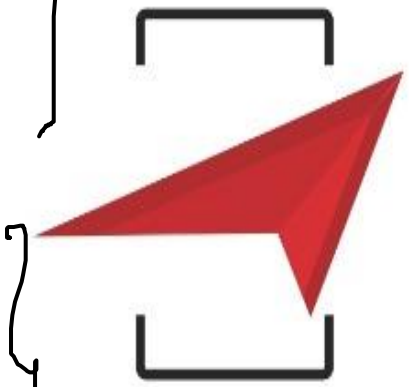
$\Rightarrow$ { metal + Non-metal }

N_2

O_2

H_2



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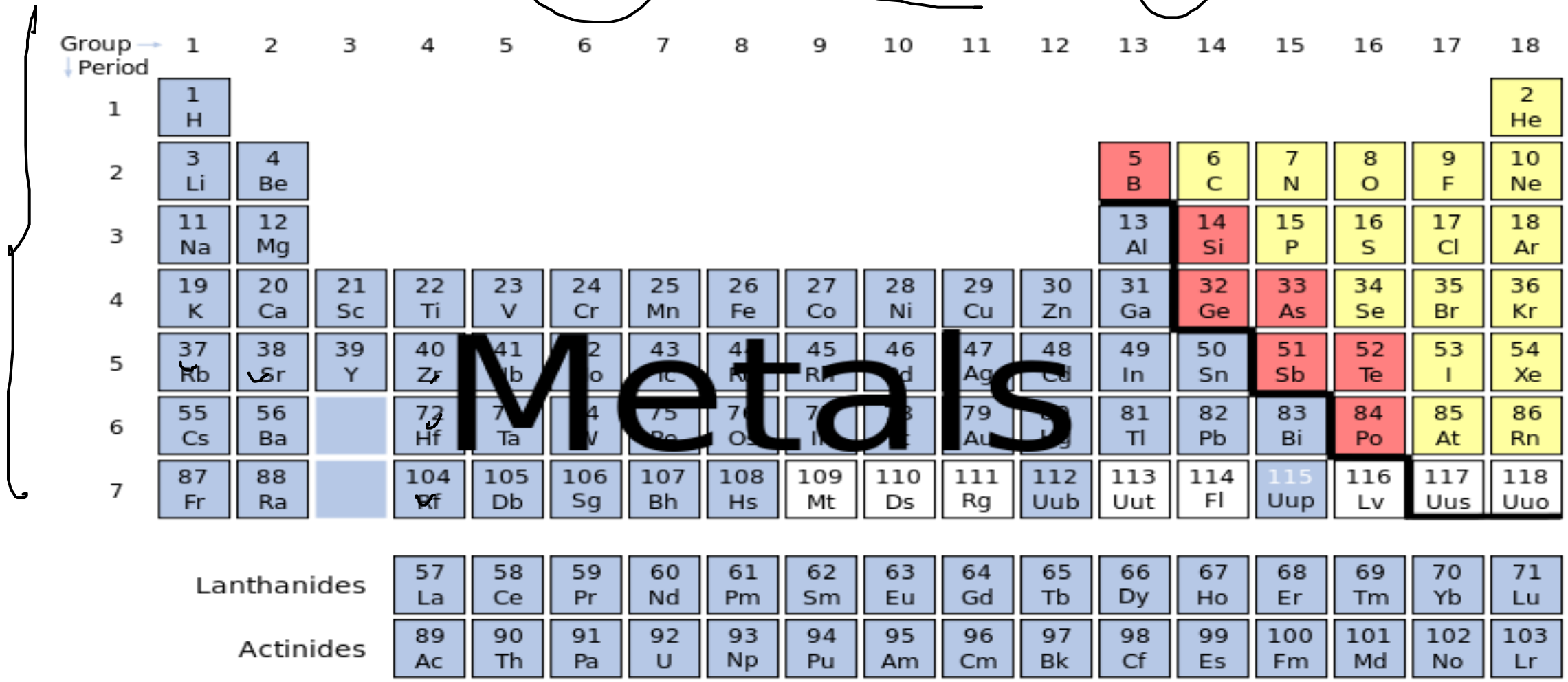
95 → metal , 22 → non-metal



METALS AND NON-METALS

(1, 2, 3)

metal < 4 e⁻ (e⁻ cond)

✓✓ ↳ e⁻ (donar) {4e⁻}

non metal - (e⁻ > 4e⁻)

(Acceptor) { }

5, 6, 7

earth crust → Aluminum (7% - 8.3%)

→ iron (4%)

→ Ca (3%)

* Silver

* Non metal:- 22 → 11 → Gas

✓ Bromine ← 1 → liquid

10 → Solid

PROPERTIES

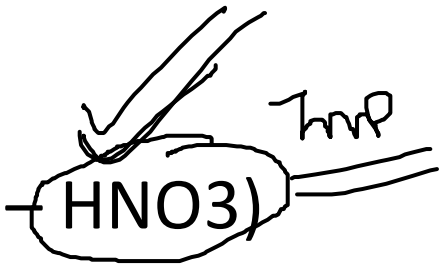
- PHYSICAL
- CHEMICAL

PHYSICAL PROPERTIES

PROPERTIES	METALS	NON-METALS
1. Conductor of electricity	Yes	No (Graphite)
2. Conductor of heat	Yes	No (exp:- Graphite)
3. Malleable 	Yes (Al-foil)	No - (Brittle)
4. Ductile (wires)	Yes	No (Break)
5. Lustrous (Shiny surf)	Yes	No (iodine)
6. Sonorous → (Ringing Sound)	yes	NO

CHEMICAL PROPERTIES

- Reaction of metal with oxygen (Air)
- Reaction of metal with Water (H_2O)
- Reaction of metal with acid and base (exception – HNO_3)
- Reaction of metal with other metal salt
- Reaction of metal with non metals.



① With Oxygen (Air)

Metal + O_2 ⟶ Metal oxide

$2Cu + O_2 \longrightarrow 2CuO$ (Base)

$4Al + 3O_2 \longrightarrow 2Al_2O_3$

except Amphoteric Oxide:- Acid & Base (Zn & Al)

Zn:- Acid:- $HCl + ZnO \longrightarrow ZnCl_2 + H_2O$

Base:- $NaOH + ZnO \longrightarrow Na_2ZnO_2 + H_2O$

* Some oxide dissolved in water :-

$$\left\{\begin{array}{l} Na_2O + H_2O \longrightarrow 2NaOH \\ K_2O + H_2O \longrightarrow 2KOH \end{array}\right\} \text{Alkali}$$

* Metal + Water :-

$$M + W \longrightarrow MO + H_2(g)$$

$$MO + W \longrightarrow \text{Metal Hydroxide}$$

* Cold water :-

$$2K + 2H_2O \longrightarrow 2KOH + H_2(g) + \text{Heat}$$

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2(g) + \text{Heat}$$

(Surface)

Imp: Exc: $Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$ (No Heat) ✓

* Hot water:- ✓

$\Rightarrow Mg + H_2O \longrightarrow Mg(OH)_2 + H_2 + Heat$

* Steam water:- (Al , Fe) ✓

$2Al + 3H_2O \longrightarrow Al_2O_3 + 3H_2$

* metal + Acid :-

Acid + metal ⟶ Salt + H_2

exp:- $Al + HCl \longrightarrow AlCl_3 + H_2$

* Base :- Base + metal ⟶ Salt + H_2

$2NaOH + Zn \longrightarrow Na_2ZnO_2 + H_2$ ✓

exp

HNO_3

exp 1

$Zn + HNO_3 \longrightarrow H_2$ (X)

$Mg + HNO_3 \longrightarrow H_2$ ✓

* other metal:- (Displacement)

* $Zn + CuSO_4 \longrightarrow Cu + ZnSO_4$

*

※ Sodium → light Yellow

Pot. → Voilet

Lith. → Reddish

* Fe ⇒ Melting Point → 1503°C

⇒ Oxes :- Red Hemetite (Fe_2O_3)

Brown " ($2Fe_2O_3 \cdot 3H_2O$)

* Compound :- Ferrous Sulphate :- (हरा कसीस)

($FeSO_4 \cdot 7H_2O$)

* मोहर लवण ($FeSO_4 \cdot (NH_4)_2 \cdot SO_4\ 6H_2O$

(Ferrous Ammonium Sulphate)

* exp:- (Berilium & magnisium) → Color (X)

Non-metal

* 22 → Total, { 11 → Gas
  1 → liquid
  10 → Solid }

*

{Nitrogen}

* N . * 7 . Group :- (VA)

elem. type :- Non-metal.

PHYSICAL & Chemical

* PHYSICAL Properties:-

1. 20°C → Gas.
2. Color → Colorless
3. Odor → Odorless
4. Melting Point:- (-210°C)
5. Boiling Point:- (-195°C)

{ Less Reactive
⇓
Dissociating
Energy (↑) }

* Chemical Properties:-

(1) With Air:- Normal Cond. $(N) + Air \rightarrow X$

✓

* Spark $\Rightarrow \{NO, NO_2\}$

(2) With Acid:- No reaction (Normal Cond.)

{Ammonia + Acid $\longrightarrow$ Ammonium ions}

(3) Halogen:- Ammonia (Haber Process)

$$N_2(g) + 3H_2(g) \xrightarrow[\text{Fe (cat)}]{400^\circ C - 500^\circ C} 2NH_3(g)$$

High pres-

* With metal & non-metal:-

$$3Ca + N_2 \longrightarrow Ca_3N_2$$

Ca_3N_2 ↓ Calcium Nitride

$$3Mg + N_2 \longrightarrow Mg_3N_2$$

* Water ⇒ NO

* Uses:- All veg., Fertilizers, Animal Protein,
{Soil ⇒ Ammonium salt}

* Occurance:- ① Atmosp:- 78.06%

② earth crust:- mineral dipositts

* Isotopes:- $_7N^{14}$, $_7N^{15}$

{ N^{14} → Stable (99.7%.)
N^{15} → less Stable (0.37%.) }

* Compounds:- (1) NH_3 → Urea

liquid Ammonium

↓↓

{Refrigerators}

(2) NH_4Cl ⇒ (Ammonium chloride)

Dry cell

(3) N_2O :- (Nitrus Oxide) (Laughing Gas)

(4) Aqua Razia (HNO_3 + HCl)

$\Rightarrow$ { 1 → HNO_3 , 3 → HCl }

$\Rightarrow$ { Gold, Silver, Platinum }

* NH_2 (Hydrazine) ⇒ As a Fuel → Aircraft & Rockets

* HNO_3 (Nitric Acid) ⇒ TNT

OXYGEN

* Symbol :- O

At. NO. → 8

Group :- 16 (IUPAC)

Elem. Type :- Non-metal.

*PHYSICAL:-

① 20°C → Gas

② Color :- Colorless (Gas)
liquid → Pale Blue
O_3 → Gas → Bluish
liquid → "
Solid → Violet Black

③ Odor : odorless

④ Melting P:- (-218.79°C) ✓

⑤ B.P:- (-182.93°C) ✓

Chemical Prop:

(1) Acid :- O_2 (Not)

(2) Air :- (NO) { electric Discharge or UV light }

$$3O_2(g) \longrightarrow 2O_3(g)$$

(3) Base :- NO

(4) Halogens :- $O_2 + F_2 \longrightarrow O_2F_2$

(Dioxygen Difluorine)

(5) Sulphur :- Sulphur dioxide

$$\left\{ \begin{array}{l} S + O_2 \longrightarrow SO_2 \\ 2SO_2 + O_2 \longrightarrow 2SO_3 \end{array} \right\}$$

(6) water :- No (Dissolve)

* Occurence :- O_2 → 21 %.

earth crust: 46.6 %.

* Isotope :- O^{16} → 99.51 %.

O^{17} → 0.03 %.

O^{18} → 0.20 %.

Stability

HYDROGEN

* Sym → H, A.N → 1

Group:- 1st

PHYSICAL Properties

*

① 20°C → Gas

② Color → Colorless, ③ odor → odorless

④ M.P. → -259°C ⑤ B.P. → -252.74°C

Chemical Properties

① Acid :- No (Dilute Acid)

② Air :- H_2 react with O_2 (Reddish flame)
(fire or explosion)

$$H_2 + O_2 \longrightarrow 2H_2O$$

(g) (g)

(4) Base :- Not react with Dilute Base.

(5) Halogens :- Yes

H_2 + Halogens → Hydrogen Halides

(Slow Reaction at Room Temp)

Exception: Fluorine + H_2 → ↑ (fast) ✓✓

$H_2 + F_2 \rightarrow 2HF$

$H_2 + Cl_2 \rightarrow 2HCl$

* metal:- $2Li + H_2 \longrightarrow 2LiH$ (Hydrides)

$2Na + H_2 \longrightarrow 2NaH$

** exp: Cd (Not with H_2)

$Cd + H_2 \xrightarrow{450^\circ C} CdH + H$

* Sulphur:- $S_8 + 8H_2 \rightleftharpoons 8H_2S$

* Water :- No (Soluble)

* Occurance :- 0.05 ppm

* Isotope :-

$_1H^1$, $_1H^2$,

$_1H^1$ → 99.9%,

$_1H^2$ → 0.15%.

$_1H^3$ (Radioactive) (β - decay)

* H_2O ✓

(liquid)

⇓

Hydrogen Bond

(tightly Bound)

✓ H_2S

(Gas)

⇓

Hydrogen Bond (X)

H_2O

D_2O

Calcium + magnesium

C + m → Sulphate

Bicarbonates

Chlorides

① Temp. ⇒ Cal + mag → Bicarbonates ✓

✓

② Perm :- Cal + mag

⇓

{ Chloride or phosphate }

Mfg Process:-

$$Na_2O_2 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O_2$$

63. If a charged particle ($+q$) is projected with certain velocity parallel to the magnetic field, then it will *[2015-I]*
(a) trace helical path
(b) trace circular path
(c) continue its motion without any change
(d) come to rest instantly

64. In the reaction $ZnO + C \rightarrow Zn + CO$, 'C' acts as *[2015-I]*
(a) an acid (b) a base
(c) an oxidising agent (d) a reducing agent

65. The alkali metals have relatively low melting point. Which one of the following alkali metals is expected to have the highest melting point? *[2015-II]*
(a) Li (b) Na
(c) K (d) Rb

66. Which one of the following oxides dissolves in water? *[2016-I]*
(a) CuO (b) Al_2O_3
(c) Fe_2O_3 (d) Na_2O

67. Matter around us can exist in three different states, namely, solid, liquid and gas. The correct order of their compressibility is *[2016-I]*
(a) Liquid < Gas < Solid (b) Solid < Liquid < Gas
(c) Gas < Liquid < Solid (d) Solid < Gas < Liquid

68. Temporary hardness in water is due to which one of the following of Calcium and Magnesium? *[2017-I]*
(a) Hydrogencarbonates (b) Carbonates
(c) Chlorides (d) Sulphates

69. Which one of the following elements is least reactive with water? *[2017-I]*
(a) Lithium (b) Sodium
(c) Potassium (d) Cesium

70. Which one of the following elements corrodes rapidly? *[2017-I]*
(a) Aluminium (b) Iron
(c) Zinc (d) Silver

54. Oxygen on reaction with non-metals forms oxides, which are *[2013-II]*
(a) basic oxides (b) acidic oxides
(c) amphoteric oxides (d) neutral oxides

55. A gas is evolved when a piece of zinc metal placed in dilute sulphuric acid (H_2SO_4). What is the gas? *[2013-II]*
(a) Hydrogen (b) Oxygen
(c) Water vapour (d) Sulphur dioxide

56. Metalloids are *[2013-II]*
(a) alloys of alkali metals with other metals.
(b) colloids of metals.
(c) elements having some properties of both metals and non-metals.
(d) metals heavier than lead.

57. Two reactants in a flask produce bubbles gas; it turns lime water into milky. The reactants in the flask are *[2013-II]*
(a) Zinc and hydrochloric acid
(b) Magnesium carbonate and hydrochloric acid.
(c) Magnesium nitrate and hydrochloric acid.
(d) Magnesium sulphate and hydrochloric acid.

58. The number of aluminium ions present in 54g of aluminium (atomic weight 27) is *[2014-I]*
(a) 2 (b) 18
(c) 1.1×10^{24} (d) 1.2×10^{24}

59. Which of the following is correct regarding the reaction of fluorine with water? *[2014-I]*
$2F_2(g) + 2H_2O(l) \rightarrow 4H^+(aq) + 4F^-(aq) + O_2(g)$
(a) Fluorine is oxidized to F^-
(b) Water is oxidized to O_2.
(c) Water is reduced to H^+
(d) Oxidation state of fluorine does not change

60. The very high heat of vaporization of water is mainly a result of *[2014-II]*
(a) van der Waals forces (b) covalent bonds
(c) interionic attraction (d) hydrogen bonding

29. Consider the following statements with regard to the properties of water *[2010-II]*

I. Water is a good solvent for ionic compound but poor solvent for covalent compound.

II. Water is a good solvent for covalent compound but poor solvent for ionic compound.

III. Water has maximum density at the temperature 277 K.

Which of the statements given above are correct?

(a) I and III only (b) II and III only
(c) I and II only (d) I, II and III

30. When aqueous solutions of two salts are mixed, the third salt formed may appear as a solid precipitate or a clear solution depending upon the solubility of its ions. It is observed that all salts of Na, K, NH_4 are soluble. All nitrates and bicarbonates are also soluble. All halides (chlorides, bromides, iodides) are soluble except those of Ag, Hg (I) and Pb. All sulphates are soluble except those of Ag, Ca, Ba and Pb. Which one among the following combinations of solutions will produce a solid precipitate?

(a) Sodium sulphate and barium chloride
(b) Magnesium sulphate and barium bicarbonate
(c) Lithium iodide and barium chloride
(d) Ammonium sulphate and potassium bromide

31. A mixture containing SiO_2, NaCl and NH_4Cl is taken for separating the constituents. The suitable steps required for this are *[2010-II]*

(a) Sublimation-dissolution-filtration-crystallisation
(b) Dissolution-filtration-crystallisation-distillation
(c) Sublimation-evaporation-dissolution-decomposition
(d) Dissolution-distillation-decomposition-evaporation .

32. Which one among the following is a chemical process? *[2010-II]*

(a) Distillation of sea (salty) water
(b) Crystallisation of impure salt (NaCl)
(c) Production of Iodine (I_2) from sea-weeds
(d) Sublimation of iodine (I_2)

18. Which among the following is an element? *[2009-I]*

(a) Alumina (b) Brass
(c) Graphite (d) Silica

19. Which one among the following is used as a moderator in nuclear reactors? *[2009-I]*

(a) Ozone (b) Heavy hydrogen
(c) Heavy water (d) Hydrogen peroxide

20. Which one of the following elements exists in liquid state at room temperature? *[2009-II]*

(a) Mercury (b) Lead
(c) Sodium (d) Calcium

21. Aluminium is more reactive than iron but aluminium is less easily corroded than iron, because *[2009-II]*

(a) oxygen forms a protective oxide layer
(b) it is a noble metal
(c) iron undergoes reaction easily with water
(d) iron forms ions

22. Equal quantities (50 ml) of the following four samples of water are placed in four beakers of 100 ml capacity. Their boiling points are determined accurately using the same thermometer. Which sample of water will have the lowermost boiling point as compared to other three samples? *[2009-II]*

(a) Distilled water (b) Bottled mineral water
(c) Well water (d) Seawater

23. Which one among the following metals is more reactive than hydrogen? *[2010-I]*

(a) Mercury (b) Copper
(c) Silver (d) Tin

24. Which one of the following is a transition metal? *[2010-I]*

(a) Aluminium (Al) (b) Manganese (Mn)
(c) Magnesium (Mg) (d) Calcium (Ca)

34. Silverware turns black after a period of time due to formation of *[2011-I]*

(a) nitrate coating on silver
(b) sulphide coating on silver
(c) chloride coating on silver
(d) oxide coating on silver

35. Which of the statements given below is/are correct?

Permanent hardness of water is due to the presence of soluble.

1. chloride of calcium
2. bicarbonate of calcium
3. sulphate of magnesium
4. bicarbonate of magnesium *[2011-I]*

Select the correct answer using the codes given below.

(a) 1 only (b) 1 and 3
(c) 2 and 4 (d) 1, 2 and 3

75. Which one of the following metals is used in the filaments of photo-electric cells that convert light energy into electric energy? *[2018-I]*

(a) Tungsten (b) Copper
(c) Rubidium (d) Aluminium

75. Permanent hardness of water cannot be removed by which one of the following methods? *[2018-II]*

(a) Treatment with washing soda
(b) Calgon's method
(c) Boiling
(d) Ion exchange method

76. Which one of the following metals does NOT react with cold water ? *[2019-I]*

(a) Calcium (Ca) (b) Potassium (K)
(c) Magnesium (Mg) (d) Sodium (Na)

36. Which one among the following methods is not effective in removing arsenic from contaminated ground water ? *[2011-I]*
(a) Boiling
(b) Reverse osmosis
(c) Ion exchange
(d) Coagulation adsorption

37. Bronze is often used to make statues and medals whereas brass is used in making utensils, scientific apparatus and cartridges. Both brass and bronze are copper containing alloys, yet they differ in their chemical composition for additionally containing *[2011-I]*
(a) zinc in brass and tin in bronze
(b) chromium in brass and nickel in bronze
(c) nickel in brass and tin in bronze
(d) iron in brass and nickel in bronze

38. Solutions in test tubes containing H_2O and aqueous NaOH can be differentiated with the help of *[2011-I]*
(a) red litmus (b) blue litmus
(c) Na_2CO_3 (d) HCl (aqueous)

39. A student heated some sulphur in a spatula and collected the gas 'X'. Which one among the following is correct about 'X'? *[2011-I]*
(a) X is SO_2 and it turns moist litmus to blue
(b) X is SO_3 and it turns moist litmus to red
(c) X is SO_2 and it turns moist litmus to red
(d) X is SO_3 and it turns dry litmus to blue

40. All the elements in a group (family) have a common valency. For example, all the elements of the carbon family (carbon, silicon, germanium, tin and lead) have common valency four. However, some of these elements can also have valency two. Which of the following can have valency two? *[2011-II]*
(a) Silicon, germanium and tin
(b) Only germanium and tin
(c) Germanium, tin and lead
(d) Only tin and lead

41. When a copper rod is dipped in aqueous silver nitrate solution, the colour of the solution changes to blue. This is because *[2011-II]*
(a) Cu is more easily reduced than Ag
(b) Ag is more easily reduced than Cu
(c) Nitrate ion acts as an oxidizing agent
(d) Nitrate ion acts as a reducing agent

42. The metal constituent of chlorophyll is *[2011-II]*
(a) Iron (b) Potassium

8. Yellow colour of usual nitric acid is due to the presence of which one of the following?
(a) N_2O (b) NO
(c) N_2O_5 (d) NO_2 *[2007-II]*

9. When iron is left exposed in open air, it gets rusted. Which constituent(s) of air is /are responsible for rusting iron?
1. Oxygen gas present in air
2. Moisture present in air
3. Carbon dioxide gas present in air
Select the correct answer using the code given below :
(a) 1 only (b) 2 only
(c) 1 and 2 (d) 2 and 3 *[2008-I]*

10. Which one of the following elements cannot displace hydrogen gas from a dilute acid?
(a) Zinc (b) Copper
(c) Magnesium (d) Iron *[2008-I]*

11. When an alkali-metal reacts with water, which one of the following gases is produced ?
(a) Hydrogen (b) Oxygen
(c) Hydrogen peroxide (d) Ozone *[2008-I]*

12. Which of the following is not a nitrogenous fertilizer?
(a) $Ca(CN)_2$ (b) $CaCN_2$
(c) NH_4NO_3 (d) Urea *[2008-II]*

13. Which one of the following is the correct order in which the gases H_2, Ne, O_2 and N_2 are evolved on fractional distillation of liquid air?
(a) H_2, Ne, O_2, N_2 (b) H_2, Ne, N_2, O_2
(c) N_2, O_2, Ne, H_2 (d) O_2, N_2, H_2, Ne *[2008-II]*

14. Which of the following is an element which never exhibits positive oxidation state in any of its compounds?
(a) Oxygen (b) Chlorine
(c) Fluorine (d) Carbon *[2008-II]*

15. The metal compound commonly found in Sindhoor or Kumkum is based on *[2009-I]*
(a) tin (b) lead
(c) copper (d) zink

16. Which among the following elements (metals) pollutes the air of a city having large number of automobiles? *[2009-I]*
(a) Cadmium (b) Lead
(c) Chromium (d) Nickel

17. Oxygen and ozone are *[2009-I]*
(a) allotropes (b) isomers
(c) isotopes (d) isobars

25. Which one of the following gases, present in the air near the surface of the Earth, has maximum concentrations? *[2010-I]*

(a) Oxygen (O_2) (b) Hydrogen (H_2)
(c) Nitrogen (N_2) (d) Methane (CH_4)

26. Which one of the following elements will replace hydrogen from acids to form salts? *[2010-I]*

(a) Sulphur (S) (b) Silicon (Si)
(c) Zinc (Zn) (d) Phosphorus (P)

27. Which of the following represent a chemical change?

1. Magnetization of iron *[2010-I]*
2. Condensation of liquid
3. Burning of fuel
4. Rusting of iron

Select the correct answer using the code given below:

Code:

(a) 1 and 2 (b) 2 and 3
(c) 3 and 4 (d) 1 and 4

28. Which one among the following is the correct order of reactivity of the elements? *[2010-I]*

(a) Cu > Mg > Zn > Na
(b) Na > Zn > Mg > Cu
(c) Cu > Zn > Mg > Na
(d) Na > Mg > Zn > Cu

77. Which one of the following could be the melting point of iron ? *[2019-I]*

(a) 25°C (b) 37°C
(c) 500°C (d) 1500°C

78. Dinitrogen (N_2) and dioxygen (O_2) are the main constituents of air but they do not react with each other to form oxides of nitrogen because *[2019-I]*

(a) the reaction requires initiation by a catalyst
(b) oxides of nitrogen are unstable
(c) the reaction is endothermic and requires very high temperature
(d) the stoichiometry of N_2 and O_2 in air is not ideal for the reaction to take place

79. On exposure to moist air, copper gains a green coat on its surface due to formation of which one of the following compounds ? *[2019-I]*

(a) Copper carbonate (b) Copper oxide
(c) Copper sulphate (d) Copper nitrate

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