Chapter 2

Chemistry

A. Physical Chemistry

1. Which one of the following can be used to confirm whether drinking water contains a gamma emitting isotope or not ? *[1995]*

(a) Microscope (b) Lead plate
(c) Scintillation counter (d) Spectrophotometer

2. Which one of the following pairs of materials serves as electrodes in chargeable batteries commonly used in devices such as torchlights, electric shaver etc. ? *[1995]*

(a) Nickel and cadmium
(b) Zinc and carbon
(c) Lead peroxide and lead
(d) Iron and cadmium

3. 'Yellow cake', an item of smuggling across border is *[1995]*

(a) a crude form of heroin
(b) a crude form of cocaine
(c) uranium oxide
(d) unrefined gold

4. The difference between a nuclear reactor and an atomic bomb is that *[1995]*

(a) no chain reaction takes place in nuclear reactor while in the atomic bomb there is a chain reaction
(b) the chain reaction in nuclear reactor is controlled
(c) the chain reaction in nuclear reactor is not controlled
(d) no-chain reaction takes place in atomic bomb while it takes place in nuclear reactor

5. The alpha particle carries two positive charge. Its mass is very nearly equal to that of *[1996]*

(a) two protons
(b) an atom of helium
(c) sum of masses of two positrons and two neutrons
(d) two positrons as each positron carries a single positive charge

6. Match the names of outstanding Indian scientists given in List I with area of their specialized work given in List II and select the correct answer by using the codes given below the lists : *[1998]*

	List- I		**List-II**
A.	Dr. Raja Ramanna	1.	Plant chemistry
B.	Dr. M.S. Swaminathan	2.	Nuclear physics
C.	Prof. U.R Rao	3.	Thermodynamics & astrophysics
D.	Prof. Meghnad Saha	4.	Space research
		5.	Agricultural science

Codes :

(a) A-3; B-5; C-2; D-1 (b) A-2; B-1; C-4; D-3
(c) A-2; B-5; C-4; D-3 (d) A-3; B-1; C-4; D-2

7. Which one of the following elements is essential for the construction of nuclear reactors? *[1998]*

(a) Cobalt (b) Nickel
(c) Zirconium (d) Tungsten

8. Barium in a suitable form is administered to patients before an X-ray examination of the stomach, because *[1999]*

(a) barium allows X-rays to pass through the stomach on account of its transparency to X-rays
(b) barium is a good absorber of γ-rays and this helps the stomach to appear clearly in contrast with the other regions in the picture
(c) barium is a good absorber of X-rays and this helps the stomach to appear clearly in contrast with the other regions in the picture
(d) barium salts are white in colour and this helps the stomach to appear clearly in contrast with other regions in the pictures

9. Cobalt-60 is commonly used in radiation therapy because it emits *[1999]*

(a) alpha rays (b) beta rays
(c) gamma rays (d) X-rays

10. **Assertion (A) :** Large cold storage plants use ammonia as refrigerant while domestic refrigerators use chlorofluoro-carbons.
Reason (R) : Ammonia can be liquefied at ambient temperature and low pressure. *[2000]*

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

11. Most of the explosions in mines occur due to the mixing of *[2000]*
(a) hydrogen with oxygen
(b) oxygen with acetylene
(c) methane with air
(d) carbon dioxide with ethane

12. In an atom, the order of filling up of the orbitals is governed by *[2001]*
(a) Aufbau's principle
(b) Heisenberg's uncertainty principle
(c) Hund's rule
(d) Pauli's exclusion principle

13. A radioactive substance has a half-life of four months. Three-fourth of the substance would decay in *[2001]*
(a) 3 months (b) 4 months
(c) 8 months (d) 12 months

14. Which one of the following is NOT radioactive? *[2001]*
(a) Astatine (b) Francium
(c) Tritium (d) Zirconium

15. Match List I with List II and select the correct answer using the codes given below the lists: *[2001]*

List-I (Characteristic)		**List-II (Particle)**
A. Zero mass	1.	Positron
B. Fractional charge	2.	Neutrino
C. Fractional spin	3.	Quark
D. Integral spin	4.	Photon

Codes:
(a) A-2; B-3; C-1; D-4 (b) A-3; B-2; C-4; D-1
(c) A-2; B-3; C-4; D-1 (d) A-3; B-2; C-1; D-4

16. With reference to ionic compounds, consider the following statements: *[2003]*
1. Ionic compounds are insoluble in alcohol.
2. Ionic compounds in the solid state are good conductor of electricity.

Which of these statements is/are correct?
(a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) Neither 1 nor 2

17. Regarding the atom of a chemical element, the magnetic quantum number refers to *[2003]*
(a) orientation (b) shape
(c) size (d) spin

18. Which one of the following statements is correct? *[2003]*
(a) Liquid sodium is employed as a coolant in nuclear reactors
(b) Calcium carbonate is an ingredient of tooth paste
(c) Bordeaux mixture consists of sodium sulphate and lime
(d) Zinc amalgams are used as a dental filling

19. In a dry cell (battery), which of the following are used as electrolytes? *[2009]*
(a) Ammonium chloride and Zinc chloride
(b) Sodium chloride and Calcium chloride
(c) Magnesium chloride and Zinc chloride
(d) Ammonium chloride and Calcium chloride

20. Hydrogen fuel cell vehicles produce one of the following as "exhaust" *[2010]*
(a) NH_3 (b) CH_4
(c) H_2O (d) H_2O_2

21. The function of heavy water in a nuclear reactor is to: *[2011 - I]*
(a) slow down the speed of neutrons
(b) increase the speed of neutrons
(c) cool down the reactor
(d) stop the nuclear reaction

B. Inorganic Chemistry

22. Which one of the following is a mixed fertilizer? *[1995]*
(a) Urea
(b) CAN
(c) Ammonium sulphate
(d) NPK

23. The chemical used as a 'fixer' in photography is *[1995]*
(a) Sodium sulphate
(b) Sodium thiosulphate
(c) Ammonium persulphate
(d) Borax

24. Which one of the following elements is alloyed with iron to produce steel which can resist high temperatures and also have high hardness and abrasion resistance? *[1996]*
(a) Aluminium (b) Chromium
(c) Nickel (d) Tungsten

25. Which one of the following is not an essential micronutrient for plants? *[1996]*
(a) Boron (b) Zinc
(c) Sodium (d) Copper

26. The most reactive among the halogens is *[1997]*
(a) Fluorine (b) Chlorine
(c) Bromine (d) Iodine

27. Match List I with List II and select the correct answer using the codes given below the lists: *[1998]*

List- I		**List-II**
A. Blue vitriol	1.	Sodium bicarbonate
B. Epsom salt	2.	Sodium hydroxide
C. Baking soda	3.	Magnesium sulphate
D. Caustic soda	4.	Copper sulphate

Codes:
(a) A-3; B-4; C-2; D-1 (b) A-4; B-3; C-2; D-1
(c) A-3; B-4; C-1; D-2 (d) A-4; B-3; C-1; D-2

28. Match List-I with List-II and select the correct answer using the codes given below the lists: *[1998]*

List-I		**List-II**
A. Potassium bromide	1.	Fertiliser
B. Potassium nitrate	2.	Photography
C. Potassium sulphate	3.	Bakery
D. Monopotassium tartarate	4.	Gun powder

Codes :
(a) A-2; B-4; C-1; D-3 (b) A-2; B-3; C-1; D-4
(c) A-4; B-2; C-3; D-1 (d) A-4; B-2; C-1; D-3

29. Consider the following statements : *[1998]*
Coke is one of the materials of the charge added to blast furnace for the production of steel/iron. Its function is to
1. act as the reducing agent
2. remove silica associated with the iron ore
3. function as fuel; to supply heat
4. act as an oxidizing agent

Of these statements
(a) 1 and 2 are correct (b) 2 and 4 are correct
(c) 1 and 3 are correct (d) 3 and 4 are correct

30. Which one of the following metals does not form amalgam? *[1998]*
(a) Zinc (b) Copper
(c) Magnesium (d) Iron

31. **Assertion (A) :** Sodium metal is stored under kerosene.
Reason (R) : Metallic sodium melts when exposed to air. *[1998]*
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

32. **Assertion (A) :** To dilute sulphuric acid, acid is added to water and not water to acid. *[1999]*
Reason (R) : Specific heat of water is quite large.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

33. Match List-I with List-II and select the correct answer using the codes given below the lists: *[2000]*

List-I	List-II
A. German silver	1. Tin
B. Solder	2. Nickel
C. Bleaching powder	3. Sodium
D. Hypo	4. Chlorine

Codes:
(a) A-1; B-2; C-4; D-3
(b) A-2; B-1; C-3; D-4
(c) A-1; B-2; C-3; D-4
(d) A-2; B-1; C-4; D-3

34. Which one of the following materials is very hard and very ductile? *[2000]*
(a) Carborundum (b) Tungsten
(c) Cast iron (d) Nichrome

35. Aluminium surface are often 'anodized'. This means the deposition of a layer of *[2000]*
(a) chromium oxide (b) aluminium oxide
(c) nickel oxide (d) zinc oxide

36. Consider the following statements: Hard water is not suitable for *[2000]*
1. drinking
2. washing clothes with soap
3. use in boilers
4. irrigating crops

Which of these statements are correct?
(a) l and 3 (b) 2 and 3
(c) 1, 2 and 4 (d) 1, 2, 3 and 4

37. An aqueous solution of copper sulphate is acidic in nature because the salt undergoes *[2001]*
(a) dialysis (b) electrolysis
(c) hydrolysis (d) photolysis

38. Consider the following statements with reference to the periodic table of chemical elements: *[2001]*
1. Ionisation potential gradually decreases along a period
2. In a group of elements, electron affinity decreases as the atomic weight increases
3. In a given period, electronegativity decreases as the atomic number increases

Which of these statement (s) is/are correct?
(a) 1 only (b) 2 only
(c) 1 and 3 (d) 2 and 3

39. Match List-I (Oxidation number) with List II (The element) and select the correct answer using the codes given below the lists : *[2002]*

List-I (Oxidation number)	List-II (The elements)
A. 2	1. Oxidation number of Mn in MnO_2
B. 3	2. Oxidation number of S in $H_2S_2O_7$
C. 4	3. Oxidation number of Ca in CaO
D. 6	4. Oxidation number of Al in $NaAlH_4$

Codes:
(a) A-3; B-4; C-1; D-2 (b) A-4; B-3; C-1; D-2
(c) A-3; B-4; C-2; D-1 (d) A-4; B-3; C-2; D-1

40. **Assertion :** Synthetic detergents can lather well in hard water.
Reason (R) : Synthetic detergents form soluble calcium and magnesium salts with hard water. *[2002]*
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A
(c) A is true but R is false
(d A is false but R is true

41. Which one of the following statements is NOT correct? *[2003]*
(a) The presence of NaCl increases the rate of setting of plaster of Paris
(b) Gypsum is added to the cement to slow down its rate of setting
(c) All alkaline earth metals form hydrated salts
(d) Barium and strontium are found free in nature

42. **Assertion (A) :** In the periodic table of chemical elements, electron affinity is always found to increase from top to bottom in a group
Reason (R) : In a group, the atomic radii generally increase from top to bottom. *[2003]*
(a) Both A and R are individually true and R is the correct explanation of A .
(b) Both A and R are individually true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

43. **Assertion (A) :** Coal-based thermal power stations contribute to acid-rain.
Reason (R) : Oxides of carbon are emitted when coal burns. *[2003]*
(a) Both A and R are individually true and R is the correct explanation of A
(b) Both A and R are individually true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

44. Consider the following statements: *[2004]*
1. Baking soda is used in fire extinguishers
2. Quick lime is used in the manufacture of glass
3. Gypsum is used in the manufacture of plaster of Paris
Which of the statements given above is/are correct?
(a) 1 and 2 (b) 2 and 3
(c) 1 only (d) 1, 2 and 3

45. Salts of which of the following elements provide colours to fireworks? *[2004]*
(a) Zinc and sulphur
(b) Potassium and mercury
(c) Strontium and barium
(d) Chromium and nickel

46. Which are the materials generally employed as solder in soldering operations in electronics? *[2006]*
(a) Iron and tin
(b) Lead and tin
(c) Aluminium and lead
(d) Aluminium and iron

47. Which one of the following non-metals is not a poor conductor of electricity? *[2007]*
(a) Sulphur (b) Selenium
(c) Bromine (d) Phosphorus

48. Which one of the following types of glass can cut off ultraviolet rays? *[2007]*
(a) Soda glass (b) Pyrex glass
(c) Jena glass (d) Crookes glass

49. Which one among the following is called philosopher's wool? *[2007]*
(a) Zinc bromide (b) Zinc nitrate
(c) Zinc oxide (d) Zinc chloride

50. Which one of the following does not contain silver? *[2007]*
(a) Horn silver (b) German silver
(c) Ruby silver (d) Lunar caustic

51. What are Rubies and Sapphires chemically known as? *[2008]*
(a) Silicon dioxide (b) Aluminium oxide
(c) Lead tetroxide (d) Boron nitride

52. Which one of the following is also called Stranger Gas? *[2008]*
(a) Argon (b) Neon
(c) Xenon (d) Nitrous oxide

53. Which one of the following pairs of metals constitutes the lightest metal and the heaviest metal, respectively? *[2008]*
(a) Lithium and mercury
(b) Lithium and osmium
(c) Aluminium and osmium
(d) Aluminium and mercury

54. Lead, ingested or inhaled, is a health hazard. After the addition of lead to petrol has been banned, what still are the sources of lead poisoning ? *[2012 - I]*
1. Smelting units 2. Pens and pencils
3. Paints 4. Hair oils and cosmetics
(a) 1, 2 and 3 only (b) 1 and 3 only
(c) 2 and 4 only (d) 1, 2, 3 and 4

55. Photochemical smog is a resultant of the reaction among *[2013 - I]*
(a) NO_2, O_3 and peroxyacetyl nitrate in the presence of sunlight
(b) CO, O_2 and peroxyacetyl nitrate in the presence of sunlight
(c) CO, CO_2 and NO_2 at low temperature
(d) high concentration of NO_2, O_3 and CO in the evening

C. Organic Chemistry

56. Which one of the following polymers is widely used for making bullet proof material? *[1995]*
(a) Polyvinyl chloride (b) Polyamides
(c) Polyethylene (d) Polycarbonates

57. The offending substance in the liquor tragedies leading to blindness etc. is *[1996]*
(a) ethyl alcohol (b) amyl alcohol
(c) benzyl alcohol (d) methyl alcohol

58. The characteristic odour of garlic is due to *[1997]*
(a) a chloro compound
(b) a sulphur compound
(c) a fluorine compound
(d) acetic acid

59. Which one of the following is an active component of oil of clove? *[1997]*
(a) Menthol (b) Eugenol
(c) Methanol (d) Benzaldehyde

60. Which one of the following was used as a chemical weapon in the first world war ? *[1997]*
(a) Carbon monoxide (b) Hydrogen cyanide
(c) Mustard gas (d) Water gas

61. Which one of the following has the highest fuel value?
(a) Hydrogen (b) Charcoal *[1997]*
(c) Natural gas (d) Gasoline

62. Which one of the following is used as an anti-freeze for the automobile engines? *[1997]*
(a) Propyl alcohol (b) Ethanol
(c) Methanol (d) Ethylene glycol

63. **Assertion (A) :** Phenyl is used as a household germicide.
Reason (R) : Phenyl is phenol derivative and phenol is an effective germicide. *[1998]*
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

64. Consider the following statements about acetylene: *[1998]*
1. It is used in welding industry
2. It is a raw material for preparing plastics
3. It is easily obtained by mixing silicon carbide and water of these statements
(a) 1 and 2 are correct
(b) 1 and 3 are correct
(c) 2 and 3 are correct
(d) 1, 2 and 3 are correct

65. **Assertion (A) :** Formic acid is a stronger acid than acetic acid. *[1998]*
Reason (R) : Formic acid is an organic acid.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

66. Match List-I (Industrial process) with List-II (Industry with which associated) and select the correct answer using the codes given below the lists: *[2000]*

List-I		List-II
A.	Cracking	1. Rubber
B.	Smelting	2. Petroleum
C.	Hydrogenation	3. Copper
D.	Vulcanization	4. Edible fats

Codes:
(a) A-3; B-2; C-1; D-4
(b) A-2; B-3; C-4; D-1
(c) A-2; B-3; C-1; D-4
(d) A-3; B-2; C-4; D-1

67. Which one of the following is the correct sequence in increasing order of molecular weights of the hydrocarbons? *[2001]*
(a) Methane, ethane, propane and butane
(b) Propane, butane, ethane and methane
(c) Butane, ethane, propane and methane
(d) Butane, propane, ethane and methane

68. The purpose of adding sodium sulphate and sodium silicate to the detergent in a washing powder is *[2003]*
1. to keep the washing powder dry
2. to maintain the alkalinity of the powder
Which of these statements is/are correct?
(a) only 1 (b) Only 2
(c) Both 1 and 2 . (d) Neither 1 nor 2

69. Match List-I (Fuel gases) with List-II (Major constituents) and select the correct answer using the codes given below the lists: *[2004]*

List-I		List-II
A.	CNG	1. Carbon monoxide, Hydrogen
B.	Coal gas	2. Butane, Propane
C.	LPG	3. Methane, Ethane
D.	Water gas	4. Hydrogen, Methane, Carbon monoxide

Codes:
(a) A-2; B-1; C-3; D-4 (b) A-3; B-4; C-2; D-1
(c) A-2; B-4; C-3; D-1 (d) A-3; B-1; C-2; D-4

70. **Consider the following statements:** *[2005]*
1. Liquefied natural gas (LNG) is liquefied under extremely cold temperatures and high pressure to facilitate storage or transportation in specially designed vessels.
2. First LNG terminal in India was built in Hassan.
3. Natural gas liquids (NGL) are separated from LPG and these include ethane, propane, butane and natural gasoline.
Which of the statements given above is/are correct?
(a) 1 only (b) 1 and 3
(c) 2 and 3 (d) 1, 2, and 3

71. **Assertion (A) :** The main constituent of the liquefied petroleum gas is methane.
Reason (R) : Methane can be used directly for burning in homes and factories where it can be supplied through pipelines. *[2005]*
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

72. Consider the following chemicals: *[2006]*
1. Benzene
2. Carbon tetrachloride
3. Sodium carbonate
4. Trichloroethylene

Which of the above/is are used as dry cleaning chemical?
(a) 1 only (b) 2 only
(c) 1, 2 and 4 only (d) 1, 2, 3 and 4

73. Which one of the following is another name of RDX? *[2007]*
(a) Cyanohydrin (b) Dextran
(c) Cyclohexane (d) Cyclonite

74. What is Bisphenol A (BPA)? *[2008]*
(a) A medical test for detecting cancer
(b) A test for testing the use of drugs to improve performance by athletes
(c) A chemical used for the development of food packaging materials
(d) A special type of alloy steel

75. Mixture of which one of the following pairs of gases is the cause of occurrence of most of the explosions in mines? *[2008]*
(a) Hydrogen and Oxygen
(b) Oxygen and acetylene
(c) Methane and air
(d) Carbon dioxide and methane

76. Which one of the following is used as an explosive? *[2009]*
(a) Phosphorus trichloride
(b) Mercuric oxide
(c) Graphite
(d) Nitroglycerine

77. Consider the following statements : *[2012 - I]*
Chlorofluorocarbons, known as ozone-depleting substances, are used
1. In the production of plastic foams
2. In the production of tubeless tyres
3. In cleaning certain electronic components
4. As pressurizing agents in aerosol cans
Which of the statements given above is/are correct?
(a) 1, 2 and 3 only (b) 4 only
(c) 1, 3 and 4 only (d) 1, 2, 3 and 4

78. With reference to the usefulness of the by-products of sugar industry, which of the following statements is/are correct? *[2013 - I]*
1. Bagasse can be used as biomass fuel for the generation of energy.
2. Molasses can be used as one of the feedstocks for the production of synthetic chemical fertilizers.
3. Molasses can be used for the production of ethanol.
Select the correct answer using the codes given below.
(a) 1 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

D. Environmental Chemistry

79. The final Agent Orange raid in Vietnam took place in 1970– areas have begun to bloom again. But 19 years after the war's end, it seems plain that Agent Orange is killing and maiming human beings, something it never intended to do. The apparent toxic fallout from those clouds–is a crop of human miseries including cancers, miscarriages and birth defects-that may persist for decades." *[1995]*
The offensive substance referred to in this quotation is:
(a) DDT used as insecticide
(b) A complex mixture of herbicides and weedicides used to increase agricultural output in the South Vietnam under the U.S. aid programme
(c) A complex mixture of DDT and other insecticides used at aerial sprays for protection against malaria and other tropical diseases
(d) Dioxin used as defoliants

80. Which one of the following fuels causes minimum environmental pollution ? *[1995]*
(a) Diesel (b) Coal
(c) Hydrogen (d) Kerosene

81. Physico-chemical characteristics of water in water sources undergo changes due to *[1996]*
(a) aquatic macrophytes
(b) aquatic fungi
(c) effluents
(d) evapotranspiration

82. The water pollution in river is measured by the dissolved amount of *[1998]*
(a) Chlorine (b) Ozone
(c) Nitrogen (d) Oxygen

83. Match List-I (Naturally occurring substances) with List-II (Elements) and select the correct answer using the codes given the lists: *[1999]*

	List-I		**List-II**
A	Diamond	1.	Calcium
B.	Marble	2.	Silicon
C.	Sand	3.	Aluminium
D.	Ruby	4.	Carbon

Codes:
(a) A-3; B- 1; C-2; D-4 (b) A - 4; B- 2; C- 1; D-3
(c) A-2; B- 1; C-3; D-4 (d) A - 4; B- 1; C- 2; D-3

84. Which one of the following is produced during the formation of photochemical smog? *[2003]*
(a) Hydrocarbons (b) Nitrogen Oxide
(c) Ozone (d) Methane

85. Which of the following substances are found in the beach sands of many parts of Kerala? *[2006]*
1. Ilmenite 2. Zirecon
3. Sillimanite 4. Tungsten
Select the correct answer using the codes given below:
(a) 1, 2, 3 and 4
(b) 1, 2 and 3 only
(c) 3 and 4 only
(d) 1 and 2 only

86. Consider the following: *[2010]*

1. Oxides of Hydrogen
2. Oxides of Nitrogen
3. Oxides of Sulphur

Which of the above causes/cause acid rain?

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

87. Excessive release of the pollutant carbon monoxide (CO) into the air may produce a condition in which oxygen supply in the human body decreases. What causes this condition? *[2010]*

(a) When inhaled into the human body CO is converted into CO_2
(b) The inhaled CO has much higher affinity for haemoglobin as compared to oxygen
(c) The inhaled CO destroys the chemical structure of haemoglobin
(d) The inhaled CO adversely affects the respiratory centre in the brain

88. Consider the following : *[2011 - I]*

1. Carbon dioxide
2. Oxides of nitrogen
3. Oxides of sulphur

Which of the above is/are the emission/emissions from coal combustion at thermal power plants ?

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

89. Regarding "carbon credits'', which one of the following statements is not correct ? *[2011 - I]*

(a) The carbon credit system was ratified in conjunction with the Kyoto Protocol.
(b) Carbon credits are awarded to countries or groups that have reduced greenhouse gases below their emission quota.
(c) The goal of the carbon credit system is to limit the increase of carbon dioxide emission.
(d) Carbon credits are traded at a price fixed from time to time by the United Nations Environment Programme.

90. Aspartame is an artificial sweetener sold in the market. It consist of amino acids and provides calories like other amino acids. Yet, it is used as a low-calorie sweetening agent in food items. What is the basis of this use ? *[2011 - I]*

(a) Aspartame is as sweet as table sugar, but unlike table sugar, it is not readily oxidized in human body due to lack of requisite enzymes
(b) When aspartame is used in food processing, the sweet taste remains, but it becomes resistant to oxidation
(c) Aspartame is as sweet as sugar, but after ingestion into the body, it is converted into metabolites that yield no calories
(d) Aspartame is several times sweeter than table sugar, hence food items made with small quantities of aspartame yield fewer calories on oxidation

91. What is the role of ultraviolet (UV) radiation in the water purification systems? *[2012 - I]*

1. It inactivates /kills the harmful microorganisms in water.
2. It removes all the undesirable odours from the water.
3. It quickens the sedimentation of solid particles, removes turbidity and improves the clarity of water.

Which of the statements given above is/are correct?

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

92. Acid rain is caused by the pollution of environment by *[2013 - I]*

(a) carbon dioxide and nitrogen
(b) carbon monoxide and carbon dioxide
(c) ozone and carbon dioxide
(d) nitrous oxide and sulphur dioxide

93. Which of the following is/are the example/ examples of chemical change? *[2014 - I]*

1. Crystallization of sodium chloride?
2. Melting of ice
3. Souring of milk

Select the correct answer using the code given below.

(a) 1 and 2 only (b) 3 only
(c) 1, 2 and 3 (d) None

94. With reference to 'fly ash' produced by the power plants using coal as fuel, which of the following statements is/are correct? *[2015-I]*

1. Fly ash can be used in the production of bricks for building construction.
2. Fly ash can be used as a replacement for some of the Portland cement concrete.
3. Fly ash is made up of silicon dioxide and calcium oxide only, and does not contain any toxic elements.

Select the correct answer using the code given below.

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

HINTS & SOLUTIONS

A. Physical Chemistry

1. **(c) Scintillation counter (scintillometer) :** An instrument which measures gamma radiation. It is also used in airborne and ground radiometre surveys. This instrument utilizes the flash of light emitted when the atoms of a suitable ' phosphor' are energized by gamma rays. The scintillations are detected by a light - sensitive cathode.

2. **(a)** Ni-Cd batteries contain nickel hydroxide as positive electrode plate, a cadmium hydroxide as negative electrode plate, and an alkaline electrolyte as seperator. The chemical reaction which occurs in Ni-Cd battery is

$$2NiO(OH) + Cd + 2H_2O \leftrightarrow 2Ni(OH)_2 + Cd(OH)_2$$

3. **(c)** Uranium oxide is smuggled across border in the form of yellow cake. Uranium oxide is produced by refining tons of dirt (ore) containing uranium to produce "Yellow cake". Typically yellow cake which contains 80% of uranium oxide, which melts at approximately 2878°C whereas modern yellow cake contains 70 to 90% triuranium octaxide (U_3O_8) by weight. Yellow cake is used in the preparation of uranium fuel for nuclear reactor. Uranium obtained from yellow cake also used in making many types of illegal nuclear explosive which is very dangerous to mankind.

4. **(b)** Nuclear fission is a perfect example of chain reaction. In case of nuclear fission a heavy atomic nucleus (such as that of uranium) disintegrates into two nearby equal fragments with release of large amount of energy when large number of nuclei are brought closer together. In such a case the neutrons released, when one nucleus splits, strikes other nuclei causing them to split and the process continues. Now atomic bomb and nuclear reactor both works on nuclear fission chain reaction but chain reaction in nuclear reactor is controlled by control rods, made up of metal cadmium or boron a neutron absorbing material, whereas in atomic bomb there is no neutron absorber. So chain reaction goes uncontrolled and is very violent.

5. **(b)** Each alpha particle contains two protons and two neutrons.
   Total number of nucleons = Number of protons + Number of neutrons
   = 2 + 2 = 4
   Total number of nucleons = Mass number of an element
   Thus mass number of alpha particle is 4 which is equal to molecular weight of helium atom.

6. **(c)** *Raja Ramanna* India's Most Eminent Nuclear Physicist, if we have today achieved the status of a "developed country" in nuclear science and technology, it is in large measure a consequence of Dr. Ramanna's ideals, policies and efforts.
   M. S. Swaminathan is an Indian agriculture scientist. He is known as the "Father of the Green Revolution in India."
   Udipi Ramachandra Rao is a space scientist and former chairman of the Indian Space Research Organisation. Prof Rao's experiments on a number of Pioneer and Explorer spacecrafts, led to a complete understanding of the solar cosmic ray phenomena and the electromagnetic state of the interplanetary space.
   Meghnad Saha was an Indian astrophysicist, best known for his development of the Saha equation, used to describe chemical and physical conditions in stars.

7. **(c)** Zirconium purified metal is primarily used by the nuclear industry to form the outer layer of fuel rods in nuclear reactors. Zirconium's major use is as cladding for nuclear reactors. It is ideal for this use, as it has a limited ability to capture neutrons, strength at elevated temperatures, considerable corrosion resistance, and satisfactory neutron damage resistance.

8. **(c)** Barium is given in adequate amount to patients before X-ray examination. The gut (gastrointestinal tract) does not show up very well on ordinary X-ray pictures. However, if you drink a white liquid that contains a chemical called barium sulphate, the outline of the upper parts of the gut (oesophagus, stomach and small intestines) shows up clearly on X-ray pictures. This is because X-rays do not pass through barium.

9. **(c)** Cobalt-60 is useful as a gamma ray source because it can be produced in predictable quantity and high activity by bombarding cobalt with neutrons. This is commonly used in radiation therapy for treatment of cancer.

10. **(a)** Ammonia is used as a large scale refrigerant because it has highest refrigerating capacity per pound of any refrigerant and a number of other excellent thermal properties that make it popular for a number of refrigeration applications in spite of its being toxic, explosive and flammable within certain conditions. Ammonia is used as refrigerant prominently in the refrigeration systems of food industry like dairies, ice creams plants, frozen food production plants, cold storage warehouses, processors of fish, meat and number of other applications. Comparatively chlorofluorocarbon (CFC) chemical, safer refrigerators were possible for home and consumer use.

11. **(b)** An acetylene molecule is composed of two carbon atoms and two hydrogen atoms. The two carbon atoms are held together by what is known as a triple carbon bond. However, the triple carbon bond is unstable, making acetylene gas very sensitive to conditions such as excess pressure, excess temperature, static electricity, or mechanical shock the possibility of such conditions are high in deep under mines. Thus oxidation of acetylene by mixing results in to very violent and explosive reaction.

12. **(a)** Aufbau principle states that 'in the ground state of the atom, the orbitals are filled in order of their increasing energies, starting with the orbital of lowest energy.' The word aufbau is German word which means building up.

The increasing order of energy and hence that of filling of orbitals is as follows: 1s, 2*s*, 2*p*, 3*s*, 3*p*, 4*s*, 3*d*, 4*p*, 5*s*, 4*d*, 5*p*, 6*s*, 4*f*, 5*d*, 6*p*.

13. **(c)** As it is given that half life of given substance is 4 months.

The amount of substance left after 4 months = 1/2

The amount of substance left after 8 months = 1/4

Therefore the amount of substance decay in 8 months = (1 – 1/4) = 3/4

14. **(d)** Zirconium is not radioactive substance as the substance which have atomic number above 80 shows radioactivity. The rest three Astatine, Francium and Tritium are radioactive in nature. There are five naturally occurring isotopes of Zirconium: Zirconium-90, Zirconium-91, Zirconium-92, Zirconium-94 and Zirconium-96. Natural Zirconium has two radioactive isotopes 94Zr & 96Zr. Three stable isotopes of Zirconium also found in nature, which account for 79.82% of the total amount.

15. **(a)** The Standard Model of particle physics assumed that neutrino are massless.

A quark is an elementary particle and a fundamental constituent of matter. Quarks have fractional electric charge values either –1/3 or +2/3 times the elementary charge.

The positron or antielectron is the antiparticle or the antimatter counterpart of the electron. The positron has an electric charge of +1e, a spin of ½, and the same mass as an electron.

In physics, a photon is an elementary particle. Spin of a photon can be –1 or +1. In a classical view we can say that one is spinning right and other to the left.

16. **(a)** Ionic compound is a chemical compound in which ions are held together in a lattice structure by ionic bonds. Following the aphorism, "like dissolves like", ionic compounds dissolve in polar solvents, especially those that ionize, such as water and ionic liquids. They are usually appreciably soluble in other polar solvents such as alcohols, acetone. Solid ionic compounds cannot conduct electricity because there are no mobile ions or electrons present in the lattice.

17. **(a)** Magnetic quantum number represents the number of orbitals present in the sub-shell magnetic quantum number about the orientation of the orbital.

18. **(a)** Liquid sodium is used as a coolant because water is difficult to use as a coolant for a fast reactor because water acts as a neutron moderator that slows the fast neutrons into thermal neutrons. While it may be possible to use supercritical water as a coolant in a fast reactor, this would require a very high pressure. In contrast, sodium atoms are much heavier than both the oxygen and hydrogen atoms found in water, and therefore the neutrons lose less energy in collisions with sodium atoms. Sodium also need not be pressurized since its boiling point is higher than the reactor's operating temperature. A disadvantage of sodium is its chemical reactivity, which requires special precautions to prevent and suppress fires. If sodium comes into contact with water it explodes, and it burns when in contact with air.

19. **(a)** A dry cell has the electrolyte immobilized as a paste, with only enough moisture in the paste to allow current to flow. The electrolyte is ammonium chloride in the form of a paste next to the zinc anode. In some more modern types of so called 'high power' batteries, the ammonium chloride has been replaced by zinc chloride.

20. **(c)** A hydrogen vehicle is an alternative fuel vehicle that uses hydrogen as its onboard fuel for motive power. The hydrogen vehicle use hydrogen fuel cell for generation of motive power. These fuel cell in which hydrogen serve as a fuel and oxygen as an oxidant emits exhaust of water.

21. **(a)** Heavy water (H_2O_2) and solid graphite is generally used to slow down the speed of neutrons.

B. Inorganic Chemistry

22. **(d)** Fertilizers are those compounds which provide essential primary nutrients (nitrogen, phosphorus and potassium) required for healthy growth of plants and crops. Nitrogeneous fertilizer provide nitrogen, phosphatic fertilizer provide phosphorus whereas potassh fertilizer provide potassium to soil.

NPK fertilizers are mixed fertilizers. They provide all three essential nutrients (nitrogen, phosphorus and potassium). NPK fertilizers contains nitrogen, phosphorus and potassium in different proportion depending upon the requirement of soil.

23. **(b)** Sodium thiosulphate is used in photography as a fixer. It removes Ag from negative by dissolving unexposed silver bromide resulting into formation of complex.

$$AgBr + 2Na_2S_2O_3 \longrightarrow Na_3\left[Ag(S_2O_3)_2\right] + NaBr$$

24. **(b)** Steel is an alloy of iron and carbon. On mixing with carbon its strength and toughness got increased. In order to make it further more temperature and

abrasion resistant chromium is generally mixed with iron, it also increases its hardness and load bearing capacity. Stainless steel is a category of steel consists. (74% Fe, 18% Cr and 8% Ni) is corrosion resistant.

25. (c) There are 13 essential nutrients required by plants for its healthy and proper growth. Now these nutrients are divided into two categories :

Macronutrients (nitrogen, phosphorus, potassium, calcium, magnesium and sulphur).

Micronutrients (iron, copper, manganese, zinc, boron, molybdenum and chlorine).

Additional mineral nutrient elements which are beneficial but not necessary are sodium, cobalt, vanadium, nickel, solenium, aluminium and silicon.

Thus boron, zinc and copper falls into category of essential micronutrients while sodium does not.

26. (a) Fluorine is the most reactive among all halogens. However the reactivity deceases from F_2 to I_2 (from top to bottom of group) may be attributed to

(1) Low dissociation enthalpies

(2) High electron affinities

27. (d) Blue vitriol is blue, crystalline hydrous solution of copper sulphate, $CuSO_4 \cdot 5H_2O$, one of the most important industrial copper salts, used in insecticides, germicides, and hair dyes and in the processing of leather and textiles.

Magnesium sulphate is a chemical compound containing magnesium, sulphur and oxygen, with the formula $MgSO_4$. It is often encountered as the heptahydrate epsomite ($MgSO_4 \cdot 7H_2O$), commonly called "Epsom salt".

Sodium bicarbonate or sodium hydrogen carbonate is the chemical compound with the formula $NaHCO_3$. The salt has many related names such as baking soda, bread soda, cooking soda, bicarbonate of soda.

Caustic soda or sodium hydroxide is an essential ingredient in an array of industrial applications. In addition, consumers use caustic soda when using cleaners, such as oven and drain cleaners.

28. (a) Potassium bromide is used in photography as a restrainer in black and white developer formulas.

Gun powder, also called black powder, is a mixture of sulphur, charcoal, and potassium nitrate. Gun powder can be made by just using potassium nitrate and charcoal (or alternatively without charcoal), but without the sulphur (or coal), the powder is not as strong.

Potassium sulfate is primarily used as a fertilizer.

Mono potassium tartrate is used in bakery by combination with baking soda it results in to evolution of CO_2 which is used for baking cakes.

29. (c) Coke is added in blast furnance along with iron ore in a blast furnace. Coke being derived from fossil fuel by destructive distillation. Thus it contains higher percentage of carbon and have high calorific value that"s why it functions as a fuel to supply heat. Coke also acts as a reducing agent and reduce metal(iron) oxide to metal.

Chemical equations involved in process are following:

$$2C(s) + O_2(g) \longrightarrow 2CO(g)$$

$$FeO(s) + CO(g) \longrightarrow Fe(s) + CO_2(g)$$

$$Fe_2O_3 + 3CO(g) \longrightarrow 2Fe(s) + 3CO_2(g)$$

30. (d) Amalgam is an alloy consisting of mercury and any other element.Iron being exceptional in nature not form amalgam with mercury. That's why mercury is stored in vessels made up of iron. Small quantities of an iron amalgam have, however, been formed by immersing sodium amalgam (containing 1 percent sodium) in a clear, saturated solution of ferrous sulphate.While rest three options zinc,copper and magnesium combine with mercury to form there respective amalgam.

31. (c) Sodium metal is generally kept inside kerosene oil because of its extreme reactive nature. In open air it reacts violently and burns vigorously to form sodium oxide .

32. (a) Sulphuric acid (H_2SO_4) reacts very vigorously with water, in a highly exothermic reaction. Thus if you add water to concentrated sulfuric acid, it can boil and you may get a nasty acid burn. That's why for dilution, acid is added to water not water to acid as specific heat of water is quite large and it can absorb large quantity of heat produced by sulphuric acid. Moreover water is less dense than sulphuric acid, so if you pour water on the acid, the reaction occurs on top of the liquid. If you add the acid to the water, it sinks and any wild and crazy reactions have to get through the water or beaker to get to you.

33. (d) German silver has a color resembling silver, but is an alloy of primarily copper, nickel and zinc.

Solder is an alloy of tin, antimony, copper and lead.

Bleaching powder contains calcium chloride and calcium hypochlorite, used in solution as a bleach. Bleaching powder is sold on the basis of available chlorine, which is liberated when it is treated with a dilute acid. It is used for bleaching paper pulps and fabrics and for sterilizing water.

Hypo solution used in iodometric titration is sodium thiosulphate ($Na_2S_2O_3$).

34. (d) Nichrome is a non-magnetic alloy of nickel, chromium, and iron, usually used as a resistance wire. A common alloy is 80% nickel and 20% chromium, by mass. This alloying provide nichrome properties like hardness and ductility.

35. (b) Anodizing or anodising in British English, is an electrolytic passivation process used to increase the thickness of the natural oxide layer on the surface of metal parts. The process is called "anodizing" because the part to be treated forms the anode electrode of an electrical circuit. Anodizing increases corrosion and wear resistance. The anodized aluminium layer is grown by passing a direct current through an electrolytic solution, with the aluminium object

serving at the anode. The current releases hydrogen at the cathode and oxygen at the surface of the aluminium anode, creating a build up of aluminium oxide layer.

36. (d) Hardness of water is due to presence of chlorides, sulphates and nitrates of calcium and magnesium. Hard water cannot be used for washing purposes as soap do not form lather with hard water easily which results in to wastage of soap in laundaries. Moreover use of hard water in industries results in to scale formation in inner layers of boilers on which insoluble calcium and magnesium carbonates gets deposited and being a bad conductor of heat result in to wastage of energy. Moreover hard water is not fit for drinking purpose as it hinders ionic imbalance in body. Repeated irrigation of crops by hard water increases calcium and magnesium ions in soil which increases soil alkalinity.

37. (c) Aqueous solution of copper sulphate is acidic in nature because copper sulphate on dissolving with water, following chemical reaction takes place

$$CuSO_4(s) + 2H_2O \longrightarrow Cu(OH)_2(l) + H_2SO_4(aq)$$

Now as we can see in above chemical equation the sulphuric acid generated is strong mineral acid which results into increase in acidity of solution. Thus aqueous solution of copper sulphate is acidic in nature.

38. (b) The electron affinity of a molecule or atom is the energy change when an electron is added to the neutral atom to form a negative ion. This property can only be measured in an atom in gaseous state.

$$X + e^- \rightarrow X^-$$

Down a group, the electron affinity decreases because of a large increase in the atomic radius, electron-electron repulsion and the shielding effect of inner electrons against the valence electrons of the atom. As one moves from left to right across a period in the periodic table, the electronegativity increases due to the stronger attraction that the atoms obtain as the nuclear charge increases. There will be an increase of ionization energy from left to right in a given period.

39. (a) The oxidation number characterises the oxidation state of an element in a compound. It is a full number, positive or negative, which indicates the amount of electron loss or gain by this element in the given compound, with respect to the neutral atom. Oxidation number of calcium is 2 in calcium oxide (CaO). Oxidation number of Aluminium is +3 in Sodium aluminium hydride ($NaAlH_4$) is a chemical compound used as a reducing agent.

Oxidation number of manganese is 4 in Manganese dioxide (MnO_2).

Oxidation number of sulphur is 6 in Pyrosulfuric Acid ($H_2S_2O_7$).

40. (a) Synthetic detergents are sodium salt of long chain sulphonic acid or alkyl hydrogen sulphate. Hardness in water is due to presence of chlorides, sulphates and nitrates salts of calcium and magnesium. Now detergents are capable of forming soluble salts even with the calcium and magnesium ions present in hard water and forms lather easily in hard water.

41. (d) Barium and Strontium are alkaline earth metals. They are quite reactive in nature, they do not occur in free state. Strontium is a relatively abundant element in the Earth's crust. The most common minerals containing strontium are celestine and strontianite. Celestine contains primarily strontium sulfate ($SrSO_4$), while strontianite contains mostly strontium carbonate ($SrCO_3$). The most common naturally occurring minerals containing barium are the very insoluble barium sulfate, $BaSO_4$ (barite), and barium carbonate, $BaCO_3$ (witherite).

42. (d) A trend of decreasing electron affinity going down the groups in the periodic table would be expected. The additional electron will be entering in an orbital farther away from the nucleus, and thus would experience a lesser effective nuclear charge. It is fairly obvious that the atoms get bigger as you go down group with the increase in atomic number. The reason is equally obvious - you are adding extra layers of electrons.

43. (b) Coal based thermal power plants contribute to acid rain because SO_2 and NO_2 are emitted from these plants which form H_2SO_4 and HNO_3 in atmosphere, that cause acid rain. Oxides of carbon are emitted when coal burns, but it does not contribute to acid rain.

44. (d) Baking soda is a great as a fire extinguisher for electrical fires and grease fires. When baking soda is heated it releases carbon dioxide and produces water.

$$2NaHCO_3 \rightarrow H_2O + CO_2 + Na_2CO_3$$

Since carbon dioxide is heavier than air and does not support combustion like oxygen does, it smothers the fire while water that is formed cools the fire to below ignition temperature.

Calcium oxide, chemical compound, CaO is also called lime, quicklime, or caustic lime. Calcium oxide is widely used in making porcelain and glass.

Plaster of Paris is a type of building material based on calcium sulphate hemihydrate nominally $CaSO_4.1/2H_2O$. It is created by heating gypsum to about 300°F (150°C).

$$2CaSO_4.2H_2O \longrightarrow 2CaSO_4.1/2H_2O + 3H_2O$$

(released as steam)

45. (c) Creating firework colors is a complex endeavor, requiring considerable art and application of physical science. Strontium and barium both are alkaline earth metal and are extremely reactive. They both impart characteristic color to flame. Strontium salts impart a red color to fireworks. Strontium compounds are also important for stabilizing fireworks mixtures. Barium is used to create green colors in fireworks, and it can also help stabilize other volatile elements.

46. **(b)** Solder is a fusible metal alloy with a melting point or melting range of 90 to 450 degree Celsius (190 to 840 °F), used in a process called soldering where it is melted to join metallic surfaces. It is especially useful in electronics and plumbing. Solder is an alloy of lead and tin.

47. **(b)** Sulphur is the best electrical insulating material known, with a resistivity of about 2×10^{23} μΩ-cm. The reason for this large resistivity is probably the electron traps produced by thermal breaking of S_8 rings. Electrical conductivity of sulphur is 5.0×10^{-14} S m^{-1}. Electrical conductivity of selenium is 8×10^{6} S m^{-1}. Electrical conductivity of bromine is 1.0×10^{-10} S m^{-1}. Electrical conductivity of phosphorous 1.0×10^{-9} S m^{-1}. Thus from this data it is clear that electrical conductivity of selenium is maximum.

48. **(d)** Crookes glass is a type of glass that contains cerium and other rare earths and has a high absorption of ultraviolet radiation used in sunglasses.

49. **(c)** Philosopher's wool is a oxide of zinc a white powder used as a pigment, cosmetics, glass, inks and in zinc ointment.

50. **(b)** German silver has a color resembling silver, but is an alloy of primarily copper, nickel and zinc. Chlorargyrite is the mineral form of silver chloride (AgCl). It is also known as horn silver. Proustite is a sulfosalt mineral consisting of silver sulfarsenide, Ag_3AsS_3, known also as light red silver or ruby silver ore, and an important source of the metal. Silver nitrate is an inorganic compound with chemical formula $AgNO_3$. It was once called lunar caustic because silver was called luna by the ancient alchemists.

51. **(b)** Rubies and Sapphires are scientifically the same stone, differing only in color. Corundum, the predominating mineral of both, is composed of nearly pure alumina (Al_2O_3).The coloring substance which differentiates rubies and sapphires is believed to be chromium.

52. **(c)** Xenon is called the 'stranger' gas. This gas very un-reactive and heavier than air, that was why named strange (in greek it means 'xenon').

53. **(b)** The lightest metal in the periodic table is lithium (Li) with atomic number 3 density 0.53 kg/L. Lithium metal is extremely soft (and highly reactive) and so is unusable for many applications. Osmium is a hard metallic element which has the greatest density of all known elements. It is twice as heavy as lead, and has a specific gravity of 22.59.

54. **(b)** Smelting units and paints are the source of the lead poisoning.

55. **(a)** The burning of fossil fuel can create another atmospheric pollution problem known as Photochemical Smog. Photochemical smog is a condition that develops when primary pollutants like oxides of nitrogen, Volatile organic compounds created from fossil fuel combustion interact under the influence of sunlight to produce secondary pollutants. The major chemical pollutants in Photochemical smog are NO and NO_2, VOCs(volatile organic compounds), Ozone(O_3) and PAN (Peroxyacetyl Nitrate). NO_2 decreases visibility due to yellowish colour. It also contributes to heart and lung problem. Ozone(O_3) contributes to bronchial constriction, coughing and wheezing. PAN causes eye irritation, high toxicity to plants.

C. Organic Chemistry

56. **(d)** Polycarbonates are the polymer widely used in making bullet proof material. Bullet proof glass is made by layering a polycarbonate material between pieces of ordinary glass in a process called lamination. A bullet fired will pierce the outside layer of the glass, but the layered polycarbonate glass material is able to absorb the bullet's energy and stop it. Polycarbonate panels are used for covering advertising posters, construction of office buildings for sound proofing and polycarbonate is also used for making bullet proof jackets.

57. **(d)** Methyl alcohol is very dangerous. May be fatal or cause blindness if swallowed. Harmful, if inhaled or absorbed through skin. It cannot be made non poisonous. Some other harmful effects are results into irritation of skin, eyes and respiratory track. It can also effects central nervous system and liver.

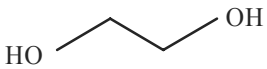
58. **(b)** Allicin is an oily, yellow liquid, which gives garlic its characteristic odour which is due to the –SO group. It also has a range of medical properties.

59. **(b)** **Oil of cloves,** also known as Clove oil, is an essential oil obtained from the clove plant. It is a natural analgesic and antiseptic used primarily in dentistry for its main ingredient eugenol. The oil produced by cloves can be used in many things from flavouring medicine to remedies for bronchitis, common cold, a cough, fever, sore throat and tending to infections.

60. **(c)** The most effective gas of the first world war was mustard gas a vesicent, which was introduced by Germany in July 1917. Mustard gas is not a particularly effective killing agent but the skin of its victims got blistered, their eyes became very sore and they began to vomit. Mustard gas caused internal and external bleeding and attacked the bronchial tubes.

61. **(a)** Fuel value can be expressed in terms of calorific value of fuel. The calorific value of a fuel is the amount of heat produced by burning 1 kg of fuel. Hydrogen has the highest calorific value of (141,790 KJ/kg) thus have highest fuel value. Calorific value of charcoal, natural gas and gasoline are (29,600; 43,000; 47,300 kJ/kg) respectively. Natural gas majorly consists of methane.

62. **(d)** Ethylene glycol solutions are marketed as "permanent anti-freeze", and is used as anti-freeze agent for the automobile engine in cold countries where temperature is below zero degree centigrade.



Structure of ethylene glycol

63. **(a)** Antiseptic are antimicrobial substances that are applied to living tissue/skin to reduce the possibility of infection, sepsis, or putrefaction. Now phenyl being a phenol derivative possesses effective germicidal properties because phenol is germicidal in strong solution.Used in the form of a powder as an antiseptic baby powder, it has a pain killing effect as well. *Example:* TCP (Trichlorophenol).

64. **(a)** Welding refers to the process of joining two or more metals together. Approximately 20% of acetylene is consumed for oxyactylene gas welding and cutting due to high temperature of flame. Combustion of acetylene with oxygen produces a flame of over 3600 K (3300°C, 6000°F). Oxyacetylene is the hottest burning common fuel gas. Oxyacetylene welding was a very popular welding process in previous decades; however the development and advantages of arc-based welding process have made oxy fuel welding nearly extinct. This high temperature of flame makes head of metal pieces to be joined melt and they joined together when solidified on cooling.

Following is the chemical reaction occurring in above process:

$$2C_2H_2 + 5O_2 \longrightarrow 4CO_2 + 2H_2O$$

The polymerization of acetylene with Ziegler – Natta catalyst produces polyacetylene films. Polyacetylene, a chain of CH centres with alternating single and double bonds, was the one of first discovered organic semiconductors.

Chemical equation representing polymerization of acetylene.

$$n\,\underset{H}{\overset{|}{C}} \equiv \underset{H}{\overset{|}{C}} \xrightarrow{Zieglar-Natta\ catalyst} \left[-\underset{H}{\overset{|}{C}} = \underset{H}{\overset{|}{C}} - \right]_n$$

65. **(b)** Formic acid is stronger than acetic acid due to its chemical composition. Formic acid is an organic acid as well as active acid in an organic acid.

66. **(b)** Cracking is the process whereby complex organic molecules such as kerosene or heavy hydrocarbons are broken down into simpler molecules such as light hydrocarbons, by the breaking of carbon-carbon bonds.

Smelting is a form of extractive metallurgy; its main use is to produce a metal from its ore. In this process the oxide ore is reduced to free metal by using reducing agents like coke or charcoal. Copper is also obtained from its oxide by this method in free state.

Hydrogenation is a reduction reaction which results in an addition of hydrogen (usually as H_2). If an organic compound is hydrogenated, it becomes more 'saturated'. Hydrogenation results in the conversion of liquid vegetable oils to solid (edible) fats.

Vulcanization is a chemical process for converting rubber into more durable materials via the addition of sulphur. Sulphur modify the rubber by forming crosslinks (bridges) between individual polymer chains. Vulcanized material is less sticky and has superior mechanical properties.

67. **(a)** As molecular weight increases with increase in the length of carbon-carbon chain.

68. **(c)** The addition of silicates to synthetic detergents has proved very beneficial. Silicates soften water by the formation of precipitates that can be easily rinsed away. Soluble silicates contribute to detergents as cleaning aids, processing aids, and corrosion inhibitors. As cleaning aids, soluble silicates provide alkalinity and promote soil suspension. Sodium sulphate is simply a filler in detergent powder, in much the same way as fillers are used in many medical tablets, it doesn't play any active role as such.

69. **(b)** Compressed natural gas (CNG) is made by compressing natural gas which is composed of methane (CH_4), it also contain small amount of ethane.

Coal gas typically contains hydrogen, methane and carbon monoxide.

LPG is the abbreviation or short form of Liquefied Petroleum gas. The major constituents of LPG is propane and butane.

Water gas is a synthesis gas, containing carbon monoxide and hydrogen.

70. **(b)** Liquified Natural Gas or LNG is natural gas (predominantly methane, CH_4) that has been converted temporarily to liquid form for ease of storage or transport. The liquefaction process involves removal of certain components, such as dust, acid gases, helium, water, and heavy hydrocarbons, which could cause difficulty downstream. The natural gas is then condensed into a liquid maximum transport pressure set at around 25 kPa/3.6 psi by cooling it to approximately –162 °C (–260 °F).

Dahej, in India has begun its first import of natural gas.

Natural gas liquids recovery (NGL) involves refrigerated gas plants, turboexpanders, debutanizers, depropanizers, and JT plants. NGL can be separated using debutanizers and depropanizers into propane, butane, naphtha, etc.

71. **(d)** Varieties of LPG bought and sold include mixes that are primarily propane and butane, the common, mixes include propane (60%) and butane (40%), depending on the season in winter more propane, in summer more butane. Propylene and butylenes are

usually also present in small concentration. A powerful odorant, ethanethiol, is added so that leaks can be detected easily.

Methane is a chemical compound with the chemical formula (CH_4). Compared to other hydrocarbon fuels, burning methane produces less carbon dioxide for each unit of heat released. In many cities, methane is piped into homes for domestic heating and cooking purposes. Methane in the form of compressed natural gas is used as a vehicle fuel. Methane is used in industrial chemical processes for the production of hydrogen, methanol, acetic acid, and acetic anhydride, also used as a fuel in factories.

72. **(c)** Dry cleaning is a cleaning process for clothing and textiles involves using a chemical solvents other then water. The solvent used is typically trichloroethylene while carbon tetra chloride and tri chloroethane is used historically. Benzene is other common agent used for this purpose.

73. **(d)** RDX, an initialism for Research Department Explosive, is an explosive nitroamine widely used in military and industrial applications. It is also known less commonly as cyclonite. Its chemical name is cyclotrimethylene trinitramine.

74. **(c)** Bisphenol A, commonly abbreviated as BPA, is an organic compound with two phenol functional groups. Bisphenol A is used primarily to make plastics which is used in making food packaging material.It is a key monomer in production of epoxy resins and used to make polycarbonate plastic. Polycarbonate plastic, which is clear and nearly shatter-proof, is used to make a variety of common products including baby and water bottles, sports equipment, medical and dental devices, dental fillings and sealants, eyeglass lenses, CDs and DVDs, and household electronics.

75. **(c)** Cause of blast in a mine in generally mixture of methane and air. CH_4 in the main gas exerted from a mine, when it comes in contact with air, explosions take place.

76. **(d)** Nitroglycerine (NG) also known as nitroglycerine, trinitroglycerin, trinitroglycerine, 1,2,3-trinitroxypropane and glyceryl trinitrate is a heavy, colorless, oily, explosive liquid obtained by nitrating glycerol. Alfred Nobel discovered that mixing nitroglycerin with diatomaceous earth would turn the liquid into a paste, called dynamite. An advantage of dynamite was that it could be cylinder-shaped for insertion into the drilling holes used for mining.

77. **(c)** Chlorofluorocarbons are used in the production of plastic foams, in cleaning electronic components and as pressurizing agents in aerosol cans.

78. **(c)** Bagasse is often used as a primary fuel source as it produces sufficient heat energy. Molasses can be used for the production of Ethanol. Ethanol is produced by the age old technique of fermentation of cereals, grams, molasses and other materials with high starch contents. Molasses is an inexpensive and readily available raw material.

Molasses cannot be used as a synthetic fertilizer as molasses contain calcium, magnesium and Iron where as synthetic fertilizers are comprised of NPK i.e. Nitrogen, Phosphorous and Potassium.

D. Environmental Chemistry

79. **(d)** America used Dioxin which is defoliants to clear the forests of Vietnam, so that is could kill the Vietnamese guerilla hiding in the forest. But the Dioxin had many after effects like cancers, miscarriage, and birth defects in after years.

80. **(c)** Except hydrogen, all the rest three options diesel, coal and kerosene are either naturally occurring fossil fuels or derived from them. Thus as we know naturally occuring fossil fuels and their products have high percentage of carbon which on combustion lead to discharge of oxides by carbon (CO_2 & CO) in air. This results in to heavy environmental pollution like CO_2 results in to green house effect causes global warming While CO is poisonous in nature, it combines with haemoglobin of blood to form carboxyhaemoglobin. Hydrogen fuel as such causes no pollution because on combustion with oxygen it forms water that's why it is also called future fuel.

81. **(c)** Aquatic macrophytes, aquatic fungi are natural organism and evapotranspiration is a natural process by which plant losses water. Thus being natural they do not results into any change in physico-chemical characteristics of water while effluents discharged into water bodies by industrial units and domestic sewage results in to change in physico-chemical characteristics like pH, conductivity, temperature, electrical conductivity, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, NH_4^+ and NO_3^- ion contents etc.

82. **(d)** Water pollution in river or any other water body is measured by amount of dissolved oxygen. Water pollution can be measured on the basis of parameters like dirtyness, change in texture, total suspended solid and other important factors like,

1. Decrease in dissolved oxygen (DO) (concentration of dissolved oxygen in water samples).
2. Increase in BOD, (Biochemical Oxygen Demand) it is a chemical procedure for determining the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period.
3. Increase in COD, (Chemical Oxygen Demand) test is commonly used to indirectly measure the amount of organic compounds in water.

83. **(d)** Diamonds is the polymorph of the element carbon. Calcium is the basic element of naturally occuring marble. Sand is formed by Silicon and Aluminium is the basic element of naturally occuring Ruby.

84. **(b)** During the photochemical smog NO and O_3 both are produced but major production is of nitrogen oxide (NO) and NO_2.

85. **(b)** Ilmenite, Zirecon and Sillimanite are found in kollam district in Kerala but tungsten is not found in the beach sands of Kerala.

86. **(c)** Acid rain is a rain or any other form of precipitation that is unusually acidic, i.e. elevated levels of hydrogen ions (low pH). It can have harmful effects on plants, aquatic animals, and infrastructure through the process of wet deposition. Acid rain is caused by emissions of sulfur dioxide and nitrogen oxides which react with the water molecules in the atmosphere to produce corresponding sulphuric and nitric acids which falls along with rain droplets on ground.

87. **(b)** Carbon Monoxide pollution occurs primarily from emissions produced by fossil fuel powered engines. The incomplete reaction of air with fuel produces the colourless, odourless and highly toxic gas. The main issue with Carbon Monoxide is its health effects. It is capable of binding to the chemicals in our blood, called haemoglobin. It does so far more effectively than oxygen and also stays bound to the haemoglobin for far longer than oxygen does. The effect is that the blood is starved of oxygen, which then affects the rest of the body.

88. **(d)** By products of power thermal plant operation need to be considered in both the design and operation. Waste heat due to the finite efficiency of the power cycle must be released to the atmosphere, using a cooling tower, or river or lake water as a cooling medium. The gas from combustion of the fossil fuels is discharged to the air; this contains carbon dioxide and water vapour, as well as other substances such as nitrogen, nitrogen oxides, sulphur oxides, and (in the case of coal-fired plants) fly ash, mercury and traces of other metals.

89. **(d)** Under the Kyoto Protocol, the 'caps' or quotas for Greenhouse gases for the developed Annex 1 countries are known as Assigned Amounts and are listed in Annex B. The quantity of the initial assigned amount is denominated in individual units, called Assigned amount units (AAUs), each of which represents an allowance to emit one metric tonne of carbon dioxide equivalent, and these are entered into the country's national registry.

90. **(d)** Aspartame is metabolized by the body into two constituent amino acids and methanol. These hydrolysis products are handled by the body in the same way as aspartic acid, L-Phenylanine and methanol from other consumed foods. These components yield NO calory and add nothing new to the diet.

91. **(a)** Ultraviolet radiation inactivates / kills harmful micro organisms in water only.

92. **(d)** Acid rain is caused by a chemical reaction that begins when compounds of sulphur dioxide and nitrogen oxide react with molecules in the atmosphere to produce acids.

93. **(b)** Chemical changes occur when a substance combines with another to form a new substance. Crystallization of sodium chloride is not a chemical as water of crystallization can be lost to get salt again . Similarly melting of ice is reversible .However souring of milk is a chemical change as it is not reversible and a new compound is formed.

94. **(a)** Fly ash brick (FAB) is a building material, specifically masonry units, containing class C fly ash and water. All fly ash includes substantial amounts of silicon dioxide (SiO_2) aluminum oxide (Al_2O_3) and calcium oxide (CaO), the main mineral compunds in coal-bearing rock strata. Fly ash can be used as a replacement for some of the Portland cement contents of concrete.

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