

# Insolation

## Exercises

### I. Short Answer Questions.

#### Question 1.

What is solar radiation ? What is its significance for the earth ?

#### Answer:

The sun continuously radiates heat and light energy in all the directions. It is known as solar radiation. Solar radiation is the only primary source of light and heat on the earth. The earth receives its heat from solar radiation which is a tiny fraction of the radiated energy of the sun.

#### Question 2.

What is meant by insolation ? State two of its main characteristics.

#### Answer:

The amount of solar energy received by the earth is called insolation, but only one part out of two billion parts reaches the earth. So, out of total 100% solar energy only 51% reaches the earth, 35% reflected back to into space and only 14% is absorbed by the ozone layer.

#### Question 3.

State two advantages of convectional heating of the atmosphere.

#### Answer:

Convectional heating of the atmosphere is done by heating up the layer of air touching land surface and rising up to warm up the upper layer, while the cold wind sinks down and again heated up by the terrestrial radiation. This circulation causes formation of clouds, rainfall and mild changes in climatic behaviour.

#### Question 4.

Name four factors that affect the temperature of a place.

#### Answer:

**The four factors that affect the temperature of a place are :**

1. Latitude
2. Distance from the sea.
3. Altitude
4. Wind direction
5. Natural vegetation

**Question 5.**

How does the distance from the sea affect the distribution of temperature ?

**Answer:**

Due to the physical property of water, which is heated up and cooled down slowly with respect to the land. So, the coastal areas experience mild climate with least range of temperature, while the regions far from the sea are affected by extreme climate with maximum range of temperature.

**Question 6.**

State the pattern of temperature in mid latitudes.

**Answer:**

Due to spherical shape of the earth, temperature zone gets less insolation resulting in moderate climate with normal temperature ranging from 15°C to 30°C. The duration of sunshine is greater in summer than winter. So the summer is warm and winter is cold.

**Question 7.**

How would the breezes that blow during the day and those that blow during the night affect the temperature of a place situated in the coastal region ?

**Answer:**

During the day the sea breeze blowing from sea towards land keeps the coastal region cool and during the night land breeze blowing from land towards sea makes the sea cooler. This interchange of breeze maintains the heat balance resulting in the mild climate of the coastal regions with lower daily and annual ranges of temperature.

**Question 8.**

What difference is there in the temperatures on a mountain and on a sea shore ?

**Answer:**

The rate of decrease of temperature is 1°C for every 166 metres, the temperatures on a mountain are for lesser than the temperatures on a sea shore which is nearly at zero height.

**Question 9.**

Why is India cooler in December than in July ?

**Answer:**

Tropic of Cancer passes midway across India, so, there is summer season in July, while in December the sun is vertical on the Tropic of Capricorn in southern hemisphere, so India experiences winter season. So naturally December is cooler than July.

**Question 10.**

State two chief characteristics of the Temperate zone.

**Answer:**

Medium temperature and medium rainfall due to slanting rays of the sun and less evaporation.

**Question 11.**

**Explain the following:**

- (a) Diurnal range of temperature.
- (b) Mean Monthly Range of Temperature.
- (c) Mean Annual Range of Temperature.

**Answer:**

- (a) Diurnal range is the difference between the maximum and minimum temperature within 24 hours, of the day.
- (b) It is the difference between the mean maximum and mean minimum temperatures within the month.
- (c) It is the difference between mean maximum and mean minimum temperatures within a year, mainly between June and January.

**Question 12.**

Define briefly 'Heat Balance'.

**Answer:**

Heat balance is defined as the state of equilibrium that exists on earth between incoming insolation from the sun and the out going terrestrial radiation from the earth.

**Question 13.**

Name the heat zones of the earth.

**Answer:**

Torrid zone, Temperate zone and Frigid zone.

**II. Distinguish between each of the following**

**Answer:**

Insolation and Terrestrial Radiation.

**Insolation :**

1. It is the incoming solar radiation intercepted by the earth.
2. It travels in short waves.
3. Insolation involves only 51 units out of 100 units of solar radiation.

**Terrestrial Radiation :**

1. It is the earth's radiation given back to atmosphere and space.
2. It travels in long waves.
3. Out of 51 units of insolation 34 units are transferred to the atmosphere and 17 units go back to space.

### Question 2.

Land Breeze and Sea Breeze.

**Answer:**

**Land Breeze :**

1. It blows from Land to sea.
2. It blows at night.
3. It makes the sea water cooler.
4. It moderates the temperature of sea.

**Sea Breeze :**

1. It blows from sea to land.
2. It blows in the day time.
3. It makes coastal parts warmer
4. It moderates the climate of the coastal parts.

### Question 3.

Torrid and Temperate Zones.

**Answer:**

**Torrid Zone :**

1. It lies between  $23\frac{1}{2}^{\circ}$  N and  $23\frac{1}{2}^{\circ}$  S
2. It receives highest temperature and rainfall.
3. It receives the vertical sun's rays.
4. Equatorial region and the tropical belt receive maximum insolation

**Temperate Zone :**

1. It lies between  $23\frac{1}{2}^{\circ}$  N and  $66\frac{1}{2}^{\circ}$  N &  $23\frac{1}{2}^{\circ}$  S and  $66\frac{1}{2}^{\circ}$  S
2. It receives medium, temperature and rainfall.
3. It received slanting rays of sun.
4. Due to spherical shape of the earth, this zone received quite less amount of insolation.

### Question 4.

Annual Range and Monthly Range of Temperature.

**Answer:**

**Annual Range of Temperature :**

1. It is the difference between the highest and lowest temperatures within one year.
2. It is the difference between the highest temperature of May-June and lowest temperature in December January, i.e. the temperature difference between summer and winter.

### Monthly range of Temperature :

1. It is the difference between the maximum and minimum temperatures within a month.
2. Mostly the middle of month is noted for maximum and end of the month records minimum temperatures.

### III. Give reasons for each of the following

#### Question 1.

North India has a greater range of temperature than South India.

#### Answer:

North India comes in temperate zone, while South India comes in Torrid Zone situated in the North and South of Tropic of Cancer. So North Indian places have greater range, which is greatest in the Desert of Rajasthan.

#### Question 2.

The temperature of Delhi is less than that of Chennai in December.

#### Answer:

Delhi is far from sea, while Chennai is situated along the coast of Bay of Bengal. So Delhi is colder than Chennai in December.

#### Question 3.

Distance from the sea affects the temperature of a place.

#### Answer:

Warm effect of sea keeps the temperature less in summer and higher in winter, e.g. Bombay (Mumbai) is warmer than Delhi in winter.

#### Question 4.

Land is heated and cooled faster than the sea.

#### Answer:

In the desert of Rajasthan range of temperature is highest due to the physical property of land to be heated and cooled down quickly with respect to the sea. So, the temperature difference is least at Mangalore and Chennai.

#### Question 5.

The temperature of a place depends largely upon its latitude.

#### Answer:

As the rays of the sun become more and more slanting with increasing latitudes. So the tropical region never gets snowfall, while the polar region is always frozen.

**Question 6.**

Desert areas experience a high day temperature and a much lower night temperature.

**Answer:**

Desert areas are covered with large sand plains. The physical property of the sand is to be heated up quickly and cooled down abruptly ; so the day temperature is very high and the night temperature is very less.

**Question 7.**

The ports of the western coast of Europe remain ice- free during winter.

**Answer:**

Due to the warm effect of the Gulf Stream and North Atlantic Drift the ports of Western Europe remain ice free in winter to motivate successful international oceanic trade, e.g., London, Calais, Lisbon, Amsterdam, Brest, Le Havre etc.

**PQ. The earth's surface receives only about 51% of the Solar energy.****Answer:**

Out of 100 units, only 51 units are received by the earth as insolation, while 35 units are reflected back by atmospheric layers, clouds, snowfields and 14 units are absorbed by the ozone layer.

**Question 8.**

The vertical rays of the sun give more insolation than the slanting rays.

**Answer:**

Tropical region gets vertical rays of the sun and receive much heat providing high temperature while the temperate and polar regions have less temperature due to slanting rays of the sun.

**Question 9.**

A desert region has a high range of temperature than a forest region.

**Answer:**

A desert region gets highly heated and quickly cooled down due to the sand cover; while the forested region most of the solar energy is used in transpiration in the vegetation realm and does not become very hot. On the other hand due to the emission of carbon dioxide by plants the temperature is maintained due to the heat absorbing property of CO<sub>2</sub>.

**IV. Long Answer Questions****Question 1.**

Describe the four factors that affect the distribution of temperature.

**Answer:**

The factors are different physical properties of land and water keeping continental climate cold and oceanic climate mild

Latitude The temperature decreases from the equator towards poles.

Distance from the sea keeping coastal ports mild and areas far from sea cold. Altitude mountains are cooler than plains due to the lapse rate of decrease of temperature of  $1^{\circ}\text{C}$  for every 166 m. of height; Slope of the land South facing slopes of mountains are warmer than northern facing. Inversion of temperature takes place in hilly valley regions due to higher sunny slopes and the valley downward covered with fog and snow are cooler than higher slopes. Wind direction Windward slopes get much rainfall, while the Leeward slopes are drier. Natural vegetation cover absorbs 90% of solar energy, which is again consumed in transpiration and keeping the forested areas mild, while snowy lands are cold. Cloud Cover and Humidity: Clouds reflect the sunlight leaving the land below cool. Still, the humidity absorbs heat keeping these areas with average temperatures not more than  $30^{\circ}\text{C}$ .

### **Question 2.**

Explain the effect of latitude and ocean currents on the temperature of a place.

#### **Answer:**

The Tropical areas are far warmer than the polar areas due to difference in the angle of incidence of the rays of the sun. Ocean currents greatly affect the climate of a place or region e.g. the European western coast enjoys ice-free coasts and developed navigation due to the warm effect of Gulf Stream – North Atlantic Drift, while the cold current of Benguela keeps the warm South African coast cool and mild.

### **Question 3.**

Describe the heat budget of the earth.

#### **Answer:**

Heat budget is actually the Heat Balance of incoming and outgoing radiation. The incoming solar radiation comes towards earth in short waves and provides heat to the earth as insolation in the day and again this insolation is given back by terrestrial radiation at night. This balance is called heat budget.

### **Question 4.**

State how the Global Heat Balance is achieved ?

#### **Answer:**

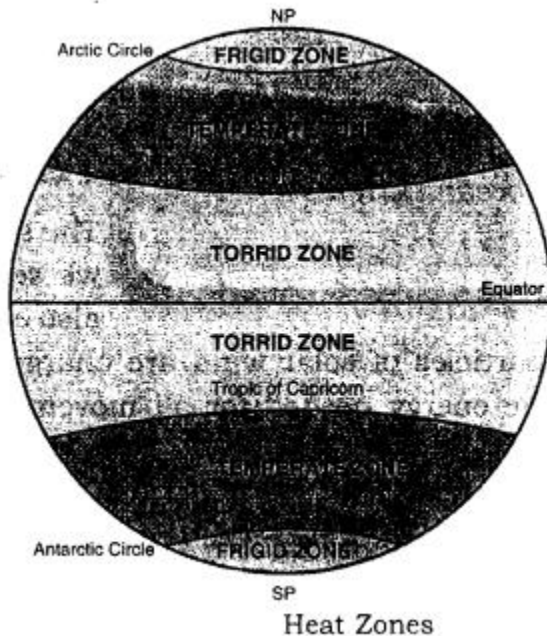
Out of 100 units of solar radiation 35 units are reflected back by atmospheric layers and clouds and snowfields etc, 14 units are absorbed by the ultra-violet rays in ozone layer and only 51 units are received by the earth as insolation and again these 51 units are reflected back by terrestrial radiation out of which 34 units are absorbed by the earth and sent back to atmospheric layers and 17 units radiated back into the space. This process is called the Heat budget or Global Heat Balance.

### Question 5.

With the help of a diagram, show the heat zones of the earth and write briefly about each of them.

#### Answer:

1. **Torrid Zone** : It lies between  $23\frac{1}{2}^{\circ}$  N and  $23\frac{1}{2}^{\circ}$  S latitudes. This zone receives maximum temperature due to vertical rays of the sun and maximum rainfall.
2. **Temperate Zone** : It lies between  $23\frac{1}{2}^{\circ}$  N –  $66\frac{1}{2}^{\circ}$  N and  $23\frac{1}{2}^{\circ}$  S –  $66\frac{1}{2}^{\circ}$  S. It is known for medium temperature and rainfall due to slanting rays of the sun.
3. **Frigid Zone** : It lies between  $66\frac{1}{2}^{\circ}$  N –  $90^{\circ}$  N and to  $66\frac{1}{2}^{\circ}$  S –  $90^{\circ}$  S. The sun's rays are slanting and have to cover a very large distance. Besides this, in spite of long summer covering 6 months, the sun's heat is immediately reflected back by the snow cover. So, the temperature is extremely low and cold Blizzards (icy winds) blow from Poles towards Arctic and Antarctic circles. The coldest place on the face of the earth is Varkhoyansk ( $-58^{\circ}\text{C}$ ) in N.E. Siberia. Although the temperature in Antarctic may be  $-94^{\circ}\text{C}$ , but there is no habituated place, (as the definition of a place is the area inhabited by people).



### Question 6.

Study the table and answer the following questions :

1. Calculate the mean annual temperature
2. Calculate annual range of temperature

3. Name the hemisphere in which it is located. Give reasons to support your answer.

| Months   | Jan.  | Feb. | Mar. | Apr. | May  | June | July | Aug. | Sep. | Oct. | Nov. | Dec. |
|----------|-------|------|------|------|------|------|------|------|------|------|------|------|
| Temp°(C) | -10.6 | -8.0 | -4.0 | 4.4  | 10.0 | 13.3 | 16.0 | 15.0 | 10.0 | 5.0  | -2.0 | -7.0 |

**Answer:**

1. Sum of the temperature of hottest month of the year  $4.4 + 10.0 + 13.3 + 16.0 + 15.0 + 10.0 + 5.0 = 73.7$  Sum of the temperature of coldest month of the year

$$- (10.6 + 8.0 + 4.0 + 2.0 + 7.0) = -31.6$$

$$\therefore \text{Mean annual temperature} = \frac{73.7 + (-31.6)}{12} = \frac{42.1}{12} = 3.5^{\circ}\text{C}$$

2. Annual range of temperature = Highest temperature in a month of year – Lowest temperature in a month of year =  $16^{\circ}\text{C} - 2^{\circ}\text{C} = 14^{\circ}\text{C}$
3. It is located in Northern hemisphere :  
The Reason is due to the Earth's Axial tilt, in the Northern hemisphere winter lasts from the winter solstice (typically December) to the March Equinox (typically March). While the summer lasts from the summer solstice (typically June) through the autumnal Equinox (typically September).

### Question 7.

Name four factors that affect the temperature of a place.

**Answer:**

**Four factors are :**

1. Distance from equator
2. Distance from sea
3. Altitude from the sea-level
4. Slope of the land.

### Question 8.

Describe world temperature patterns and its three chief characteristics.

**Answer:**

The world distribution of temperature generally shows a decreases in insolation from the Equator towards the poles. But this pattern is not everywhere the same. Three chief characteristics are the distance from the sea, physical properties of land and ocean (water), Height from the sea level.

### Question 9.

Explain the ranges of temperature and show their calculation.

**Answer:**

The Diurnal range is calculated by subtracting minimum temperature from the maximum

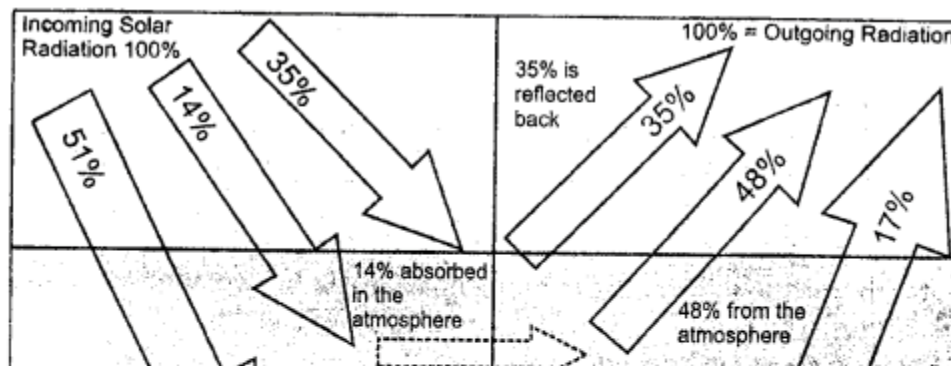
temperature within 24 hours or of one day. The Mean monthly range is calculated by subtracting the mean minimum temperature from mean maximum temperature within 30 days or a month. Annual range of temperature is calculated by subtracting the mean minimum temperature from the mean maximum temperature within one year i.e. mostly between June and January.

## V. Practical Exercises

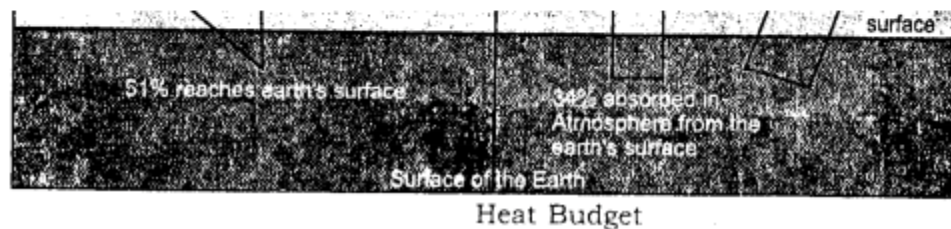
### Question 1.

Draw a labelled diagram showing the heat budget of the earth.

**Answer:**



*1. Draw a labelled diagram showing the heat budget of the earth.*



### Question 2.

Calculate the mean annual temperature and annual range of temperature of the following station and name the hemisphere in which it is located.

**Answer:**

Mean annual temperature is 3.5°C.

The range of temperature is 20°C.

It is located in Northern hemisphere.

## Practice Questions (Solved)

### Question 1.

State the importance of insolation.

#### Answer:

Importance of insolation The radiant energy received by the earth from the sun is called the incoming solar radiation or insolation. The insolation received by the earth is responsible for all forms of activity on the Earth. The circulation in the atmosphere is due to the differential heating of the atmosphere by insolation. The radiant energy from the sun enables plants to manufacture their own food. This forms the basis for food needed by all other organisms on the Earth. The circulation of ocean water is also due to the unequal heating of the ocean water by insolation.

### Question 2.

Why does only 51% of the insolation reach the Earth's surface ?

#### Answer:

Only 51% of the insolation reaches the earth's surface because 35% is reflected back into space by the atmospheric layers and 14% is absorbed by the atmosphere.

### Question 3.

What do you understand by daily range of temperature and annual range of temperature ?

#### Answer:

The difference between the maximum and minimum temperature recorded in a particular day at a place is called daily range of temperature. It is low in coastal areas while it is high in deserts and in interiors of continents.

The difference between the mean temperature of the hottest month (July) and mean temperature of the coldest month is called the annual range of temperature. It is low equatorial region, while it is high in polar areas.

### Question 4.

Define the following :

- (a) Daily Mean Temperature.
- (b) Monthly Mean Temperature.
- (c) Annual Mean Temperature.
- (d) Mean Temperature of a place.

#### Answer:

**(a) Daily Mean Temperature** — The average of the maximum temperature and minimum temperature recorded during a day (24 hours) is known as daily mean temperature.

Daily Mean Temperature

$$= \frac{\text{Max. Temp.} + \text{Min. Temp.}}{2}$$

For example, if a place has the maximum temperature of 39°C and minimum temperature of 27°C for a particular day, the daily mean temperature.

$$= \frac{39^{\circ} + 27^{\circ}}{2} = \frac{66^{\circ}}{2} = 33^{\circ}\text{C}$$

**(b) Monthly Mean Temperature** — The average of the daily mean temperature of all days of a month is known as monthly mean temperature.

Monthly mean temperature of July

$$= \frac{\text{Daily mean temp. of 1 + 2 + 3.....31 days}}{31}$$

**(c) Annual Mean Temperature** — The average of daily mean temperature of all days of a year is known as Annual mean temperature.

Annual mean temperature of year 2010

$$= \frac{\text{Daily mean temp. of 1 + 2 + 3.....365 days}}{365}$$

**(d) Mean Temperature of a place** — Mean temperature of a place is obtained by collecting the data for a period of 30 – 40 years. The average of mean annual temperature of a place is calculated. This is also known as normal temperature of a place.

Mean temperature

$$= \frac{\text{Mean Annual temp. of 1986 + 1985.....for 35 years}}{35}$$

### Question 5.

Distinguish between maritime climate and continental climate.

#### Answer:

The nearness to sea has a moderating influence on the temperature of coastal areas. Maritime or equable temperatures are found in coastal areas. But extremes of temperatures, with a continental climate, are found in inland areas remote from the sea. Due to the presence of land breezes and sea breezes in coastal areas : the summers are warm and winters are cool. This is due to the differential heating and cooling of land and water. Land surfaces are heated more quickly than water. But a greater annual range of temperature is found as we go away from the equator. The climate of Mumbai is more equable than that of Delhi.

### Question 6.

Explain the importance of insolation.

#### Answer:

Sun is the most important source of atmospheric heat. Sun's diameter is more than 100 times the Earth's diameter and has a surface temperature of more than 10,000 °F. The

heat waves radiate from the sun in all directions at a speed 186,000 miles per second or 3 lakh km per second. The solar radiation received by the earth is 1/2000 millionth part of solar output. Yet, this small amount is vital for our existence on the earth. It is estimated that, on the average the earth receives about 1.9 g calories per minute per sq. cm. This is known as 'solar constant'. All the physical phenomena depend upon insolation. Winds and ocean currents originate due to insolation. The earth is habitable only due to insolation.

#### **Question 7.**

Explain the Greenhouse effect of atmosphere.

##### **Answer:**

Atmosphere is heated by the radiation from the earth's surface below. This action is compared to that of a glasshouse or greenhouse in which vegetables and flowers are grown in polar areas. Glasshouse permits radiation to get in but does not allow radiation to escape out. Therefore, glasshouse is warmer from inside than outside. Atmosphere also acts like a blanket keeping the earth warm. It is known as greenhouse effect of atmosphere. This is due to presence of carbon dioxide in atmosphere. Carbon dioxide has the ability to absorb earth radiation. The carbon dioxide layer acts as a glass roof of the greenhouse. With the increase in carbon dioxide, the temperature of the earth is increasing. Due to this, the year 1955 was the hottest year in India during this century.

#### **Question 8.**

What is global warming ? What are its causes ? State its effects.

##### **Answer:**

Global warming : The burning of fossil fuels, (coal, gas, petroleum), the cultivation of soil, large scale industrialisation, rapid means of transport and deforestation has caused an imbalance in the atmosphere. These activities are increasing the amount of carbon dioxide. Thus, greenhouse effect has raised the average temperature of the earth by 0.5°C. By the year 2000, the earth's average temperature will go up by 2°C. This is called global warming. Global warming is causing a rise in sea-levels due to melting of glaciers. It is threatening to submerge many coastal areas.

#### **Question 9.**

Mountains are cooler than plains. Discuss.

##### **Answer:**

The temperature decreases with height at the rate of 1°C per 165 metres or about 0°C per kilometre. The atmosphere is heated by radiation from the earth below. Therefore, lower layers are warmer than higher layers. There is absence of water vapour and dust particles on high mountains. So there is unchecked radiation. That is why mountains are cooler than plains. Shimla is cooler than Delhi. Similarly, Nainital is cooler than Allahabad.

**Question 10.**

“Winter nights at Delhi are cooler than in Mumbai”. Why?

**Answer:**

Mumbai has an equable climate due to coastal location, while Delhi is an inland town. The presence of land and sea breezes keep the nights warm at Mumbai.

**Question 11.**

Vertical rays are Hotter than slanting rays. Why ?

**Answer:**

**Vertical rays are hotter than slanting rays due to the following reasons:**

- Vertical rays heat up a smaller surface. Hence, the heat received per unit of area is large. On the other hand, slanting rays heat up a large area.
- Vertical rays travel through a shorter distance in the atmosphere and the loss of heat is less. Slanting rays travel a longer distance through the atmosphere where much of its heat is absorbed by clouds, water vapour and dust particles.

**Question 12.**

Why is noon hotter than morning and evening ?

Or

Maximum temperatures are found in the afternoon. Why?

**Answer:**

The sun is overhead at noon. The Sun rays are almost vertical. But in the morning and evening, the angle of Sun rays is oblique. Slanting rays fall in the morning and evening. Vertical rays are hotter than slanting rays. As the vertical rays give more heat per unit area, the noon is hotter than morning and evening.

**Question 13.**

‘Despite its location in higher latitudes, the coast of Norway is never frozen.’ Why ?

**Answer:**

The areas situated in higher latitudes have a cold climate. In winter, these areas have temperatures below freezing point (0°C). But coast of Norway is never frozen. Its ports are ice free. North Atlantic Drift (Gulf Stream currents) flows along its coast. It is a warm current which raises the winter temperatures of this area.

**Question 14.**

Why are the northern slopes of Himalayas cooler than its southern slopes ?

**Answer:**

The Northern Slopes of Himalayas are away from the Sun. These slopes get oblique rays. These slopes are exposed to cold winds. These are shady slopes and are cooler. But the Southern Slopes are Sun facing slopes. These get Sun’s rays more directly and also for longer periods. These are Sunny slopes and shelters from cold winds. So the Southern Slopes of Himalayas are warmer than northern slopes.