NET, IAS, State-SET (KSET, WBSET, MPSET, etc.), GATE, CUET, Olympiads etc.: Atmosphere Composition

Get video tutorials on geography @ Youtube Examrace Channel [https://www.youtube.com/c/Examrace]

Weather Climate [https://www.youtube.com/watch?v=IPnz0tZDN_w]

1. Nitrogen (N_2) 78.08%
2. Oxygen (O_2) – 20.9%
3. Argon (Ar) – 0.9%
4. Carbon Dioxide (CO_2) – 0.033%. These 4 constitute 99.997%.
5. Water vapour (H_2O) Trace Constituents:

Neon (Ne) Helium (He) Krypton (Kr) Xenon (Xe)

Hydrogen (H_2) ethane (CH_4) Nitrous Oxide (N_2O)

Radon (Rn)

Highly variable constituents:

Water vapour Ozone (O_3) Sulphur dioxide (SO_2)

Nitrogen dioxide (NO_2)

Carbon Monoxide (CO) Particles (dust, salt)

Characteristics

- Nitrogen: When the weathering of igneous rocks takes place, it adds nitrogen in the atmosphere. It is found between 50 - 100 km. but dominates the lower 50 km.
- Oxygen: It occurs up to 120 km. but up to 6 km. as 02, while above it occurs in dissociated form or 0.
- Carbon dioxide: Absorbs heat radiation from the earth in the atmosphere. It is transparent and keeps the earth temperature at high level. The rocks gradually remove away the $C0_2$ from the atmosphere. It dissolves in water to form carbonic acid, a compound i.e.. $C0_2 + H_20 = H_2C0_3$. The ocean contains 60 times more $C0_2$ than the atmosphere.
- Argon, Neon, Krypton, Xenon: Chemically inactive; present in tiny proportion; known as noble gases. Water Vapour: Most variable in proportion and largely concentrated in the

lowest Kms. ; recycles in evaporation- condensation. It is mainly found in lowest region: 6 km of atmosphere. Therefore it becomes less with height.

- Neon: Bright Red. Used in Neon sign, tubelights and advertisement boards.
- Helium: Chemically inert. It is added in the atmosphere by the oil fields. The amount of helium has increased 10 times. Since it is chemically inert hence it can only be lost by escape in the space.
- Hydrogen: It is negligible in low atmosphere but present above 1500 km. Protons and electrons are found in hydrogen.
- Ozone (O_3) -Absorbs ultraviolet and infrared radiation and therefore increases the temperature above stratosphere. Maximum production of ozone occurs at 30 - 40 km above the earth's surface but its maximum concentration occurs at 20 - 30 km above the earth. Ozone hole was first sighted above Antarctica. Ozone immediately reacts with chlorine.

Variations in Atmospheric Composition

Variation with height

- Water Vapour comprises up to 4% of the atmosphere by volume near surface but non existent above 10 km. of the atmosphere;
- Ozone is mainly concentrated between 15 - 35 km. ;
- 100 - 200 km. is the nitrogen layer;
- 200 - 1,100 km. is the oxygen layer;
- 1,100 - 3,500 km. is helium layer;
- Above 3,500 km. is the oxygen layer again.

Variations with latitude and seasons

- Above 30° latitude north, CO_2 is least;
- Ozone content is low over the equator and high over 50 degree north latitude, particularly in spring.

Atmosphere can be divided into following layers:

Troposphere; Stratosphere; Mesosphere; Ionosphere; Thermosphere; Exosphere; Magnetosphere Troposphere:

Troposphere

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Layers of Atmosphere [https://www.youtube.com/watch?v=p1P_d8hV-QU]

- It is the most important zone for weather phenomenon, because of: Gradual decrease of temperature with height i.e.. 6.5 degree C per km. Temperature decreases except at winter pole; lowest part of troposphere up to 1.5 - 2 km. is called friction layer, where topography greatly influences wind speed and circulation;

- It contains all the major atmosphere pollutants. This is also called Connective layer where the clouds are formed;
- It roughly extends to a height of 8 kms near the poles and about 18 kms. at the equator
- The thickness at the equator is greatest
- It contains dust particles and over 90% of the earth's water vapour
- Aviators of jet aeroplane often avoid this layer due to presence of bumpy air pockets.
- The upper limit of the troposphere is called Tropo-pause, literally means zone or region of mixing. Its height is 17 km during January and July over the equator and the temperature of this height is 700 C

Stratosphere

- From Tropopause to about 50 Km;
- It is an Isothermal region and extremely dry free with clouds, water vapour and dust; here air is at rest and movement is almost horizontal
- Some clouds found are called Mother of Pearls or Nacreous.
- Contains much of Ozone (03) ; therefore called Ozono-sphere, especially between 15 kms to 35 km from the sea level. The combining of atmosphere oxygen 02with individual oxygen results in the creation of ozone.
- In the lower stratosphere (up to 25 km.) temperature remains constant, temperature increase gradually with height up to 50 Kms; and at 50 kms becomes 0° C or 32° F.
- The upper limit of the Stratosphere is called Stratopause.
- Winds decrease with height in the lower stratosphere and then increase with height in the upper stratosphere.
- Feable winds and Cirrus Clouds are found in the lower stratosphere

Chemosphere

- Chemosphere extends from troposphere to an altitude of 50 kms. Overlapping both homosphere and heterosphere.
- In this air glove occurs at night especially green and red. It is a part of Stratosphere.
- In this air glow occurs at night, especially green and red.

Mesosphere

- Height from 50 Km to 80 Km.
- The temperature decreases fairly with the height with the minimum temperature of about -90 degree. Mesopause (the top of the layer) ; above Mesopause temperature increases with increasing height
- The presence is because of meteoric dust particles.

Thermosphere

- The part of the atmosphere beyond Mesopause is known as thermosphere wherein temperature increases rapidly with increasing height.

- it is above 200 km. and N02 and 02 are found.
- its lower portion is composed mainly of nitrogen and oxygen in molecular and atomic forms;
- rapid temperature increase approaching 1700 degree C, at 350 kms.
- thermosphere is divided into two layers: (1) Ionosphere and (2) Exosphere Ionosphere:
- 80 kms. to 640 kms. and above
- Radio waves found; it is a region of electrically charged or ionized air lying next to Mesosphere
- High electron density;
- 150 kms. -380 kms. known as Appleton;
- Absorbs deadly X-rays;
- The northern lights or aurora borealis are found.
- This layer is called Kennelly Heaviside Layer (99 - 130 kms) here interaction takes place between solar-ultra-violet photons with nitrogen
- Sporadic Layer is associated with high velocity winds. The bulk of the atmosphere consists of electrically neutral atoms and molecules. At high altitudes, however, a significant fraction of the atmosphere is electrically charged. This region is generally called the Ionosphere.
- It extends throughout the mesosphere and thermosphere but is most important and distinct at altitudes above about 80 kilometres.
- Most of the ionization in the ionosphere is effected by pho-toionization. Photons of short wavelength (i.e.. , high energy) are absorbed by atmospheric gases. A portion of the energy is used to eject an electron, converting a neutral atom or molecule to a pair of charged species: an electron, which is negatively charged, and a com-panion positive ion. Ionization in the Fl region is produced mainly by ejection of electrons from 02,0, and N2. The threshold for ionization of 02-corresponds to a wavelength of 102.7 nanometres. Thresholds for 02 and N2 are at 91.1 and 79.6 nanometres, respectively. Exosphere:
- 640 kms and above;
- The atoms of oxygen, hydrogen and helium form the tenuous atmosphere;
- The density becomes extremely low and the atmosphere resembles a nebula because it is highly rarefied. Aurora Australis and Aurora Borealis are produced- magnetic storms on the sun discharge electrified particles in the space. The earth’s magnetic poles attract these particles. Aurora Australis (the southern dawn) . Aurora Borealis (the northern dawn) .

Chemical Composition

It is basically divided into two parts:

(1) Homosphere

(2) Heterosphere

Homosphere

(1) It represents the lower portion of the atmosphere and extends upto the height of 90 km from the sea-level.

(2) The main constituent gases are Oxygen (20.946%) , Nitrogen (78.084%) . Others are Argon, Carbon-dioxide, Neon, Helium, Krypton, Xenon, Hydrogen, etc.

(3) The proportion of different gases is uniform at different levels in this zone.

Heterosphere

(1) This zone extends from 90 km to 10,000 km.

(2) There are four parts of it:

i. Molecular nitrogen layer- it is dominated by molecular nitrogen and extends upward up to the height of200 km (90 to 200 km) ;
ii. Atomic oxygen layer: extends from 200 to 100 km;
iii. Further upward there is helium layer which extends up to the height of 3500m;
iv. Atomic hydrogen layer- it is the top most layer of the atmosphere and extends up to the outer most limit of the atmosphere.