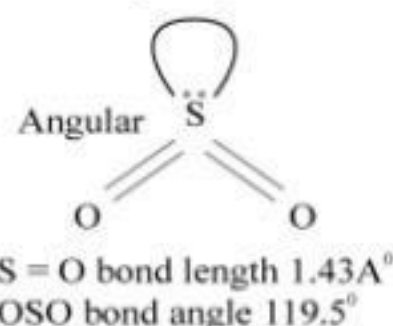


# Crystalline form of Sulphur is?

## 16TH GROUP ELEMENTS

Continued from October 13<sup>th</sup>

**Structure of  $\text{SO}_2$ :** In  $\text{SO}_2$ , sulphur atom is  $\text{sp}^2$  hybridised. It is an angular molecule with a lone pair on 'S' atom. S-O bond length 143 pm or  $1.43 \text{ \AA}$ . In  $\text{SO}_2$ ,  $2\sigma$  and  $2\pi$  bonds are present one  $d\pi - p\pi$  and one  $p\pi - p\pi$  bond.



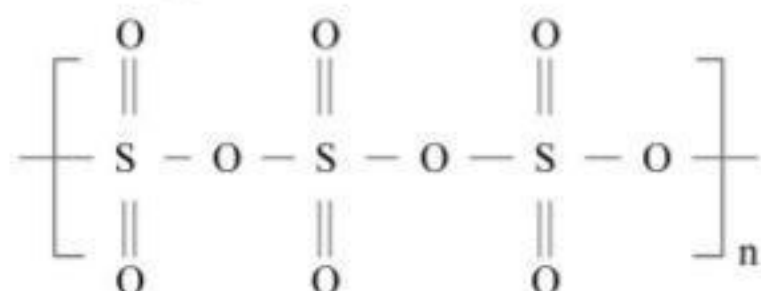
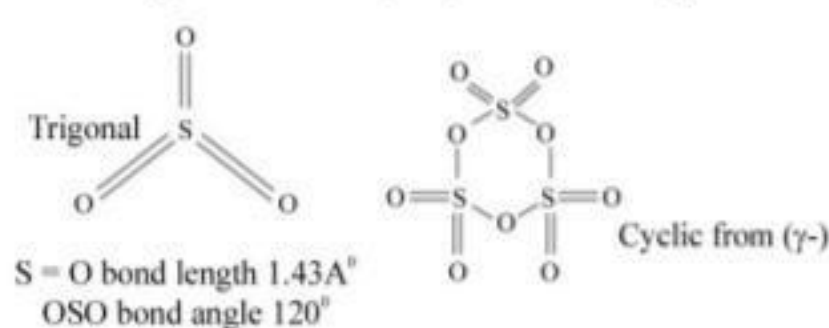
**Uses of  $\text{SO}_2$ :** In refining petroleum and sugar

- In bleaching like wool and silk
- As an antichlor in textile industry.
- Disinfectant and preservative
- In the manufacture of  $\text{H}_2\text{SO}_4$ ,  $\text{NaHSO}_3$ ,  $\text{Ca(HSO}_3)_2$

➤ Liquid  $\text{SO}_2$  is used as a solvent to dissolve a number of organic and inorganic compounds

**Structure of  $\text{SO}_3$ :** In gaseous  $\text{SO}_3$ , the central atom sulphur shows  $\text{sp}^2$  hybridisation.

In  $\text{SO}_3$ ,  $3\sigma$  bonds and  $3\pi$  bonds are present they are  $[(\text{two } d\pi - p\pi) \& (\text{one } p\pi - p\pi)]$  bonds.



- In solid state,  $\text{SO}_3$  exists in  $\alpha$ ,  $\beta$  and  $\gamma$  forms.
- In  $\gamma$ -form 3 molecules of  $\text{SO}_3$  polymerise to give cyclic structure.  $\gamma$  form of  $\text{SO}_3$  is a cyclic trimer.
- No. of  $\sigma$  bonds in it is 12
- No. of  $\pi$  bonds in it is 6
- $\alpha$  form is the most stable form and is made of cross linked chains.

**Oxyacids of sulphur:** Dioxides of VIA group elements dissolve in water to give 'ous' acids of the type  $\text{H}_2\text{MO}_3$ . (M=S, Se, Te)

- The acidic strength of 'ous' oxyacids of VI A group follows the order:  
 $\text{H}_2\text{SO}_3 > \text{H}_2\text{SeO}_3 > \text{H}_2\text{TeO}_3$
- The trioxides of VI A group elements dissolve in water to give 'ic' acids of the type  $\text{H}_2\text{MO}_4$ .  
 $\text{H}_2\text{SO}_4 > \text{H}_2\text{SeO}_4 > \text{H}_2\text{TeO}_4$  (Acidic strength of ic acids)
- The oxyacids of sulphur are classified into four series.

- Sulphurous acid series
- Sulphuric acid series
- Thionic acid series
- peroxy acid series

➤ The hybridisation of 'S' in all oxyacids is  $\text{sp}^3$

### I. SULPHUROUS ACID SERIES:

Name	Formula	Structure	O.N
I. Sulphurous acid	$\text{H}_2\text{SO}_3$		+4
ii. Thiosulphurous acid	$\text{H}_2\text{S}_2\text{O}_3$		+4, -2 Av. = +1
iii. Dithionous acid or Disulphurous acid	$\text{H}_2\text{S}_2\text{O}_4$		+3
iv. Di or pyro sulphurous acid	$\text{H}_2\text{S}_2\text{O}_5$		+5, +3 Av. = +4

### II. SULPHURIC ACID SERIES:

Name	Formula	Structure	O.N
I. Sulphuric acid	$\text{H}_2\text{SO}_4$		+6
ii. Thiosulphuric acid	$\text{H}_2\text{S}_2\text{O}_3$		+6, -2 Av. = +2
iii. Dithionic acid or Disulphuric acid	$\text{H}_2\text{S}_2\text{O}_7$		+6

### III. THIONIC ACID SERIES:

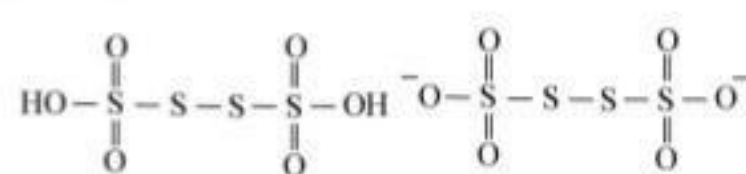
Name	Formula	Structure	O.N
I. Dithionic acid	$\text{H}_2\text{S}_2\text{O}_6$		+5
ii. Polythionic acid	$\text{H}_2(\text{S})_{n-2}\text{O}_6$		+5, (0)

### IV. PEROXO ACID SERIES:

Name	Formula	Structure	O.N
I. Peroxomono sulphuric acid or caro's acid	$\text{H}_2\text{SO}_5$		+6
ii. Peroxo disulphuric acid or Marshall's acid	$\text{H}_2\text{S}_2\text{O}_8$		+6

**W.E-15: Write the structure and oxidation numbers of sulphur in tetrathionic acid.**

**Sol.** Tetrathionic acid or its salt tetrathionate has persulphide link, S-S.



The oxidation states of sulphur are: +5, 0, 0 and +5. The average oxidation state of S is +2.5

**Sulphuric Acid ( $\text{H}_2\text{SO}_4$ ):** Sulphuric acid is a very important chemical used in industry.

- Because of its wide applications in industry, it is called 'King of chemicals'. It was also called as 'OIL OF VITRIOL'.

**Preparation of Sulphuric acid by Contact process:** The steps involved are:

- Burning of sulphur (or) sulphide ores (like iron pyrites) in air to get  $\text{SO}_2$   
 $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$   
 $4\text{FeS}_2 + 11\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 + 8\text{SO}_2$
- Conversion of  $\text{SO}_2$  to  $\text{SO}_3$  catalytically  
 $2\text{SO}_2 + \text{O}_2 \xrightarrow[\Delta]{\text{Catalyst}} 2\text{SO}_3$
- $\text{SO}_3$  is absorbed in 98%  $\text{H}_2\text{SO}_4$  to get oleum  
 $\text{SO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{S}_2\text{O}_7$
- Oleum is diluted with water to get sulphuric acid of desired concentration  
 $\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$
- The key step in the process is catalytic oxidation of  $\text{SO}_2$  with  $\text{O}_2$  to give  $\text{SO}_3$  in presence of catalyst  $\text{V}_2\text{O}_5$
- The process is reversible  
 $2\text{SO}_{2(g)} + \text{O}_{2(g)} \xrightleftharpoons[\Delta]{\text{Catalyst}} 2\text{SO}_{3(g)}; \Delta H = -196.6 \text{ kJ}$
- Forward reaction is: Exothermic and  $\Delta H = -ve$
- According to Lechatlier's principle to favour forward process the following conditions are to be maintained.
- I. High pressure is preferred. But actually 2 bar pressure is maintained. This is because acid resistant towers that can withstand high pressures cannot be built.
- II. Low temperatures are preferred. At low temperature the kinetic energy of reactants is less and hence in industry low temperatures are not advisable. So optimum temperatures are used. A temperature of 720 K is generally used.
- III. A suitable catalyst is to be used to increase the rate of formation of  $\text{SO}_3$

- The type of catalysis in contact process is heterogenous catalysis.
- All the gases used in this process must be extremely pure as the catalysts are easily poisoned. Ex: Pt gets poisoned by  $\text{As}_2\text{O}_3$

- $\text{As}_2\text{O}_3$  impurity is removed by passing through arsenic purifier containing gelatinous hydrated ferric oxide ( $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ )

**Advantages of Contact Process:** Acid obtained is very pure (96-98%)

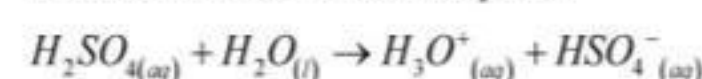
- Gases can be tested and if impurities are present, reactants can be recycled.
- The reactants are relatively cheap.

**Physical Properties:** It is a colourless, dense oily liquid (sp. gravity: 1.84 at 298K)

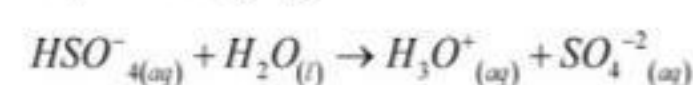
- Melting point is 283 K
- Boiling point is 611 K
- During dilution, conc. acid is slowly added to water as acid dissolves in  $\text{H}_2\text{O}$  liberates large amount of heat

**Chemical Properties:** Its chemical reactions are due to

- Low volatility,
  - Strong acidic character
  - Strong affinity for water.
  - Ability to act as oxidising agent
- It ionises in water in two steps as



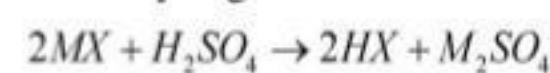
$K_{a1} > 10$  Very high



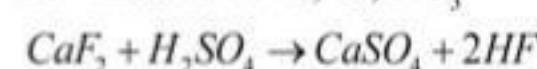
$K_{a2}$  is very less ( $1.2 \times 10^{-2}$ )  $K_{a2} \ll K_{a1}$

## JEE MAIN Special

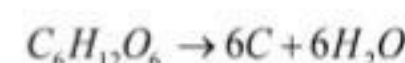
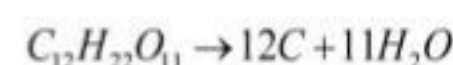
- It reacts with metal halides and forms more volatile hydrogen halides.



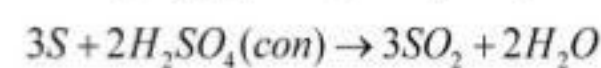
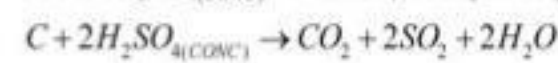
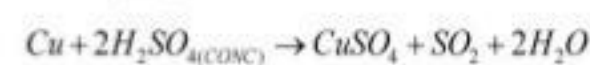
M = metal: X = F, Cl, NO<sub>3</sub>



- It is very good dehydrating agent. It removes water from carbohydrates as



- Hot conc.  $\text{H}_2\text{SO}_4$  is moderately strong oxidising agent. (Strength is in between  $\text{H}_3\text{PO}_4$  and  $\text{HNO}_3$ ) eg:



**Uses of  $\text{H}_2\text{SO}_4$ :** It is extensively used in

- Petroleum refining
- Manufacture of paints, dye stuffs
- Detergent industry
- Storage batteries (Lead storage batteries)
- Manufacture of nitrocellulose products
- Pickling agent
- Laboratory reagent
- In the manufacture of fertilisers eg: ammonium sulphate, super phosphate
- Metallurgical applications eg: cleansing metals before enameling, electro plating and galvanising

### LEVEL IA

#### GENERAL PROPERTIES

- Which of the following is a highly basic oxide  
1.  $\text{SO}_2$  2.  $\text{SO}_3$  3.  $\text{TeO}_2$  4.  $\text{TeO}_3$
- The element with highest boiling point in the following is  
1. Oxygen 2. Sulphur 3. Tellurium 4. Polonium

# విజేత

For Feedback...  
vijetha.nt@gmail.com

**Dr. Krupakar Pendli**  
Centre Head  
Urbane junior colleges  
7893774888



- Oxygen exhibits its +ve oxidation states in its

1. Fluorides 2. Chlorides
3. Nitrides 4. Sulphides

- Which of the following acts only as reducing agent

1.  $\text{KMnO}_4$  2.  $\text{CaOCl}_2$  3.  $\text{H}_2\text{S}$  4.  $\text{HNO}_2$

- Which of the following is not a normal oxide

1.  $\text{Na}_2\text{O}$  2.  $\text{Al}_2\text{O}_3$  3.  $\text{KO}_2$  4.  $\text{MgO}$

#### OXIDATION STATES

- The two sulphur atoms in  $\text{Na}_2\text{S}_2\text{O}_3$  have

1. -2 and +4 oxidation states
2. +4 and +6 oxidation states
3. +6 and -2 oxidation states
4. same oxidation state

- Oxygen as a super oxide is in the form of

1.  $\text{O}_2^{2-}$  2.  $\text{O}^{2-}$  3.  $\text{O}_2^-$  4.  $\text{O}^-$

- The oxidation number of oxygen in  $\text{K}_2\text{O}$ ,  $\text{K}_2\text{O}_2$  and  $\text{KO}_2$  are respectively

1. -2, -1,  $-\frac{1}{2}$  2.  $-\frac{1}{2}$ , -1, -2

3. -1, -2,  $-\frac{1}{2}$  4. -2,  $-\frac{1}{2}$ , -1

#### ALLOTROPIC FORMS

- Crystalline form of Sulphur is

1. Plastic sulphur 2. Colloidal sulphur
3. Monoclinic sulphur 4. All of these

- Rhombic sulphur consists of

1.  $\text{S}_8$  chains 2.  $\text{S}_2$  molecules
3.  $\text{S}_4$  rings 4.  $\text{S}_8$  rings

#### HYDRIDES

- Which of the following turns lead acetate paper black?

1.  $\text{SO}_2$  2.  $\text{SO}_3$  3.  $\text{H}_2\text{S}$  4.  $\text{H}_2\text{SO}_4$

- Strongest reducing agent of the following is

1.  $\text{H}_2\text{O}$  2.  $\text{H}_2\text{S}$  3.  $\text{H}_2\text{Se}$  4.  $\text{H}_2\text{Te}$

- $\text{H}_2\text{S}$  cannot be dried by passing over conc.  $\text{H}_2\text{SO}_4$  because

- 1) The acid oxidises  $\text{H}_2\text{S}$  into S
- 2) The acid combines with  $\text{H}_2\text{S}$  to form a ppt
- 3) Both form complex
- 4) It dissolves in the acid

#### OXIDES

- A gas which bleaches substances by reduction process is

1. Moist  $\text{Cl}_2$  2.  $\text{SO}_2$  3.  $\text{O}_3$  4. Dry  $\text{Cl}_2$

- In which of the following central atom makes use of  $\text{sp}^3$  hybrid orbitals

1.  $\text{SO}_2$  2.  $\text{SO}_3$  3.  $\text{H}_2\text{S}$  4.  $\text{H}_2\text{O}$

- Conversion of  $\text{SO}_2$  to  $\text{SO}_3$  is

1. Exothermic reaction
2. Endothermic reaction
3. Photochemical reaction
4. Reduction reaction

#### LEVEL-IA KEY

- 1)3 2)3 3)1 4)3 5)3 6)3 7)3
- 8)1 9)3 10)4 11)3 12)4 13)2 14)2
- 15)4 16)1



# 'You are Unique' is written by?

## GENERAL AWARENESS

- Preliminary expenses are the example of.....**
  - Capital expenditure
  - Capital gain
  - Revenue expenditure
  - Deferred revenue expenditure
- Which economic activity cannot be included in the tertiary sector?**
  - Working in a call-centre
  - Tuition occupation
  - Bee-keeping
  - Banking
- Which of the following statement is true for the Public Sector Unit?**
  - Most of assets is owned by a group of people
  - Most of assets is owned by big companies
  - Most of assets is owned by government
  - Most of assets is owned by an individual
- The percentage of India's population in the total population of the world as per 2011 census is.....**
  - 17.5%
  - 18.01%
  - 19.35%
  - 20.25%
- Which of the following five year plan of India recognized human development as the core of development efforts?**
  - Eighth five year plan
  - Ninth five year plan
  - Tenth five year plan
  - Eleventh five year plan
- Which of the following thinker is associated with "the concept of political sovereignty?"**
  - Malvern
  - Socrates
  - Rousseau
  - Plato
- Who said, "A good citizen makes a good state and a bad citizen makes a bad state"?**
  - Plato
  - Aristotle
  - G.B. Shaw
  - Rousseau
- Panchayat Samiti at the block level in India is a/an**
  - Advisory body
  - Coordinating Authority only
  - Supervisory Authority only
  - Administrative Authority
- According to Indian Constitution, who decides the salary of members of Parliament?**
  - Union Council of Ministers
  - Parliament
  - Supreme Court
  - President of India
- Which one of the following is not correctly matched?**
  - Eighth Schedule : Languages
  - Second Schedule : Form of Oath of office
  - Fourth Schedule : Allocation of Seats in Rajya Sabha
  - Tenth Schedule : Deflection related provisions
- When did the Chinese traveler 'Sung Yun' come to India?**
  - 510 AD
  - 518 AD
  - 525 AD
  - 528 AD
- Which among the following state "Odantapuri" education center was situated?**
  - Bengal
  - Gujarat
  - Bihar
  - Tamil nadu
- Who was the founder of Bahmani Kingdom?**
  - Hasan Gangu
  - Firoz Shah
  - Mahmud Gawan
  - Asaf Khan
- During whose rule in India did the**

### Khilafat movement begin?

- Lord Mountbatten
- Lord Dalhousie
- Lord Chelmsford
- Lord Curzon

### 15. Who among the following was the founder of the Arya Mahila Samaj in the early 1880s?

- Swami Dayananda Saraswati
- Swamy Vivekananda
- Ramabai Ranade
- Pandita Ramabai

### 16. Dasht-e-Kavir Desert is located in which country?

- Iran
- Saudi Arab
- Iraq
- Sudan

### 17. Which of the following layers is called "Barysphere:"?

- Earth's most internal layer
- Earth's intermediate layer
- Earth's topmost layer
- Lowest part of the atmosphere where climate changes occur



### 18. The Blue Nile river originates from which of the following lakes?

- Lake Victoria
- Lake Tana
- Lake Edward
- Lake Albert

### 19. Which of the following states of India has the largest percentage of geographical area under forest as per the report of the Forest Survey of India?

- Manipur
- Meghalaya
- Mizoram
- Nagaland

### 20. At which of the following towns the Alaknanda and the Bhagirathi combines to form River Ganga?

- Haridwar
- Rishikesh
- Rudraprayag
- Devprayag

### 21. "Nirvana Fund" was set up by NSDC for financial help to.....

- Entrepreneurs from the bottom rungs of society
- Displaced Kashmiri Pandits
- Old age people having no means of livelihood
- Ventures of selected candidates trained under PMKVY but did not get any job

### 22. Nakul Swasthya Patra is a scheme by the Government for which among the following purposes?

- Wellness of animals
- Wellness of animal owners
- Taking care of lactating mother in the rural areas
- Taking care of newborn babies in the rural areas

### 23. Which mine of India was in the news recently for becoming the country's first iron-one mine to have a solar plant for reducing carbon footprint?

- Talcher mine
- Koraput mine
- Noamundi mine
- Ratnagiri mine

### 24. Where will the Summer Olympics be held in 2028?

- Sydney
- Paris
- Los Angeles
- Copenhagen

### 25. Which country has won the 2017 Davis Cup Tennis Tournament?

- Switzerland
- Serbia
- France
- Belarus

### 26. "You are Unique" is written by.....

- Dr. A.P.J.Abdul Kalam

- Khushwant Singh

- Taslima Nasrin

- Arvind Adiga

### 27. The third Indian Council for Cultural Relations (ICCR) Distinguished Indologist Award for the year 2017 was awarded to Japanese professor.....

- Hiroshi Marui

- Shimamaru Marui

- Nagasaki Marui

- Toyota Marui

### 28. Which of the following city has become first Indian city to get UNESCO's world heritage city tag?

- Jaipur

- Ahmedabad

- Gandhi Nagar

- Allahabad

### 29. In June 2017, which of the following countries have signed a protocol of co-operation in the field of archive?

- India and Israel

- India and Portugal

- India and Netherland

- India and Iran

### 30. India has signed an agreement to provide USD 318 million as line of credit for developing railway sector of which of the following country?

- Bangladesh

- Nepal

- China

- Sri Lanka

### 31. Dot Matrix is a type of .....

- Tape

- Disk

- Printer

- Bus

### 32. The secondary storage devices can only store data but they cannot perform.....

- Arithmetic operations

- Logic operations

- Fetch operations

- All options are correct

### 33. In the modern periodic table metals, metalloids and non metals are found in which block?

- s-block

- p-block

- d-block

- f-block

### 34. Cinnabar is ore of which of the following?

- Magnesium

- Aluminium

- Mercury

- Iron

### 35. In which of the following mirror size of image formed is always equal to the size of object ?

- Convex mirror

- Concave mirror

- Plane mirror

- Both convex and concave mirror

### 36. Mass of a hydrogen atom is how many time the mass of an electron?

- 1000
- 8000
- 1837
- 5000

### 37. Which of the following are Fabrics that may contain polyester?

- I. Polycot

- II. Polywool

- III. Terrycot

- 1) Only I and II

- 2) Only I and III

- 3) Only II and III

- 4) All I, II and III

### 38. Which of the following term does NOT represent electrical power in circuit ?

- I<sup>2</sup>R

- IR<sup>2</sup>

- VI

- V<sup>2</sup>/R

### 39. A positively charged particles projected towards west is deflected towards north by a magnetic field. What is the direction of magnetic field?

- toward south

- toward east

- downward

- upward

### 40. Which of the following is NOT positively charged?

- Alpha particle

- Proton

- Helium nucleus

- Electron

### 41. Which is a water soluble Vitamin?

- Vitamin A

- Vitamin C

- Vitamin D

- Vitamin K

### 42. Match the items given in column (A) with those in column (B)



**Shashikanth Valmiki**

Coordinator

Saimedha Space

Koti

9246212138



### Column - A

I.Frog

II. Leaves

III.Earthworm

1) I-C, II-B, III-A

3) I-C, II-A, III-B

### Column - B

A. Skin

B. Stomata

C. Lungs and skin

2) I-A, II-B, III-C

4) I-B, II-A, III-C

### 43. How many number of chambers are there in human heart?

1) Two 2) Three 3) Four 4) Five

### 44. Which of the following is NOT present in a matured stomata?

1) Plasmodesma

2) Chloroplast

3) Cell wall

4) Vacuole

### 45. What is/are the cause(s) of arise hypermetropia?

1) Excessive curvature of the eye lens

2) Elongation of the eye ball

3) Focal length of the eye lens is too long

4) No option is correct.

### 46. Antibiotics are useful for which type of infections?

1) Only bacteria

2) Only virus

3) Both bacteria and virus

4) Neither bacteria nor virus

### 47. Which one of the following is NOT responsible for water shortage?

1) Rapid growth of industries

2) Increasing population

3) Forestation

4) Mismanagement of water resources

### 48. Which gas is major contributor to greenhouse effect?

1) Carbon dioxide

2) Chlorofluorocarbons

3) Sulphur dioxide

4) Nitrogen dioxide

### 49. Which of the following is NOT a major problem in development of resources?

1) Depletion of resources for satisfying the greed of few individuals

2) Accumulation of resources in few hands

3) An equitable distribution of resources

4) Indiscriminate exploitation of resources.

### 50. Which of the following is NOT man made eco-system?

1) Orchards

2) Home Aquarium

3) Botanical garden

4) Grassland

## ANSWERS

1-4	2-3	3-3	4-1	5-1
6-3	7-2	8-4	9-2	10-2
11-2	12-3	13-1	14-3	15-4
16-1	17-1	18-2	19-3	20-4
21-1	22-1	23-3	24-3	25-3
26-1	27-1	28-2	29-2	30-4
31-3	32-4	33-2	34-3	35-3
36-3	37-1	38-2	39-4	40-4
41-2	42-1	43-3	44-1	45-3
46-1	47-3	48-1	49-3	50-4