

Chapter-9

Solar Radiation, Heat Balance and Temperature

1. Multiple choice questions

Question 1(i).

The sun is directly overhead at noon on 21st June at:

- (a) The equator**
- (b) 23.5° S**
- (c) 23.5° N**
- (d) 66.5° N.**

Answer:

- (a) The equator**

Question 1(ii).

In which one of the following cities, are the days the longest?

- (a) Thiruvananthapuram**
- (b) Chandigarh**
- (c) Hyderabad**
- (d) Nagpur.**

Answer:

- (a) Thiruvananthapuram**

Question 1(iii).

The atmosphere is mainly heated by the:

- (a) Short wave solar radiation**
- (b) Reflected solar radiation**
- (c) Long wave terrestrial radiation**
- (d) Scattered solar radiation.**

Answer:

(c) Long wave terrestrial radiation

Question 1(iv).

Make correct pairs from the following two columns.

(a) Insolation	(i) The difference between the mean temperature of the warmest and the coldest months
(b) Albedo	(ii) The lines joining the places of equal temperature
(c) Isotherm	(iii) The incoming solar radiation
(d) Annual range	(iv) The percentage of visible light reflected by an object.

Answer:

(a) (iii)

(b) (iv)

(c) (ii) and

(d) (i)

Question 1(v).

The main reason that the earth experiences highest temperatures in the subtropics in the northern hemisphere rather than at the equator is:

(a) Subtropical areas tend to have less cloud cover than equatorial areas.

(b) Subtropical areas have longer day hours in the summer than the equatorial.

(c) Subtropical areas have an enhanced "green house effect" compared to equatorial areas.

(d) Subtropical areas are nearer to the oceanic areas than the equatorial locations.

Answer:

(b) Subtropical areas have longer day hours in the summer than the equatorial.

2. Answer the following questions in about 30 words.

Question 2(i).

How does the unequal distribution of heat over the planet earth in space and time cause variations in weather and climate?

Answer:

Weather and climate gets affected by the unequal distribution of temperature on the earth. The areas where there is high temperature, wind blows from low temperature areas. Therefore, wind move upward from equatorial regions and blow towards two poles.

Due to this wind, pressure on both the poles increases. In winter season, wind blows from land regions to oceanic regions. Therefore these wind are dry. On the other hand, during summers, wind blow from ocean towards land. Therefore, these winds are humid. Unequal distribution of temperature is main case of blowing of wind. Rainfall and cyclone also arise due to unequal distribution of temperature. In this way, unequal distribution of temperature affects climate and weather.

Question 2(ii).

What are the factors that control temperature distribution on the surface of the earth?

Answer:

Factors controlling temperature distribution: The temperature of air at any place is influenced by

1. the latitude of the place;
2. the altitude of the place;
3. distance from the sea, the air- mass circulation;
4. the presence of warm and cold ocean currents;
5. local aspects.

1. The latitude: The temperature of a place depends on the insolation received. It has been explained earlier that the insolation varies according to the latitude hence the temperature also varies.

2. The altitude: The atmosphere is indirectly heated by terrestrial radiation from below. Therefore, the places near

the sea-level record higher temperature than the places situated at higher elevations.

3. Distance from the sea: Another factor is the location of a place with respect to the sea. Compared to land, the sea gets heated slowly and loses heat slowly. Land heats up and cools down quickly. Therefore, the differences in the temperature over the sea is less compared to land. And this places near the sea has a moderate temperature.

4. Air-mass and ocean currents: Air- masses affects the temperature. The places which come under the influence of warm air- masses experience higher temperature and the place that comes under the influence of cold air-masses experience low temperature.

Question 2(iii).

In India, why is the day temperature maximum in May and why not after the summer solstice?

Answer:

The main cause behind temperature being highest in May is due to summer solstice. At that time sun shines on the Tropic of Capricorn. Tropic of Capricorn passes through middle of India. But it remains till end of May in India. It is because rain starts on Malabar coast at the end of the May. Due to this, temperature does not increase in South India. Although increase in temperature continues in India till 21 June and we find highest temperature in first week of June in India.

Question 2(iv).

Why is the annual range of temperature high in the Siberian plains?

Answer:

Siberian plains are quite far off from sea. Uneven climate is found in areas located away from oceans and seas. The mean monthly temperature for January is between -18°C to -48°C in the Siberian plains. In summers, it is up to 20°C . Therefore, the annual range of temperature is -68 ($-48-20$) which is extremely high. The pressure of warm ocean currents, Gulf Stream and north Atlantic drift, make the northern Atlantic Ocean warmer and the isotherms bend towards the north. Over the land, the temperature decreases sharply and the isotherms bend towards south in Europe.

3. Answer the following questions in about 150 words.

Question 3(i).

How do the latitude and the tilt in the axis of rotation of the earth affect the amount of radiation received at the earth's surface?

Answer:

Sunrays fall vertical on equator through the year. From 0° to 23.5° north and south, the sun keeps fluctuating. From 1st march to 21st march, the sun is southern and sunrays fall vertical on tropic of cancer. This time there is summer in northern hemisphere. From 23rd September to 22nd December, the sun is southern. During

this time, the sunrays fall vertical on tropic of capricorn. On 21st march and 23rd September, sunrays fall vertical on equator. As we move towards poles from tropic of cancer and tropic of Capricorn, temperature keeps on decreasing. Therefore, after 6614 degree north and south there is cold zone. Throughout the year, the temperature remains low here. In this region, throughout the year, there is frigid snow. It is because the sun's rays fall tilted on it. In this way, the latitude and the tilt in the axis of rotation of the earth affect the amount of radiation received at the earth's surface.

Question 3(ii).

Discuss the processes through which the earth-atmosphere system maintains heat balance.

Answer:

1. Conduction:

- The earth after being heated by insolation transmits the heat to the atmospheric layers near to the earth in long wave form. The air in contact with the land gets heated slowly and the upper layers in contact with the lower layers also get heated.
- It takes place when two bodies of unequal temperature are in contact with one another, there is a flow of energy from the warmer to cooler body. The transfer of heat continues until both the bodies attain the same temperature or the contact is broken. Conduction is important in heating the lower layers of the atmosphere.

2. Convection:

- The air in contact with the earth rises vertically on heating in the form of currents and further transmits the heat of the atmosphere. This vertical heating of atmosphere is known as convection.
- The convection transfer of energy is confined only to the troposphere.

3. Advection:

- The transfer of heat through horizontal movement of air is called advection. Horizontal movement of the air is relatively more important than the vertical movement.
- In tropical regions particularly in northern India during summer season local winds called 'loo' is the outcome of advection process.

Question 3(iii).

Compare the global distribution of temperature in January over the northern and the southern hemisphere of the earth.

Answer:

In January, there is summer in southern hemisphere and winter in northern hemisphere. The main reason behind it is that sun has northern face and sunrays fall vertical in northern hemisphere. The areas which are closer to equator have temperature up to 27°C and over the land the temperature decreases sharply and the isotherms bend towards south in Europe. It is much pronounced in the Siberian plain. The mean January temperature along 60°E longitude is minus 20°C both at 80°N and 50°N latitudes. The mean monthly temperature for January is over 27°C , in equatorial oceans over 24°C in the tropics and $2^{\circ}\text{C} - 0^{\circ}\text{C}$ in the middle latitudes and -18°C to -48°C in the Eurasian continental interior.