)
6. (*required memorization*)
7. (*required memorization*)

SOME of the steps for Balancing Oxidation-Reduction ("Redox") Reactions (ref. chapter 4, section 4.10, *Chemistry, seventh edition, Zumdahl & Zumdahl*)

- 2a. balance all elements other than O & H
- 2b. balance O with H_2O
- 2c. balance H with H^+
- 2d. balance charge with electrons (e^-)