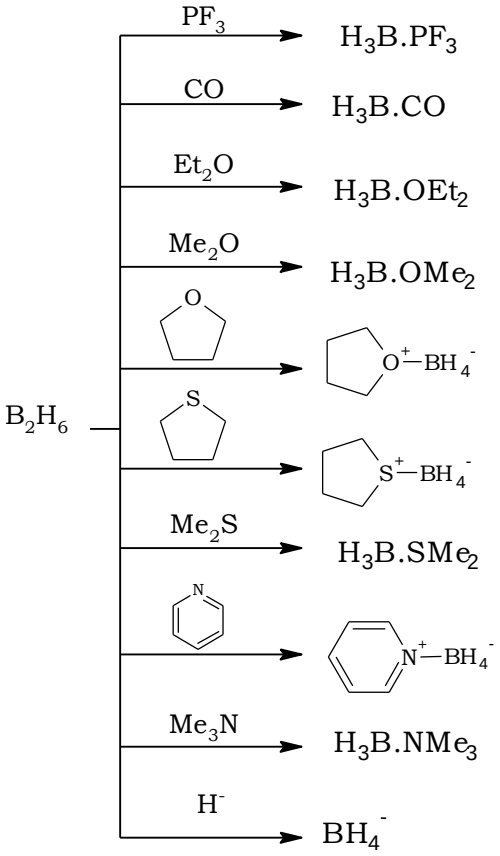
Reaction Drill
Group 13

Complete and balance the following reactions. Indicate the colour of product if any.

1.	$Na_2B_4O_7.10H_2O \xrightarrow{acid} H_3BO_3 \xrightarrow{\Delta} B_2O_3 \xrightarrow[\Delta]{Mg} B + MgO$
2.	$BCl_3 + H_2 \xrightarrow{\text{red hot W or Ta filament}} B + HCl$ $BI_3 \xrightarrow{\text{red hot W or Ta filament}} B + I_2$ $B_2H_6 \xrightarrow{\Delta} B + H_2$
3.	$Al(OH)_3 + NaOH + HF \longrightarrow Na_3[AlF_6] + H_2O$
4.	$[Ga(H_2O)_6]^{3+} + H_2O \longrightarrow [Ga(H_2O)_5OH]^{2+} + H_3O^+$
5.	$B \xrightarrow{O_2/\Delta} B_2O_3$ $B \xrightarrow{S/\Delta} B_2S_3$ $B \xrightarrow{N_2/\Delta} BN$ $B \xrightarrow[X = F, Cl, Br, I]{X_2/\Delta} BX_3$ $B \xrightarrow{NaOH/Fuse} Na_3BO_3 + H_2$ $B \xrightarrow{NH_3/\Delta} BN + H_2$
6.	In the following reactions M is any group 13 element but B.
	$M + O_2 \longrightarrow M_2O_3$ M = Al, Ga, In
	$M + O_2 \xrightarrow{\Delta} M_2O_3 + M_2O$ M = Tl
	$M + N_2 \xrightarrow{\Delta} MN$ M = Al
	$M + F_2 \longrightarrow MF_3$ $M + Cl_2 \longrightarrow MCl_3$ $M + Br_2 \longrightarrow MBr_3$ $M + I_2 \longrightarrow MI_3$

	M = Al, Ga, In
7.	$Tl + F_2 \longrightarrow TlF + TlF_3$ $Tl + Cl_2 \longrightarrow TlCl + TlCl_3$ $Tl + Br_2 \longrightarrow TlBr + TlBr_3$ $Tl + I_2 \longrightarrow Tl^+[I_3]^-$
8.	$2M + 6HCl \longrightarrow 2MCl_3 + 3H_2$ M = Al, Ga, In, Tl
9.	$2M + 2NaOH + 6H_2O \longrightarrow Na[M(OH)_4] + 3H_2$ M = Al, Ga
10.	$Al + Mn_3O_4 \longrightarrow Al_2O_3 + Mn$ $Al + Cr_2O_3 \longrightarrow Al_2O_3 + Cr$
11.	$H_3BO_3 \xrightarrow{100°C} HBO_2 \xrightarrow{\text{red hot}} B_2O_3$
12.	$CoO + B_2O_3 \xrightarrow{\Delta} Co(BO_2)_2$ $P_4O_{10} + B_2O_3 \xrightarrow{\Delta} BPO_4$ $As_2O_5 + B_2O_3 \xrightarrow{\Delta} BAsO_4$
13.	$H_3BO_3 + NaOH \longrightarrow Na[B(OH)_4]$ or $NaBO_2.2H_2O$
14.	$Na_2B_4O_7.10H_2O + 5H_2O \rightleftharpoons 2H_3BO_3 + 2Na[B(OH)_4]$ $2Na[B(OH)_4] + 2HCl \longrightarrow 2NaCl + 2H_3BO_3 + 4H_2O$
15.	$2NaBO_2 + 2H_2O_2 + 6H_2O \longrightarrow Na_2[(OH)_2B(O-O)_2B(OH)_2].6H_2O$
16.	$H_3BO_3 + 4HF \longrightarrow H[BF_4] + 3H_2O$
17.	$H_3BO_3 + 3MeOH \longrightarrow B(OMe)_3 + 3H_2O$
18.	$6H_2 + 4BCl_3 + C(\text{fiber}) \longrightarrow B_4C + 12HCl$
19.	$B_2O_3 + 3CaF_2 + 3\ Con.H_2SO_4 \xrightarrow{\Delta} 2BF_3 + 3CaSO_4 + 3H_2O$
20.	$B_2O_3 + 6NH_4BF_4 \xrightarrow{\Delta} 8BF_3 + 6NH_3 + 3H_2O$
21.	$4BF_3 + 3H_2O \longrightarrow H_3BO_3 + 3H[BF_4]$
22.	$BX_3 + 3H_2O \longrightarrow H_3BO_3 + 3HX$ X = ? X = Cl, Br, I
23.	$2BCl_3 + 2Hg \xrightarrow[\text{low pressure}]{\text{electric discharge}} B_2Cl_4 + Hg_2Cl_2$ $GaCl_3 + Ga \longrightarrow 2GaCl_2$
24.	$Mg_3B_2 + H_3PO_4 \longrightarrow$ mixture of boranes (mainly B_4H_{10}) $\xrightarrow{\Delta} B_2H_6$ $B_2O_3 + 3H_2 + 2Al \xrightarrow[750\ atm]{150°C} B_2H_6 + Al_2O_3$ $2BF_3 + 6NaH \xrightarrow{180°C} B_2H_6 + 6NaF$
25.	$4\ BF_3 + 3\ LiAlH_4 \xrightarrow{Et_2O} 2B_2H_6 + 3Li[AlF_4]$

	$4\ BF_3 + 3\ NaBH_4 \xrightarrow{\text{diglyme}} 2B_2H_6 + 3Na[BF_4]$ $2NaBH_4 + I_2 \xrightarrow{\text{diglyme}} 2NaI + H_2 + B_2H_6$
26.g	$2NaBH_4 + 2H_3PO_4(l) \longrightarrow B_2H_6 + 2NaH_2PO_4 + 2H_2$
26.	$B_2H_6 + 3O_2 \longrightarrow 2B_2O_3 + 3H_2O$
27.	$B_2H_6 + 6H_2O \longrightarrow 2H_3BO_3 + 3H_2$
28.	$B_2H_6 + 6\ MeOH \longrightarrow 2B(OMe)_3$
29.	$B_2H_6 + 2\ LiH \longrightarrow 2LiBH_4$
30.	$B_2H_6 + HCl \longrightarrow B_2H_5Cl + H_2$
31.	$B_2H_6 + 3Cl_2 \longrightarrow 2B + 6HCl$
31a.	$B_2H_6 + 6Cl_2 \longrightarrow 2BCl_3 + 6HCl$
32.	$B_2H_6 + NH_3$ (excess) $\xrightarrow{\text{low temperature}} [BH_2(NH_3)_2]^+[BH_4]^-$
33.	$B_2H_6 + NH_3$ (excess) $\xrightarrow{\text{high temperature}} (BN)_x$
34.	$B_2H_6 + NH_3$ (excess) $\xrightarrow{\text{high temperature}} B_3N_3H_6$ 1 : 2
35.	$BCl_3 \xrightarrow[140\ °C]{NH_4Cl}$ **[A]** $\xrightarrow{NaBH_4}$ **[B]** $\xrightarrow{HCl}$ **[C]** **[A]** $\xrightarrow{MeMgBr}$ **[D]** **[A]** = $B_3N_3H_3Cl_3$; **[B]** = $B_3N_3H_6$; **[C]** = $B_3N_3H_9Cl_3$; **[D]** = $B_3N_3H_3Me_3$
36.g	$B_2H_6 + MeNH_2 \longrightarrow [BH_2(NH_2Me)_2]^+[BH_4]^-$ $B_2H_6 + Me_2NH \longrightarrow [BH_2(Me_2NH)_2]^+[BH_4]^-$
37.g	

	
38.g	$2[Al(H_2O)_6]Cl_3 \xrightarrow{\Delta} Al_2O_3 + 6HCl + 9H_2O$
39.g	$[Al(OH)_4]^- + CO_2 \longrightarrow Al(OH_3 + CO_3^{2-} + H_2O$