CHART - 3 Revision Equations - CHAPTER 6 – WATER

REACTIONS OF WATER –	
WITH METALS	
1. Potassium	$2K + 2H_2O \rightarrow 2KOH + H_2$ [g]
2. Sodium	$2Na + 2H_2O \rightarrow 2NaOH + H_2$ [g]
3. Calcium	$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ [g]
4. Magnesium	$Mg + H_2O \rightarrow MgO + H_2$ [g]
5. Aluminium	$2Al + 3H_2O \rightarrow Al_2O_3 + 3H_2$ [g]
6. Zinc	$Zn + H_2O \rightarrow ZnO + H_2$ [g]
7. Iron	$3Fe + 4H_2O \rightleftharpoons Fe_3O_4 + 4H_2$ [g]
WITH NON-METALS	
8. Coke	$C + H_2O \rightarrow CO + H_2$ ([steam] → [water gas])
9. Chlorine	$Cl_2 + H_2O \rightarrow HCl + HClO$
NON-METALLIC OXIDES	
10. Sulphur dioxide	$SO_2 + H_2O \rightarrow H_2SO_3$
11. Sulphur trioxide	$SO_3 + H_2O \rightarrow H_2SO_4$
12. Carbon dioxide	$CO_2 + H_2O \rightarrow H_2CO_3$
13. Nitrogen dioxide	$2NO_2 + H_2O \rightarrow HNO_2 + HNO_3$
METALLIC OXIDES	
14. Potassium oxide	$K_2O + H_2O \rightarrow 2KOH$
15. Calcium oxide	$CaO + H_2O \rightarrow Ca(OH)_2$
TESTS – FOR WATER	
16. Anhydrous copper sulphate	$CuSO_4$ [white] $+ 5H_2O \rightarrow CuSO_4.5H_2O$ [blue]
17. Cobalt chloride	$CoCl_2$ [blue] $+ 6H_2O \rightarrow CoCl_2.6H_2O$ [pink]
BIOLOGICAL IMPORTANCE – of dissolved gases in water	
18. Dissolved oxygen - respiration	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy
19. Dissolved CO_2 - photosynthesis	$6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$
20. Dissolved CO_2 - formation of shells	$CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$
WATER AS A – CATALYST	
21. Synthesis of hydrogen chloride	$H_2 + Cl_2 \rightarrow 2HCl$
22. Combustion of phosphorus	$4P + 5O_2 \rightarrow 2P_2O_5$

REACTIONS OF WATER –	
WITH METALS	
1. Potassium	$K + H_2O \rightarrow$ _____ + _____ [g]
2. Sodium	$Na + H_2O \rightarrow$ _____ + _____ [g]
3. Calcium	$Ca + H_2O \rightarrow$ _____ + _____ [g]
4. Magnesium	$Mg + H_2O \rightarrow$ _____ + _____ [g]
5. Aluminium	$Al + H_2O \rightarrow$ _____ + _____ [g]
6. Zinc	$Zn + H_2O \rightarrow$ _____ + _____ [g]
7. Iron	$Fe + H_2O \rightleftharpoons$ _____ + _____ [g]
WITH NON-METALS	
8. Coke	$C + H_2O \rightarrow$ _____ + _____ ([steam] → [water gas])
9. Chlorine	$Cl_2 + H_2O \rightarrow$ _____ + _____
NON-METALLIC OXIDES	
10. Sulphur dioxide	$SO_2 + H_2O \rightarrow$ _____
11. Sulphur trioxide	$SO_3 + H_2O \rightarrow$ _____
12. Carbon dioxide	$CO_2 + H_2O \rightarrow$ _____
13. Nitrogen dioxide	$NO_2 + H_2O \rightarrow$ _____ + _____
METALLIC OXIDES	
14. Potassium oxide	$K_2O + H_2O \rightarrow$ _____
15. Calcium oxide	$CaO + H_2O \rightarrow$ _____
TESTS – FOR WATER	
16. Anhydrous copper sulphate	$CuSO_4$ [white] $+ 5H_2O \rightarrow$ _____ [blue]
17. Cobalt chloride	$CoCl_2$ [blue] $+ 6H_2O \rightarrow$ _____ [pink]
BIOLOGICAL IMPORTANCE – of dissolved gases in water	
18. Dissolved oxygen - respiration	$C_6H_{12}O_6 + O_2 \rightarrow$ _____ + _____ + energy
19. Dissolved CO_2 - photosynthesis	$CO_2 + H_2O \rightarrow$ _____ + _____ + _____
20. Dissolved CO_2 - formation of shells	$CaCO_3 + H_2O + CO_2 \rightarrow$ _____
WATER AS A – CATALYST	
21. Synthesis of hydrogen chloride	$H_2 + Cl_2 \rightarrow$ _____
22. Combustion of phosphorus	$P + O_2 \rightarrow$ _____

PREPARATIONS OF HYDROGEN – General Methods

REACTIONS OF METALS -	
WITH COLD WATER	
1. Potassium	$2K + 2H_2O \rightarrow 2KOH + H_2$ [g]
2. Sodium	$2Na + 2H_2O \rightarrow 2NaOH + H_2$ [g]
3. Calcium	$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ [g]
WITH BOILING WATER OR STEAM	
4. Magnesium	$Mg + H_2O \rightarrow MgO + H_2$ [g]
5. Aluminium	$2Al + 3H_2O \rightarrow Al_2O_3 + 3H_2$ [g]
6. Zinc	$Zn + H_2O \rightarrow ZnO + H_2$ [g]
7. Iron	$3Fe + 4H_2O \rightleftharpoons Fe_3O_4 + 4H_2$ [g]
WITH DILUTE ACIDS	
8. Magnesium	$Mg + 2HCl \rightarrow MgCl_2 + H_2$ [g]
9. Aluminium	$2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2$ [g]
10. Zinc	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ [g]
11. Iron	$Fe + 2HCl \rightarrow FeCl_2 + H_2$ [g]
WITH ALKALI [conc. soln.]	
12. Zinc	$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$ [g]
	$Zn + 2KOH \rightarrow K_2ZnO_2 + H_2$ [g]
13. Lead	$Pb + 2NaOH \rightarrow Na_2PbO_2 + H_2$ [g]
14. Aluminium	$2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$ [g]
	$2Al + 2KOH + 2H_2O \rightarrow 2KAlO_2 + 3H_2$ [g]
Laboratory Method	
15. Zinc – With dil. HCl	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ [g]
Industrial Method - *Bosch process*	
16. Production of water gas – [$CO + H_2$]	$C + H_2O \xrightarrow{1000^oC} [CO + H_2] - \Delta$
17. Reduction of steam to H_2 by CO	$CO + H_2 + H_2O \xrightarrow[Fe_2O_3]{450^oC} CO_2 + 2H_2 + \Delta$ [water gas]
18. Removal of unreacted CO_2 & CO from the above mixture	$2KOH + CO_2 \rightarrow K_2CO_3 + H_2O$ $CuCl + CO + 2H_2O \rightarrow CuCl\cdot CO\cdot 2H_2O$

TESTS AND USES

CONVERSION OF HYDROGEN TO	
19. Water	$2H_2 + O_2 \rightarrow 2H_2O$
20. Hydrogen chloride	$H_2 + Cl_2 \rightarrow 2HCl$
21. Ammonia	$N_2 + 3H_2 \rightleftharpoons 2NH_3$
22. Hydrogen sulphide	$H_2 + S \rightarrow H_2S$
HYDROGEN IN METALLURGY	
23. Zinc oxide	$ZnO + H_2 \rightarrow Zn + H_2O$
24. Iron [III] oxide	$Fe_2O_3 + 3H_2 \rightarrow 2Fe + 3H_2O$
25. Lead oxide	$PbO + H_2 \rightarrow Pb + H_2O$

PREPARATIONS OF HYDROGEN – General Methods

REACTIONS OF METALS -

WITH COLD WATER

1. Potassium — $K + H_2O \rightarrow$ ____ + ____ [g]
2. Sodium — $Na + H_2O \rightarrow$ ____ + ____ [g]
3. Calcium — $Ca + H_2O \rightarrow$ ____ + ____ [g]

WITH BOILING WATER OR STEAM

4. Magnesium — $Mg + H_2O \rightarrow$ ____ + ____ [g]
5. Aluminium — $Al + H_2O \rightarrow$ ____ + ____ [g]
6. Zinc — $Zn + H_2O \rightarrow$ ____ + ____ [g]
7. Iron — $Fe + H_2O \rightleftharpoons$ ____ + ____ [g]

WITH DILUTE ACIDS

8. Magnesium — $Mg + HCl \rightarrow$ ____ + ____ [g]
9. Aluminium — $Al + H_2SO_4 \rightarrow$ ____ + ____ [g]
10. Zinc — $Zn + HCl \rightarrow$ ____ + ____ [g]
11. Iron — $Fe + HCl \rightarrow$ ____ + ____ [g]

WITH ALKALI [conc. soln.]

12. Zinc — $Zn + NaOH \rightarrow$ ____ + ____ [g]
    $Zn + KOH \rightarrow$ ____ + ____ [g]
13. Lead — $Pb + NaOH \rightarrow$ ____ + ____ [g]
14. Aluminium — $Al + NaOH + H_2O \rightarrow$ ____ + ____ [g]
    $Al + KOH + H_2O \rightarrow$ ____ + ____ [g]

Laboratory Method

15. Zinc – With dil. HCl — $Zn + HCl \rightarrow$ ____ + ____ [g]

Industrial Method - *Bosch process*

16. Production of water gas — $C + H_2O \xrightarrow{1000^oC}$ [____ + ____] - Δ
17. Reduction of steam to H_2 by CO — $CO + H_2 + H_2O \xrightarrow[Fe_2O_3]{450^oC}$ ____ + ____ + Δ
    [water gas]
18. Removal of unreacted CO_2 & CO from the above mixture — $KOH + CO_2 \rightarrow$ ____ + ____
    $CuCl + CO + 2H_2O \rightarrow$ ____

TESTS AND USES

CONVERSION OF HYDROGEN TO

19. Water — $H_2 + O_2 \rightarrow$ ____
20. Hydrogen chloride — $H_2 + Cl_2 \rightarrow$ ____
21. Ammonia — $N_2 + H_2 \rightleftharpoons$ ____
22. Hydrogen sulphide — $H_2 + S \rightarrow$ ____

HYDROGEN IN METALLURGY

23. Zinc oxide — $ZnO + H_2 \rightarrow$ ____ + ____
24. Iron [III] oxide — $Fe_2O_3 + H_2 \rightarrow$ ____ + ____
25. Lead oxide — $PbO + H_2 \rightarrow$ ____ + ____