Name:

Exam Chemistry 101 for Chemical Engineers

Questions from Chapter-2: Atoms and Atomic Theory

1) What is the correct symbol for the species that contains 18 neutrons, 17 protons, and 16 electrons?

2) Which of the following have the same charge and approximately the same mass?
   a. an electron and a proton;
   b. a proton and a neutron;
   c. a hydrogen atom and a proton;
   d. a neutron and a hydrogen atom;
   e. an electron and ion.

3) Arrange the following species in order of increasing
   (a) number of electrons;
   (b) number of neutrons;
   (c) mass.

   ${}^{112}_{50}Sn$, ${}^{40}_{18}Ar$, ${}^{122}_{52}Te$, ${}^{59}_{29}Cu$, ${}^{120}_{48}Cd$, ${}^{58}_{27}Co$, ${}^{39}_{29}K$

Questions from Chapter-3: Compounds

4) Write the names of the following chemicals:
   a. SiF_4 :
   b. BCl_3 :
   c. MgI_2 :
   d. Al_2O_3 :
   e. N_2O_5 :

5) Write the formulas for the following chemicals:
   a. Carbon tetrachloride :
   b. Hydrochloric acid :
   c. Ammonium Bromide :
   d. Copper (II) Chloride :
   e. Sodium Sulfate :

6) Determine the number of Moles and number of molecules or atoms of
   a. N_2O_4 in a 115 g sample
   b. N atoms in 43.5 of $Mg(NO_3)_2$
   c. N atoms in a sample of $C_7H_5(NO_2)_3$ that has the same number of O atoms as 12.4 g $C_6H_{12}O_6$.

Questions from Chapter-4: Chemical Reactions

7) Sodium nitrite ($NaNO_2$) is used in the production of dyes for coloring fabrics,

as a preservative in meat processing (to prevent botulism), as a bleach for fibers, and in photography. It can be prepared by passing nitrogen monoxide and oxygen gases into an aqueous solution of sodium carbonate. Carbon dioxide gas is another product of the reaction.
In one experimental method, which gives a 95.0% yield, 225 mL of 1.50 M aqueous solution of sodium carbonate, 22.1 g of nitrogen monoxide, and a large excess of oxygen gas are allowed to react. What mass of sodium nitrite is obtained?

8) Titaniumtetrachloride,$TiCl_4$, is prepared by the reaction below.
TiO_4 (s) + C(s) + Cl_2 (g) → $TiCl_4$(g) + CO_2 (g) + CO (g)
First balance the equation. And find the maximum mass of $TiCl_4$ that can be obtained from 35 g TiO_2, 45 g Cl_2 and 11 g C?

9) In the reaction of 227 g CCl_4 with an excess of HF, 187 g CCl_2F_2 is obtained. What are the a) Theoretical, b) Actual and c) Percent Yields of this reaction?
$CCl_4 + 2HF \rightarrow CCl_2F_2 + 2\ HCl$

Questions from Chapter-5: Reactions in Water

Solubility Rules:

I. Salts of group 1 cations (with some exceptions of Li) and are NH_4 soluble.
II. Nitrates, acetates, and perchlorates are soluble.
III. Salts of silver, lead, and mercury(I) are insoluble.
IV. Chlorides, bromides, and iodides are soluble.
V. Carbonates,phosphates,sulfides,oxides,and hydroxides are insoluble (sulfides of group 2 cations and hyadarrenodxides of Ca^{2+}, Sr^{2+}, Ba^{2+} slightly soluble).
VI. Sulfates are soluble except for those of calcium, strontium, and barium.

10) Indicate whether a precipitate forms when the following compounds in aqueous solution are mixed. If no reaction occurs, so state. (Indicate the precipitation rules)

(a) sodium phosphate + aluminum chloride -->

(b) aluminum sulfate + barium chloride -->

11) 11) Indicate whether a precipitate forms by the following equations. If no reaction occurs, so state. (Indicate the precipitation rules)

(a) $AlCl_3$ (aq) + KOH (aq) ->

(b) KSO_4 (aq) + $FeBr_3$ (aq) →

Periodic Table of the Elements

1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 **H** Hydrogen 1.008																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012											5 **B** Boron 10.811	6 **C** Carbon 12.011	7 **N** Nitrogen 14.007	8 **O** Oxygen 15.999	9 **F** Fluorine 18.998	10 **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 47.88	23 **V** Vanadium 50.942	24 **Cr** Chromium 51.996	25 **Mn** Manganese 54.938	26 **Fe** Iron 55.933	27 **Co** Cobalt 58.933	28 **Ni** Nickel 58.693	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.732	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.922	34 **Se** Selenium 78.09	35 **Br** Bromine 79.904	36 **Kr** Krypton 84.80
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 95.94	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 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.71	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.6	53 **I** Iodine 126.904	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.905	56 **Ba** Barium 137.327	57-71	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.948	74 **W** Tungsten 183.85	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.22	78 **Pt** Platinum 195.08	79 **Au** Gold 196.967	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.383	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.980	84 **Po** Polonium [208.982]	85 **At** Astatine 209.987	86 **Rn** Radon 222.018
87 **Fr** Francium 223.020	88 **Ra** Radium 226.025	89-103	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 unknown	114 **Fl** Flerovium [289]	115 **Uup** Ununpentium unknown	116 **Lv** Livermorium [298]	117 **Uus** Ununseptium unknown	118 **Uuo** Ununoctium unknown

Lanthanide Series	57 **La** Lanthanum 138.906	58 **Ce** Cerium 140.115	59 **Pr** Praseodymium 140.908	60 **Nd** Neodymium 144.24	61 **Pm** Promethium 144.913	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.966	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.925	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.930	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.934	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
Actinide Series	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 [254]	100 **Fm** Fermium 257.095	101 **Md** Mendelevium 258.1	102 **No** Nobelium 259.101	103 **Lr** Lawrencium [262]