1) What pH is needed to precipitate $Ni(OH)_2$ so completely that the Nickel concentration is less than
1.0×10^{-5} M ($K_{sp} = 1.6 \times 10^{-14}$) Is it ever possible to precipitate ALL the Nickel?

OH=SQRT(1.6E-14/1.0e-5)= 4.0E-05 pOH= 4.39 **pH=9.60**

2) The solubility of $PbCl_2$ is 0.016M at 25C
a) What is its $K_{sp}(25^{\circ}C)$ (3pts)
$=4x^3= 4*0.016^3 = 1.64E-05$

b) Would solubility change with temperature and what ADDED information would you need to determine trend/direction? (2pts)
YES, Ksp is a Equilibrium Constant that changes with temperature. We would need to know **ΔH** to determine the direction of the reaction. (If they say ΔG, give them one point)

3) What is the solubility in Molarity and (g/ml) of Ag_2CO_3 at 25°C ($K_{sp}=8.1x10^{-12}$)

4x3=Ksp x= **1.27E-04M** Molar Mass=276. 2.12E-02g/L **3.5e-5**

4) Excess Calcium Phosphate $Ca_3(PO_4)_2$ is placed into a 0.1 L volumetric. ($K_{sp}= 2.0x10^{-29}$). How many gram will dissolve. Would you consider calcium phosphate to be very soluble?

x = 7.1x10-7moles/L = 7.1e-8moles in 0.1 L x 310.182= **2.20229E-05 g** **Very Insoluble**

5) The Solubility of the solid salt Ag_2SO_3 in pure water is $1.3x10^{-4}$ M *Hint(First determine K_{sp}=?)*;
WHAT is the solubility in 0.01$AgNO_3$
Ksp=4x3= 8.788E-12 x*(0.01)^2=Ksp **8.788E-08 M**

6) If Strong Acid where added to the following salts what would happen to their solubility

Compound	**Solubility Change***(increase/decrease/minimal change)* and **WHY?**
$Mg_3(PO_4)_2$	PO4+H+==HPO4 Increase Solubility (Remove PO4 from solution)
$Al(OH)_3$	OH +H+ == H2O Increase Solubility (Remove OH from solution)

7) 100 ml of 0.00040 M $BaCl_2$(soluble) and 300ml of 0.00080M K_2SO_4(soluble) are mixed. (Ksp for $BaSO_4$ is $1.1x10^{-10}$) Determine **Q** and assess **if precipitation** will occur (2pts)

0.1X0.0004 moles of Ba	**0.00004**	**moles in 0.4L**	**0.0001**	**M**
0.3x 0.0008 moles of SO4	**0.00024**	**moles in 0.4L**	**0.0006**	**M**

	Ba++	SO4=				
Q=	0.0001	0.0006	**6.00E-08**	>>	1.10E-10	**Precipitate**

What would be the FINAL concentration of Barium in solution; ***SETUP ONLY***(3pts)

SETUP ONLY: (0.0001-x)*(0.0006-x)= 1.1e-10

Extra Credit: Determine the actual final concentrations. (5pts)

x= **9.95E-05**

8) What is the $\mathbf{K_{sp}}$ expression for magnesium phosphate, $Mg_3(PO_4)_2$?

$K_{sp}=[Mg^{+2}]^3\,[PO_4^{-3}]^2$

9) Consider a solution containing 0.181 *M* lead ions and 0.174 *M* mercury(II) ions. The K_{sp} for lead sulfide is 3.4×10^{-28} and that for mercury(II) sulfide is 4.0×10^{-53}. Calculate the maximum concentration of sulfide ions that can be in solution **without** precipitating any lead ions.

[S=]=3.4E-28/0.181 **1.87845E-27**

10) Will $Mn(OH)_2$ precipitate from solution if the pH of a 0.050 *M* solution of $MnCl_2$ is adjusted to 8.0 ($K_{sp} = 1.8 \times 10^{-11}$)? AND At what pH(approximately) will a precipitate form?

no

$Q = 5 \times 10^{-14} < K_{sp}$.

0.05*x2 = 1.8e-11

1.89737E-05

4.72184875 **pH=** **9.28**

11) A solution is 10 millimolar in each of the metal ions in the following table (Fe^{+2},Ni^{+2},Pb^{+2},Cu^{+2})

H_2S gas is bubbled through the solution to attain a [$S^{=}$] concentration of 0.10 M.

Predict which of the sulfides precipitate under the given conditions.

FeS	6.2×10^{2}	1.00E-03	Q<Ksp	Undersaturated
NiS	8.0×10^{-1}			
		1.00E-03	Q<Ksp	Undersaturated
PbS	3.1×10^{-7}			
		1.00E-03	Q>Ksp	Precipitation
CuS	6.1×10^{-16}			
		1.00E-03	Q>Ksp	Precipitation