Write balanced equations for the following chemical reactions:

silver carbonate + nitric acid
$Ag_2CO_3 + 2HNO_3 = 2AgNO_3 + CO_2 + H_2O$

hypoiodous acid + strontium hydroxide
$10HOI + Sr(OH)_2 = Sr(IO_3)_2 + 4\ I_2 + 6\ H_2O$; strontium iodate
($5\ HOI \rightarrow HIO_3 + 2I_2 + 2H_2O$; disproportionation)

(ortho)phosphoric acid + sodium hydroxide (1 : 2 ratio)
$H_3PO_4 + 2\ NaOH = Na_2HPO_4 + 2\ H_2O$

iron(III) ions + hexacyanoferrate(II) ions
$4Fe^{3+} + 3\ [Fe(CN)_6]^{4-} = Fe_4[Fe(CN)_6]_3$

lead(II) oxide + dinitrogen pentoxide
$PbO + N_2O_5 = Pb(NO_3)_2$; Lead(II) nitrate

aluminium ions + metasilicate ions
$Al^{3+} + SiO_3^{2-} = Al_2(SiO_3)_3$; Aluminum Metasilicate

sulfur trioxide + magnesium hydroxide
$SO_3 + Mg(OH)_2 = MgSO_4 + H_2O$

bismuth hydroxide + hydrobromic acid
$Bi(OH)_3 + 3\ HBr = BiBr_3 + 3\ H_2O$; Bismuth tribromide; Bismuth(III) bromide

(ortho)boric acid + sodium hydroxide
$H_3BO_3 + NaOH = Na[B(OH)_4]$, sodium tetrahydroxyborate

iodide ions + iodine molecules
$I_2 + I^- = I_3^-$

Examples for calculations:

Example 1.

We need 0.12 mol ethyl alcohol (C_2H_5OH) in a reaction. Calculate the volume needed! Density: 0.789 g/cm^3; M(ethanol): 46.07 g/mol

1 step: Calculation of the ethanol needed in grams (conversion of moles to grams):

1 mol ethanol → 46.07 g
0.12 mol ethanol → *m* g

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$m = n \cdot M = 0.12 \cdot 46.07 =$ **5.53 g**

1 step: Calculation of the volume based on the density:

0.789 g ethanol → 1 cm^3
5.53 g ethanol → *V* cm^3

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V = 5.53/0.789 = **7.0 cm^3 ethanol is needed.**

<u>Example 2.</u>

We have 25 cm^3 sulfuric acid solution: 12 m/m % with a density of 1.08 g/cm^3
How much 0.8 M NaOH is needed in the neutralization reaction (in cm^3)?
M(H_2SO_4): 98,08 g/mol

Write the equation:

$H_2SO_4 + 2\ NaOH = Na_2SO_4 + 2\ H_2O$

1 step: Calculate the amount of the H_2SO_4 solution in grams:

25 cm^3, 1.08 g/cm^3 solution is:
$25 \cdot 1.08 =$ **27 g**

2. step: Calculate the weight of sulfuric acid in this solution:

We have 12 m/m % solution, which means that we have 12 g sulfuric acid in 100 g water.
Calculation:

100 g solution → 12 g sulfuric acid
27 g solution → *x* g sulfuric acid

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$x = 27 \cdot 12/100 =$ **3.24 g H_2SO_4**

3. step: Convert the amount of sulfuric acid to moles:

n=m/M = 3.24/98.08 = **0.033 mol H_2SO_4**

4. step: Calculate the amount of NaOH needed:

Based on the reaction, 1 mole of sulfuric acid reacts with 2 moles of NaOH
Therefore, 0.033 mole H_2SO_4 reacts with **0.066 moles of NaOH**

5. step: Calculate the volume of the NaOH:

The concentration of the NaOH solution is 0.8M, which means that we have 0.8 moles in 1000 cm^3 solution.
Calculation:

0.8 mol NaOH → 1000 cm^3
0.066 mol NaOH → *V* cm^3

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V = 1000 · n/c = 1000 · 0.066/0.8 = **82.5 cm^3 NaOH solution is needed**.