16. $4HCl(aq) + O_2(g) \rightarrow 2H_2O + 2Cl_2(g)$

given #1 = 750g HCl
given #2 = 320g $O_2$
} needed = ? g $Cl_2$

$750g\ HCl \times \frac{1\ mol\ HCl}{36.46g\ HCl} \times \frac{2\ mol\ Cl_2}{4\ mol\ HCl} \times \frac{70.90g\ Cl_2}{1\ mol\ Cl_2} = 729.22\ g\ Cl_2$ (730g)

$320g\ O_2 \times \frac{1\ mol\ O_2}{32.00g\ O_2} \times \frac{2\ mol\ Cl_2}{1\ mol\ O_2} \times \frac{70.90g\ Cl_2}{1\ mol\ Cl_2} = 142g\ Cl_2$ (140g $Cl_2$)

limiting factor

theo yield

17. $NaCl + H_2O \rightarrow NaOH + HCl(aq)$ ($HCOH$)

given #1 = 645g NaCl
given #2 = 290g $H_2O$
} needed = ? g NaOH

LF $645g\ NaCl \times \frac{1\ mol\ NaCl}{58.45g\ NaCl} \times \frac{1\ mol\ NaOH}{1\ mol\ NaCl} \times \frac{40.01g\ NaOH}{1\ mol\ NaOH} = 441g\ NaOH$

Theo yield

$290g\ H_2O \times \frac{1\ mol\ H_2O}{18.02g\ H_2O} \times \frac{1\ mol\ NaOH}{1\ mol\ H_2O} \times \frac{40.01g\ NaOH}{1\ mol\ NaOH} = 644g\ NaOH$

18. $2Na + Cl_2(g) \rightarrow 2NaCl$

given #1 = 50.0g Na
given #2 = 30.0L $Cl_2$
} needed: ? g NaCl

LF $50.0g\ Na \times \frac{1\ mol\ Na}{23.00g\ Na} \times \frac{2\ mol\ NaCl}{2\ mol\ Na} \times \frac{58.45g\ NaCl}{1\ mol\ NaCl} = 127g\ NaCl$

Theo yield

$30.0L\ Cl_2 \times \frac{1\ mol\ Cl_2}{22.4L\ Cl_2} \times \frac{2\ mol\ NaCl}{1\ mol\ Cl_2} \times \frac{58.45g\ NaCl}{1\ mol\ NaCl} = 157\ g\ NaCl$

19. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

given #1 63.4g Cu
given #2 213g $AgNO_3$
} needed = ?g Ag

$$63.4g\,Cu \times \frac{1mol\,Cu}{63.55g\,Cu} \times \frac{2mol\,Ag}{1mol\,Cu} \times \frac{107.9g\,Ag}{1mol\,Ag} = 215g\,Ag$$

limiting factor

$$213g\,AgNO_3 \times \frac{1mol\,AgNO_3}{169.91g\,AgNO_3} \times \frac{2mol\,Ag}{2mol\,AgNO_3} \times \frac{107.9g\,Ag}{1mol\,Ag} = 135g\,Ag$$

Theo yield

$$\frac{104.9g}{135g} \times 100 = 77.7\%\ yield$$

20. $2K_3PO_4 + 3Ni(ClO_3)_2 \rightarrow Ni_3(PO_4)_2 + 6KClO_3$

given #1 - 1500g $K_3PO_4$
given #2 = 1250g $Ni(ClO_3)_2$
} needed = ? g $Ni_3(PO_4)_2$

$$1500g\,K_3PO_4 \times \frac{1mol\,K_3PO_4}{212.27g\,K_3PO_4} \times \frac{1mol\,Ni_3(PO_4)_2}{2mol\,K_3PO_4} \times \frac{381.01g\,Ni_3(PO_4)_2}{1mol\,Ni_3(PO_4)_2} =$$

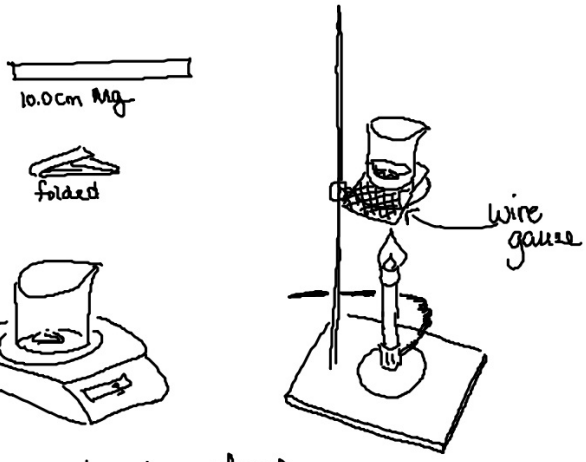
$$= 1293\ g\,Ni_3(PO_4)_2$$

limiting factor

$$1250g\,Ni(ClO_3)_2 \times \frac{1mol\,Ni(ClO_3)_2}{225.59g\,Ni(ClO_3)_2} \times \frac{1mol\,Ni_3(PO_4)_2}{3mol\,Ni(ClO_3)_2} \times \frac{381.01g\,Ni_3(PO_4)_2}{1mol\,Ni_3(PO_4)_2}$$

$$= 676g\,Ni_3(PO_4)_2$$ theo yield

$$\frac{658g}{676g} \times 100 = 97.3\%\ yield$$




① mass beaker alone

② then mass beaker + magnesium

③ See Mrs. Shoemaker for HCl(aq).