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Temperature is the property of matter which reflects the quantity of energy of motion of the component particles. It is a comparative measure of how hot or cold a material is. The coldest theoretical temperature is called absolute zero. It is the temperature where the thermal motion of particles is at its minimum (not the same as motionless). Absolute zero is 0 K on the Kelvin scale, −273.15 C on the Celsius scale, and −459.67 F on the Fahrenheit scale. The instrument used to measure temperature is a thermometer. The International System of Units (SI) unit of temperature is the Kelvin (K), although other temperature scales are more commonly used for everyday situations. Temperature may be described using the Zeroth Law of Thermodynamics and the kinetic theory of gases. There are several scales used to measure temperature. Three of the most common are Kelvin, Celsius, and Fahrenheit. Temperature scales may be relative or absolute. A relative scale is based on the kinetic behavior relative to a certain material. Relative scales are degree scales. Both the Celsius and Fahrenheit scales are relative scales based on the freezing point (or triple point) of water and its boiling point, but the size of their degrees are different from each other. The Kelvin scale is an absolute scale, which has no degrees. The Kelvin scale is based on thermodynamics and not on the property of any specific material. The Rankine scale is another absolute temperature scale. Temperature is one of the most widespread and significant physical variables in an organism's surroundings. It is a measurement of the average rate of atom and molecule random motions: the greater the temperature, the faster the motion. In this article, we will mainly discuss atmospheric temperature. The sun is the primary indirect source of atmospheric temperature. (Atmosphere receives the majority of its energy from long-wave terrestrial radiation). On average, the heating and cooling of the atmosphere is accomplished through direct solar radiation and the transfer of energy from the earth via conduction, convection, and radiation. The Temperature as an Element of Weather & Climate plays an instrumental role and is an important concept in the Geography syllabus of the UPSC examination. Elements of Weather and Climate Temperature As An Element of Weather and Climate Temperature As An Element of Weather and Climate Temperature is the degree of hotness or coolness of the atmosphere on a scale of one to ten. Temperature varies throughout the day due to the Earth's rotation and during the annual seasons due to the Earth's translational motion around the sun. It's usually expressed in degrees Celsius or Fahrenheit. A thermometer is a device that is used to measure temperature. As temperature influences other aspects of the weather, it is a critical factor in determining the weather. Temperature as an element of Weather and Climate The energy radiated in the form of light from the Sun to the Earth is known as heat. About half of the solar energy is reflected back into space by clouds, water vapor, and air dust, while the rest is absorbed by soil and water and converted to heat. (* Click here to read more about Heat Budget of the Earth) Temperature varies throughout the day due to the Earth's rotation and during the annual seasons due to the Earth's translational motion around the sun. In more practical terms, kinetic energy is created when particles in the air move or vibrate at a given speed. In other terms, temperature can also be defined as the measure of the amount of kinetic energy in the air that manifests physically as heat or cold. The temperature rises as the particles begin to move/rotate faster. The temperature begins to drop as the particles begin to slow down. Thus temperature has a significant impact on weather and climate and also on other primary elements. Significance of Temperature Significance of Temperature Temperature influences the distribution of rainwater on Earth. Higher temperatures, together with other climate factors, result in greater convectional heat transfer, which leads to more convectional rainfall. Higher temperatures result in reduced pressure on the planet, therefore winds blow from higher to lower pressure to fill the void. As a result, temperature has a significant impact on wind direction and speed. It causes changes in the reflectivity of the Earth's atmosphere as well as the surface. It has a significant impact on the lives of marine organisms and also causes sea levels to rise due to warmer sea temperatures. Conclusion Temperature not only is an important element of weather and climate as a separate entity but also as a whole because it influences the remaining elements of the weather and climate like atmospheric pressure, wind, precipitation, humidity, and so on. FAQs Question: What is temperature in the context of weather and climate? Answer: Temperature refers to the measure of warmth or coldness of an environment as determined by a thermometer. It is a fundamental element of both weather and climate, influencing various atmospheric processes and conditions. Temperature affects air pressure, humidity, and wind patterns, and is essential in determining the type of weather experienced in a region. While weather refers to short-term atmospheric conditions, climate encompasses long-term temperature trends and averages for a specific area. Question: How is temperature measured? Answer: Temperature is commonly measured using thermometers, which can be calibrated in degrees Celsius (°C), Fahrenheit (°F), or Kelvin (K). Various types of thermometers are used in meteorology, including liquid-in-glass thermometers, digital thermometers, and infrared thermometers. The measurements can be taken at various altitudes and locations to provide accurate readings of air temperature, surface temperature, and atmospheric conditions. Question: What factors influence temperature variations in different regions? Answer: Several factors influence temperature variations across different regions, including latitude, altitude, distance from the sea, and prevailing winds. Latitude affects the angle of sunlight received, with equatorial regions generally experiencing higher temperatures. Altitude plays a role as well, with higher elevations typically experiencing cooler temperatures. Proximity to large bodies of water can moderate temperatures, leading to milder climates, while winds can bring varying air masses that influence local temperatures. Question: What is the significance of understanding temperature in the study of climate change? Answer: Understanding temperature is critical in the study of climate change as it serves as a key indicator of global warming trends. Rising average temperatures can lead to severe consequences, including melting polar ice, rising sea levels, and increased frequency of extreme weather events. By monitoring temperature changes over time, scientists can assess the impacts of human activities on the environment and develop strategies to mitigate climate change effects. Additionally, temperature data is vital for formulating climate policies and environmental conservation efforts. Question: How does temperature affect ecosystems? Answer: Temperature plays a crucial role in shaping ecosystems by influencing the distribution of species, their behavior, and their physiological processes. Different species have specific temperature ranges in which they thrive, and changes in temperature can disrupt these ranges, leading to habitat loss or shifts in species distributions. Additionally, temperature affects plant growth, reproduction cycles, and food availability, which can impact entire food webs and ecosystem dynamics. Understanding temperature impacts is essential for biodiversity conservation and ecosystem management. MCQs 1. What is the primary unit of measurement for temperature in meteorology? A) Kilograms B) Meters C) Degrees Celsius D) Liters Answer: (C) See the Explanation Explanation: The primary unit of measurement for temperature in meteorology is degrees Celsius (°C), although Fahrenheit (°F) and Kelvin (K) are also used. 2. Which factor primarily affects temperature differences at various latitudes? A) Altitude B) Proximity to water C) Angle of sunlight D) Wind patterns Answer: (C) See the Explanation Explanation: The angle of sunlight received at different latitudes primarily affects temperature differences, with equatorial regions receiving more direct sunlight and thus higher temperatures. 3. What is the significance of monitoring temperature changes in relation to climate change? A) It has no impact B) It helps in assessing global warming trends C) It is only relevant for urban areas D) It is only important for weather forecasts Answer: (B) See the Explanation Explanation: Monitoring temperature changes is significant for assessing global warming trends and understanding the impacts of human activities on the climate. 4. How does altitude influence temperature? A) Higher altitude leads to warmer temperatures B) Higher altitude leads to cooler temperatures C) Altitude has no effect on temperature D) Altitude only affects air pressure Answer: (B) See the Explanation Explanation: Higher altitude generally leads to cooler temperatures, as the air is less dense and cannot hold heat as effectively. 5. What is one way temperature impacts ecosystems? A) It does not affect species distribution B) It only affects terrestrial ecosystems C) It influences species behavior and reproduction D) It has no relation to food availability Answer: (C) See the Explanation Explanation: Temperature influences species behavior and reproduction, affecting the dynamics of ecosystems and food webs. GS Mains Questions and Model Answers Q1: Discuss the relationship between temperature and climate. How does temperature influence weather patterns? Answer: Temperature and climate are intricately connected, as temperature is a fundamental component of climate systems. Climate refers to the long-term average of weather patterns, including temperature, precipitation, and humidity over extended periods. Changes in temperature can significantly influence weather patterns, leading to variations in precipitation, storm frequency, and intensity. For instance, rising temperatures can increase evaporation rates, resulting in more moisture in the atmosphere and potentially leading to heavier rainfall or severe storms. Understanding this relationship is crucial for predicting climate change impacts and developing strategies for adaptation and mitigation. Q2: Analyze the implications of rising global temperatures on ecosystems and biodiversity. What measures can be taken to mitigate these impacts? Answer: Rising global temperatures have profound implications for ecosystems and biodiversity, including habitat loss, altered species distributions, and increased extinction rates. As temperatures rise, many species may struggle to adapt to changing conditions, leading to a decline in biodiversity. Ecosystems such as coral reefs are particularly vulnerable to temperature changes, resulting in bleaching and ecosystem degradation. To mitigate these impacts, measures such as establishing protected areas, promoting sustainable land-use practices, and enhancing climate resilience through conservation efforts are essential. Additionally, reducing greenhouse gas emissions and fostering public awareness about climate change can contribute to preserving biodiversity and ecosystems. Q3: Evaluate the role of temperature in determining agricultural productivity. How can farmers adapt to changing temperature patterns? Answer: Temperature plays a critical role in determining agricultural productivity, influencing crop growth cycles, yield, and overall food security. Changes in temperature patterns can lead to altered planting and harvesting times, affecting crop viability. Higher temperatures can stress plants, reduce yields, and increase water requirements. To adapt to these changes, farmers can adopt climate-smart agricultural practices, such as selecting heat-resistant crop varieties, improving irrigation efficiency, and employing soil management techniques that enhance moisture retention. Additionally, farmers can utilize weather forecasting tools to make informed decisions about planting and harvesting, ensuring better resilience to temperature fluctuations. Previous Year Questions on Temperature and Climate Question: What factor primarily influences temperature variations across different regions? A) Latitude B) Wind direction C) Soil type D) Urbanization Answer: (A) Explanation: Latitude primarily influences temperature variations across different regions, as it affects the angle and intensity of sunlight received. 2. UPSC CSE Mains 2019 (GS Paper 1): Question: "Discuss the impact of rising global temperatures on weather patterns and climate change. What strategies can be implemented to address these challenges?" Answer: Rising global temperatures significantly impact weather patterns, leading to increased frequency and intensity of extreme weather events such as hurricanes, floods, and droughts. This exacerbates climate change effects, causing disruptions in ecosystems and human activities. Strategies to address these challenges include enhancing climate resilience through infrastructure improvements, promoting sustainable practices in agriculture and urban planning, and implementing policies aimed at reducing greenhouse gas emissions. International cooperation and public awareness are essential to drive collective action towards mitigating the impacts of climate change and adapting to new weather realities. *The article might have information for the previous academic years, please refer the official website of the exam.Share on FacebookShare on TwitterHow likely are you to recommend Prepp.in to a friend or a colleague?Test will end in 00:00:00Test will end in 00:00:00View MoreView MoreTest will end in 00:00:00View MoreView More To help you plan your year 7 geography lesson on: Weather and climate, download all teaching resources for free and adapt to suit your pupils' needs.The starter quiz will activate and check your pupils' prior knowledge, with versions available both with and without answers in PDF format.We use learning cycles to break down learning into key concepts or ideas linked to the learning outcome. Each learning cycle features explanations with checks for understanding and practice tasks with feedback. All of this is found in our slide decks, ready for you to download and edit. The practice tasks are also available as printable worksheets and some lessons have additional materials with extra material you might need for teaching the lesson.The assessment exit quiz will test your pupils' understanding of the key learning points.Our video is a tool for planning, showing how other teachers might teach the lesson, offering helpful tips, modelled explanations and inspiration for your own delivery in the classroom. Plus, you can set it as homework or revision for pupils and keep their learning on track by sharing an online pupil version of this lesson.Explore more key stage 3 geography lessons from the Weather and climate: how do they vary? unit, dive into the full secondary geography curriculum, or learn more about lesson planning. Reviewing Class 7 SST Notes Chapter 2 Understanding the Weather Class 7 Notes regularly helps in retaining important facts. Class 7 Understanding the Weather Notes Class 7 SST Chapter 2 Understanding the Weather Notes Class 7 SST Chapter 2 Notes – Understanding the Weather Notes Class 7 → Weather is the condition of the atmosphere at a specific time and place. → The troposphere is the lowest layer of the atmosphere, where weather occurs. → Temperature refers to how hot or cold the air is and changes daily and seasonally. → Precipitation includes rain, snow, sleet, and hail falling from the sky. → Wind is the movement of air from high-pressure to low-pressure areas. → Humidity is the moisture or water vapour present in the air. → a As air warms, its ability to hold water vapour increases, making it more humid. → On humid days, clothes dry slowly and sweat evaporates less easily. → Atmospheric pressure is the weight of air above us; it decreases with height. → People observed nature to predict weather, like ants moving eggs before rain. → Birds take dust baths before rain due to humidity and pressure changes. → Pine cones open in dry weather and close in humidity to protect seeds. → Scientists developed instruments to measure weather elements accurately. → Thermometers measure temperature using liquids or digital sensors. → Temperature data helps calculate range and mean daily temperature. → a Rain gauges measure rainfall using a funnel and a cylinder with a scale. → Atmospheric pressure is measured using a barometer in millibars (mb). → Low pressure (below 1000 mb) can signal storms or cyclones. → Wind direction is measured with a wind vane; speed with an anemometer. → Humidity is measured with a hygrometer and expressed as relative humidity. → Relative humidity ranges from 0% (dry) to 100% (saturated). → Humidity affects comfort, drying time, and is important in industries and museums, → A weather station has all instruments to track weather in one place. → Automated Weather Stations (AWS) record weather data without human help. → In 2023, AWS was installed in a glacial lake in Sikkim for disaster warning. → Meteorologists collect and study weather data to predict future conditions. → Weather prediction is important due to the increase in extreme weather caused by climate change. → Atmosphere : The layer of air around the Earth. → Troposphere : The lowest part of the atmosphere where weather happens. → Temperature : How hot or cold something is. → Precipitation : Water that falls from the sky like rain, snow, or hail. → Humidity : The amount of water vapour (moisture) in the air. → Evaporate : When water changes into gas (water vapour) and mixes in the air. → Pressure : The force or weight of something pressing down. → Atmospheric pressure : The weight of air pressing down on the Earth. → Weather Forecast : : A prediction or guess about what the weather will be like. → Meteorologist : A person who studies and predicts the weather. → Thermometer : A tool used to measure temperature. → Rain gauge : A tool used to measure how much it rains. → Barometer : : A tool used to measure air pressure. → Anemometer : A tool used to measure how fast the wind is blowing. → Wind vane : A tool used to show the direction of the wind. → Relative humidity : A way to measure how humid the air is, shown in percentage (%). → Automated Weather Station (AWS) : A machine that measures weather automatically. → Altitude : How high a place is from sea level. → Cyclone : A very strong wind and rain storm. → Drought : A long time with no rain. → Disaster : A sudden bad event like a flood or earthquake. Understanding the Weather Class 7th Notes A change in the weather is sufficient to create the world and oneself anew. (Marcel Proust, French novelist) Weather and its Elements You wake up one winter morning and shiver. You reach for thick clothes to keep yourself warm. In the summer, you choose clothes that keep you cool and comfortable. You are responding to your body's signals; your body is sensing the weather. What is weather? Weather is a state of the Earth's atmosphere at a particular time and place. But what is an atmosphere? In simple terms, it is the layer of gases that surround some planets—in the case of our Earth, we call these gases 'air'. The Earth's atmosphere may Fig. 2.2 be compared to a cake with several layers. The layer closest to the surface of the Earth is called the 'troposphere', and that is where all land-based plants and animals (including humans!) live and breathe. It is also where almost all weather phenomena, which we will explore in this chapter, take place. The troposphere extends to a height of 6 to 18 kilometres from the ground; it is less thick at the poles (where the cold air contracts) and thicker in the tropical zone (where the warmer air expands). You will study more about the other layers in your Science classes. We use many words to describe the weather—hot, cold, rainy, cloudy, humid, snowy, windy, and so on. They describe the different ways in which we experience the elements of weather. The elements of weather are: Temperature: How hot or cold the atmosphere is. Precipitation: Any form of water, such as rain, snow, sleet or hail, that falls from the sky. Atmospheric Pressure: The weight of the air above us, felt on the Earth's surface. Wind: The movement of air, including its speed and direction. Humidity: The amount of water vapour in the air. As you can see, it would be difficult for Krishnan to convey his sense of chillness to Amir unless there is a commonly agreed way to measure the temperature. It is the same with other elements of the weather. In this chapter, we will learn how we measure the weather using common standards. From early times, humans have closely observed Nature and learnt to read her signals to forecast the weather. Observing birds fling low, ants carrying eggs, squirrels gathering nuts, frogs croaking loudly, or even the opening and closing of pine cones, provided valuable information about coming rain or storms. This knowledge has been passed down from generation to generation. Even today, in many parts of India, people use traditional ways to predict the weather, especially the arrival of the monsoon. Observing Nature's clues Fig. Ants shifting their eggs to higher ground is a natural behaviour that indicates an expected change in the weather, especially heavy rain. Fig. A frog croaking in a forest of the Western Ghats, in expectation of rain. Fig. The opening and closing of pine cones are natural mechanisms driven by environmental humidity. Pine cones close in humid conditions to protect their seeds, and open in dry conditions to release them, ensuring they spread in favourable weather In the last few centuries, scientists have worked out methods to measure and monitor the elements of the weather with great precision. Based on those inputs, meteorologists try to predict how the weather will behave in a particular region after a few hours or a few days, or even a few weeks. How do they do it? Do they just look up at the sky and guess? No, they've got some cool gadgets, a few of which we will now look at. Weather Instruments a) Temperature In your Grade 6 Science textbook, Curiosity, you read about different types of thermometers used for measuring the temperature—the clinical thermometer and the laboratory thermometer. You also learnt about temperature scales. One of them is the Celsius scale; another is the Fahrenheit scale. If, for instance, we have a cool temperature of 15 degrees Celsius (noted as 15°C), it is the same as 59 degrees Fahrenheit (noted as 59°F). Fig. Snow melts quickly when it's warm. Fig. Cloudy weather —it's getting cold. Fig. In winter, coconut oil turns solid. Fig. Curd takes longer to set in cold weather There are several types of thermometers. Some simply measure the ambient temperature; others record the maximum and minimum temperatures during a day. Thermometers often use a coloured liquid which expands when the temperature increases. However, more and more, digital thermometers are preferred as they are more precise and can record more data. Indeed, temperature recordings can be used to collect some useful statistics, including: Range of temperature or the maximum temperature minus the minimum temperature during a particular period of time (usually 24 hours). Mean daily temperature or the maximum temperature plus the minimum temperature of the day divided by two. Don't Miss Out The India Meteorological Department was set up in 1875. Its motto is adityat jayate vrishti, which means, "From the sun arises rain." The phrase comes from the ancient text Manusmṛti, and the complete sentence reads, "From the sun arises rain, from rain comes food, and from food, living beings originate." Can you think of a reason why rain arises from the sun? b) Precipitation If the news says that a particular place received 30 mm of rainfall in a day, what does it mean? How is rainfall measured? The amount of rainfall is measured with the help of an instrument called a rain gauge (Fig. 2.6). When it rains, the water falls into a funnel and is collected in a cylinder. A scale is attached to the cylinder to measure the depth of rainwater collected. For example, when the height of the water collected is 5 mm, we say that the area received 5 mm of rainfall. Fig. Rain Gauge c) Atmospheric pressure Our bodies are quite aware of temperature and rainfall. But you may also have experienced that the weather sometimes feels 'heavy', as before a thunderstorm. This is related to atmospheric pressure, which is the pressure exerted by the weight of the air above and around us. The atmospheric pressure is higher near the sea coast and lower as we go higher up into the mountains. When you climb a mountain, the air gets thinner than in the plain below. As a result, the air pressure is lower, and there is less oxygen available for your lungs to take in. With less oxygen getting into your blood, your body has to work harder to keep you moving! That's why people sometimes feel breathless, dizzy or tired at high altitudes. This does not mean that the atmospheric pressure is always high in the plains below or on the coast. In fact, it sometimes drops dramatically, resulting in what meteorologists call a 'depression' or 'low-pressure system', which can sometimes develop into a storm or even a cyclone. The instrument used to measure atmospheric pressure is called a barometer. As with thermometers, there are several types of barometers. The unit they display is generally the millibar (abbreviated as mb). The normal atmospheric pressure at the sea coast is around 1013 mb; a pressure below 1000 mb indicates a depression. People who journey to places at a high altitude are advised to make pauses on the way to allow the body to acclimatise. Our army personnel serve in high-altitude places like Khar dung la in Ladakh, which is over 5600 metres above sea level. It is hard to imagine how they live and work in places where the oxygen level is so low—the atmospheric pressure there is generally about 650 millibars! d) Wind Wind is the movement of air from areas of high pressure to areas of low pressure. Speed and direction are two important factors when we describe the wind. The wind is an important element of the weather. Its direction and speed help in weather forecasting. Besides, air pilots and sailors need to be aware of wind data, as the wind has a great influence on flying or sailing. Farmers also use the wind direction to predict where rain might come from. Also, a greater wind speed will cause the soil to dry faster. So, how do we measure this direction and speed? A wind vane (or weather vane) has a rotating arm with a pointer at one end and a tail at the other. When the wind blows, the tail is pushed, and the pointer turns in the direction of the wind. It responds even to a light breeze. Left: Wind vane on the tarmac. Right: Anemometer This wind vane on the tarmac is called a 'wind sock'. It gives pilots an indication of the direction of the wind during take-of and landing. Similar socks are used in industries that release ash or gases. The simplest instrument to measure the wind direction and speed is the anemometer. It has three or four metal cups that rotate on a vertical shaft when the wind blows — the stronger the wind, the faster the rotation. A meter attached at the bottom counts how many times the anemometer spins in a certain period of time and calculates the wind speed in kilometres per hour (km/h) e) Humidity Humidity is the last element of the weather on our list. It refers to the amount of water vapour present in the air. It also depends on factors like temperature, wind, pressure and location. We can answer these questions more precisely by learning how to measure humidity. Before we move forward, we need to remember our Science lesson from Grade 6 about the states of water. This will help us to understand how humidity is measured. When water evaporates, it causes a cooling effect. If the amount of water in the air is already high (more humidity), water evaporates slowly. That is typically the case on a rainy day. Humidity of the air is measured as relative humidity: air that would contain absolutely no water vapour (which is impossible in natural conditions) is rated at 0%, while air saturated with water vapour will have a humidity of 100%. In practice, dry weather has a relative humidity range between 20% and 40%, while humid weather usually falls between 60% and 80% relative humidity. But how do we measure such numbers? This is done through an instrument called a hygrometer. Again, there are several types of hygrometers, depending on the principle they are based on. The measurement of humidity is of great importance in many industrial processes, such as food processing. Museums also monitor humidity as they need to maintain a dry environment to preserve their exhibit. Weather Stations As you can see, we need several instruments to measure the weather at a particular place and time. A weather station brings all these instruments together, making it easy to measure and track the weather. Readings of all the measurements are taken at regular intervals, which helps in mapping and forecasting the weather. An automated weather station An Automated Weather Station (AWS) is a self-operating system that uses various sensors to measure and record weather data, such as temperature, humidity, wind speed and direction, precipitation, and atmospheric pressure. Such stations are widely used in fields like agriculture, aviation, navigation, environmental monitoring, and so on, providing accurate and timely weather information without the need for human intervention. Don't Miss Out In 2023, the National Disaster Management Authority set up an AWS at a glacial lake of Sikkim at an altitude of more than 4800 metres above sea level. The AWS provides early information about upcoming weather conditions. Fig. AWS at a glacial lake of Sikkim Predicting the Weather Meteorologists collect data using these instruments over long periods of time. They study the data and use scientific methods to try and predict the weather. Such predictions are very important nowadays, as climate change makes extreme weather, such as droughts, flods, cyclones, etc., more frequent. Accurate predictions help us to be ready for such events. They also enable local governments to mobilise resources and prepare for any disasters. For example, if stormy weather is expected at sea, fishermen are warned about venturing out in their boats, or an entire coastal area might have to be evacuated if a cyclone is expected. Before we move on ... Temperature, humidity, precipitation, wind and atmospheric pressure together define the weather at a particular place. The condition of these elements is measured using special instruments. Data collected from these help us to monitor and predict the weather. In different times or situations, one of the elements is dominant—for example, rainfall in July, the temperature in May and December, atmospheric pressure when a cyclone is moving, and wind when a loo (strong, hot and dusty winds that blow in north India in summers) is blowing, or forest fires are spreading. Weather is closely linked to climate. We will discuss this in the next chapter.

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Temperature is the property of matter which reflects the quantity of energy of motion of the component particles. It is a comparative measure of how hot or cold a material is. The coldest theoretical temperature is called absolute zero. It is the temperature where the thermal motion of particles is at its minimum (not the same as motionless). Absolute zero is 0 K on the Kelvin scale, −273.15 C on the Celsius scale, and −459.67 F on the Fahrenheit scale. The instrument used to measure temperature is a thermometer. The International System of Units (SI) unit of temperature is the Kelvin (K), although other temperature scales are more commonly used for everyday situations. Temperature may be described using the Zeroth Law of Thermodynamics and the kinetic theory of gases. There are several scales used to measure temperature. Three of the most common are Kelvin, Celsius, and Fahrenheit. Temperature scales may be relative or absolute. 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I'm on my summer holidays and although I love Scotland, sometimes it's nice to go somewhere with a warmer climate.We work out what the climate in a place is by looking at the average weather for about 30 years, and seeing how warm or cold, rainy and windy it is during that time.The climate is different depending on where you are in the world.In Nigeria it's usually very hot.In Siberia it's usually very cold.In parts of New Zealand it's very windy.And in parts of India it's very wet.The climate across the world has always changed over hundreds, thousands, even millions of years.600,000 years ago, parts of Britain used to be so warm, palm trees grew and hippos swam in the River Thames.And 20,000 years ago, Britain was going through an ice age and woolly mammoths roamed the land.These changes occurred naturally.There are all sorts of reasons why the environment causes climate change. This is called a natural climate cycle.But these days some of the change is because of the way humans have been burning fossil fuels to power our homes, factories and vehicles, which has caused lots of carbon dioxide to enter the atmosphere.The carbon dioxide traps heat and is warming the planet faster than before.This is called the greenhouse effect.So maybe this year I'll think a little more about the fuel I use and where I travel and stay in Scotland instead! Question 1 What is meant by climate? Explain with the help of an example? Name the four major types of climate? Question 2 State the factors which affect the climate of a place? What is the difference in the locations of Srinagar and Thiruvananthapuram? How do their climates differ? Question 3 State few factors which affect the climate of a place? Climate The average weather pattern at a place taken over a long period is called the climate of that place. If the temperature at a place is high most of the time, then we say that the climate of that place is hot. If there is heavy rainfall on most of the days at that place, then we say that the climate of that place is hot and wet (or hot and humid). Four major types of climates in the world (1) Polar Climate Polar climate is always very cold. Polar regions have the coldest climate in the world. The air is so cold in polar regions of the earth that water falls there as snow. So, the air contains very little water vapour (or moisture) at the poles. Thus, the polar climate is extremely cold and dry. (2) Temperate climate A climate which is neither very hot in summer nor very cold in winter is called temperate Climate.In temperate climate, there is moderate rain and snowfall. (3) Tropical Climate A climate having very high temperatures and high humidity is called tropical climate. Thus, tropical climate is very hot and humid. There is usually a lot of rain in tropical climate. (4) Desert Climate Desert climate is very hot during the day. There is little rain in desert areas so the desert climate is also dry. Thus, desert climate is very hot and dry. Our climate depends on our position on the earth and our distance from the sun. The regions around the equator of earth called tropical regions (where the sun shines directly overhead) get the maximum heat from the sun and have a very hot climate. As a region gets more and more away from the equator (towards the poles), the amount of sun's heat received by the region goes on decreasing, leading to gradually cooler climates. The poles of the earth are at the maximum distance from the sun. Due to this, the sun's rays have to travel much more to reach the polar regions of earth which makes them lose much of their heat. The polar regions of earth (near north pole and south pole of earth) receive the minimum amount of sun's heat, so the polar regions of earth have an extremely cold climate. The climate in tropical region is very hot whereas that in polar regions is extremely cold. The tropical regions and polar regions are the two regions of the earth which have extreme climatic conditions. Factors Which Affect Climate (1) Temperature and rainfall (2) Altitude Whether place is located on high mountains or on plains (flat ground). A place at higher altitude will have a cooler climate than another place on plains (flat ground). This is why hill stations always have a cool climate (3) Location with respect to the sea Whether place is located near the sea or far away from the sea. Sea-water heats up slowly and also cools down slowly. This has a moderating effect on the climate of coastal areas. The temperatures in coastal areas are neither very high nor very low. Mean Temperature The mean temperature for a given month is found in two steps: 1) First we find the average of temperatures recorded during the month. 2) Second we calculate the average of such average temperatures over many years. The mean temperatures are found for the maximum as well as the minimum temperatures for the month. 1) Srinagar is situated at high altitude on a mountain in the Northern part of India whereas Thiruvananthapuram is situated on plains at sea level in the south-west part of India. 2) Srinagar is located very far away from the sea whereas Thiruvananthapuram is located near the sea. 3) Srinagar is located quite far away from the equator whereas Thiruvananthapuram is comparatively nearer to the equator. So, due to their totally different positions on earth, Srinagar and Thiruvananthapuram have entirely different climates. (1) In Srinagar, the temperatures round the year are neither very low nor very high. Also, the rainfall is neither very low nor very high. Thus, Srinagar has a moderately hot and wet climate. (2) In Thiruvananthapuram , the temperatures round the year are quite high. Also, the rainfall is very high. Thus, Thiruvananthapuram has a very hot and wet climate. Rajasthan state lies in the Western region of India. In Rajasthan, the temperature is very high during most part of the year, so it is very hot. Rajasthan receives very little rainfall, so it is dry, Thus, the climate of Rajasthan is hot and dry This is the typical desert climate. The North-East India (like Assam) receives rain for a major part of the year, therefore, we can say that the climate of North-East India is wet. Weather is the day-to-day condition of the atmosphere at a place whereas climate is the average weather pattern at a place taken over a long period of time When two objects at different temperatures are in contact with each other, heat transfer will occur, with heat flowing from the object at the higher temperature to the object at the lower temperature until thermal equilibrium is reached. This transfer occurs due to collisions between the higher-energy molecules in the hot object with the lower-energy molecules in the cooler object, transferring energy to them in the process until enough random collisions between molecules in the materials have occurred that the energy becomes equally distributed between the objects or substances. As a result, a new final temperature is achieved, which lies between the original temperatures of the hot and the cool objects. Another way to think of this is that the total energy contained in both substances eventually becomes equally distributed between the substances. The final temperature of two objects at different initial temperatures once they reach thermal equilibrium can be found by using the relationship between heat energy Q, specific heat capacity c, mass m and the temperature change given by the following equation: $Q = mc\Delta T$ **Example:** Suppose 0.1 kg of copper pennies (_cc_ = 390 J/kgK) at 50 degrees Celsius are dropped into 0.1 kg of water (_cw_ = 4,186 J/kgK) at 20 degrees Celsius. What will the final temperature be once thermal equilibrium is achieved? Solution: Consider that the heat added to the water from the pennies will equal the heat removed from the pennies. So if the water absorbs heat _Qw_ where: $Q_w = m_wc_w\Delta T_w$ Then for the copper pennies: $Q_c=-Q_w = m_cc_c\Delta T_c$ This allows you to write the relationship: $m_cc_c\Delta T_c=-m_wc_w\Delta T_w$ Then you can make use of the fact that both the copper pennies and the water should have the same final temperature, _Tf_, such that: $\Delta T_c=T_f-T_{ic}\Delta T_w=T_f-T_{iw}$ Plugging these ΔT expressions into the previous equation, you can then solve for _Tf_. A little algebra gives the following result: $T_f = \frac{m_cc_c T_{ic}+m_wc_w T_{iw}}{m_cc_c+m_wc_w}$ Plugging in the values then gives: $T_f = \frac{0.1\times 390\times 50+0.1\times 4186\times 20}{0.1\times 390+0.1\times 4186}= 22.6 \text{ degrees Celsius}$ Note: If you're surprised that the value is so close to the water's initial temperature, consider the significant differences between the specific heat of water and the specific heat of copper. It takes a lot more energy to cause a temperature change in water than it does to cause a temperature change in copper. Temperature is one of the most widespread and significant physical variables in an organism's surroundings. It is a measurement of the average rate of atom and molecule random motions: the greater the temperature, the faster the motion. In this article, we will mainly discuss atmospheric temperature. The sun is the primary indirect source of atmospheric temperature. (Atmosphere receives the majority of its energy from long-wave terrestrial radiation). On average, the heating and cooling of the atmosphere is accomplished through direct solar radiation and the transfer of energy from the earth via conduction, convection, and radiation. The Temperature as an Element of Weather & Climate plays an instrumental role and is an important concept in the Geography syllabus of the UPSC examination. Elements of Weather and Climate Temperature As An Element of Weather and Climate Temperature As An Element of Weather and Climate Temperature is the degree of hotness or coolness of the atmosphere on a scale of one to ten. Temperature varies throughout the day due to the Earth's rotation and during the annual seasons due to the Earth's translational motion around the sun. It's usually expressed in degrees Celsius or Fahrenheit. A thermometer is a device that is used to measure temperature. As temperature influences other aspects of the weather, it is a critical factor in determining the weather. Temperature as an element of Weather and Climate The energy radiated in the form of light from the Sun to the Earth is known as heat. About half of the solar energy is reflected back into space by clouds, water vapor, and air dust, while the rest is absorbed by soil and water and converted to heat. (* Click here to read more about Heat Budget of the Earth) Temperature varies throughout the day due to the Earth's rotation and during the annual seasons due to the Earth's translational motion around the sun. In more practical terms, kinetic energy is created when particles in the air move or vibrate at a given speed. In other terms, temperature can also be defined as the measure of the amount of kinetic energy in the air that manifests physically as heat or cold. The temperature rises as the particles begin to move/rotate faster. The temperature begins to drop as the particles begin to slow down. Thus temperature has a significant impact on weather and climate and also on other primary elements. Significance of Temperature Significance of Temperature Temperature influences the distribution of rainwater on Earth. Higher temperatures, together with other climate factors, result in greater convectional heat transfer, which leads to more convectional rainfall. Higher temperatures result in reduced pressure on the planet, therefore winds blow from higher to lower pressure to fill the void. As a result, temperature has a significant impact on wind direction and speed. It causes changes in the reflectivity of the Earth's atmosphere as well as the surface. It has a significant impact on the lives of marine organisms and also causes sea levels to rise due to warmer sea temperatures. Conclusion Temperature not only is an important element of weather and climate as a separate entity but also as a whole because it influences the remaining elements of the weather and climate like atmospheric pressure, wind, precipitation, humidity, and so on. FAQs Question: What is temperature in the context of weather and climate? Answer: Temperature refers to the measure of warmth or coldness of an environment as determined by a thermometer. It is a fundamental element of both weather and climate, influencing various atmospheric processes and conditions. Temperature affects air pressure, humidity, and wind patterns, and is essential in determining the type of weather experienced in a region. While weather refers to short-term atmospheric conditions, climate encompasses long-term temperature trends and averages for a specific area. Question: How is temperature measured? Answer: Temperature is commonly measured using thermometers, which can be calibrated in degrees Celsius (°C), Fahrenheit (°F), or Kelvin (K). Various types of thermometers are used in meteorology, including liquid-in-glass thermometers, digital thermometers, and infrared thermometers. The measurements can be taken at various altitudes and locations to provide accurate readings of air temperature, surface temperature, and atmospheric conditions. Question: What factors influence temperature variations in different regions? Answer: Several factors influence temperature variations across different regions, including latitude, altitude, distance from the sea, and prevailing winds. Latitude affects the angle of sunlight received, with equatorial regions generally experiencing higher temperatures. Altitude plays a role as well, with higher elevations typically experiencing cooler temperatures. Proximity to large bodies of water can moderate temperatures, leading to milder climates, while winds can bring varying air masses that influence local temperatures. Question: What is the significance of understanding temperature in the study of climate change? Answer: Understanding temperature is critical in the study of climate change as it serves as a key indicator of global warming trends. Rising average temperatures can lead to severe consequences, including melting polar ice, rising sea levels, and increased frequency of extreme weather events. By monitoring temperature changes over time, scientists can assess the impacts of human activities on the environment and develop strategies to mitigate climate change effects. Additionally, temperature data is vital for formulating climate policies and environmental conservation efforts. Question: How does temperature affect ecosystems? Answer: Temperature plays a crucial role in shaping ecosystems by influencing the distribution of species, their behavior, and their physiological processes. Different species have specific temperature ranges in which they thrive, and changes in temperature can disrupt these ranges, leading to habitat loss or shifts in species distributions. Additionally, temperature affects plant growth, reproduction cycles, and food availability, which can impact entire food webs and ecosystem dynamics. Understanding temperature impacts is essential for biodiversity conservation and ecosystem management. MCQs 1. What is the primary unit of measurement for temperature in meteorology? A) Kilograms B) Meters C) Degrees Celsius D) Liters Answer: (C) See the Explanation Explanation: The primary unit of measurement for temperature in meteorology is degrees Celsius (°C), although Fahrenheit (°F) and Kelvin (K) are also used. 2. Which factor primarily affects temperature differences at various latitudes? A) Altitude B) Proximity to water C) Angle of sunlight D) Wind patterns Answer: (C) See the Explanation Explanation: The angle of sunlight received at different latitudes primarily affects temperature differences, with equatorial regions receiving more direct sunlight and thus higher temperatures. 3. What is the significance of monitoring temperature changes in relation to climate change? A) It has no impact B) It helps in assessing global warming trends C) It is only relevant for urban areas D) It is only important for weather forecasts Answer: (B) See the Explanation Explanation: Monitoring temperature changes is significant for assessing global warming trends and understanding the impacts of human activities on the climate. 4. How does altitude influence temperature? A) Higher altitude leads to warmer temperatures B) Higher altitude leads to cooler temperatures C) Altitude has no effect on temperature D) Altitude only affects air pressure Answer: (B) See the Explanation Explanation: Higher altitude generally leads to cooler temperatures, as the air is less dense and cannot hold heat as effectively. 5. What is one way temperature impacts ecosystems? A) It does not affect species distribution B) It only affects terrestrial ecosystems C) It influences species behavior and reproduction D) It has no relation to food availability Answer: (C) See the Explanation Explanation: Temperature influences species behavior and reproduction, affecting the dynamics of ecosystems and food webs. GS Mains Questions and Model Answers Q1: Discuss the relationship between temperature and climate. How does temperature influence weather patterns? Answer: Temperature and climate are intricately connected, as temperature is a fundamental component of climate systems. Climate refers to the long-term average of weather patterns, including temperature, precipitation, and humidity over extended periods. Changes in temperature can significantly influence weather patterns, leading to variations in precipitation, storm frequency, and intensity. For instance, rising temperatures can increase evaporation rates, resulting in more moisture in the atmosphere and potentially leading to heavier rainfall or severe storms. Understanding this relationship is crucial for predicting climate change impacts and developing strategies for adaptation and mitigation. Q2: Analyze the implications of rising global temperatures on ecosystems and biodiversity. What measures can be taken to mitigate these impacts? Answer: Rising global temperatures have profound implications for ecosystems and biodiversity, including habitat loss, altered species distributions, and increased extinction rates. As temperatures rise, many species may struggle to adapt to changing conditions, leading to a decline in biodiversity. Ecosystems such as coral reefs are particularly vulnerable to temperature changes, resulting in bleaching and ecosystem degradation. To mitigate these impacts, measures such as establishing protected areas, promoting sustainable land-use practices, and enhancing climate resilience through conservation efforts are essential. Additionally, reducing greenhouse gas emissions and fostering public awareness about climate change can contribute to preserving biodiversity and ecosystems. Q3: Evaluate the role of temperature in determining agricultural productivity. How can farmers adapt to changing temperature patterns? Answer: Temperature plays a critical role in determining agricultural productivity, influencing crop growth cycles, yield, and overall food security. Changes in temperature patterns can lead to altered planting and harvesting times, affecting crop viability. Higher temperatures can stress plants, reduce yields, and increase water requirements. To adapt to these changes, farmers can adopt climate-smart agricultural practices, such as selecting heat-resistant crop varieties, improving irrigation efficiency, and employing soil management techniques that enhance moisture retention. Additionally, farmers can utilize weather forecasting tools to make informed decisions about planting and harvesting, ensuring better resilience to temperature fluctuations. Previous Year Questions on Temperature and Climate Question: What factor primarily influences temperature variations across different regions? A) Latitude B) Wind direction C) Soil type D) Urbanization Answer: (A) Explanation: Latitude primarily influences temperature variations across different regions, as it affects the angle and intensity of sunlight received. 2. UPSC CSE Mains 2019 (GS Paper 1): Question: "Discuss the impact of rising global temperatures on weather patterns and climate change. What strategies can be implemented to address these challenges?" Answer: Rising global temperatures significantly impact weather patterns, leading to increased frequency and intensity of extreme weather events such as hurricanes, floods, and droughts. This exacerbates climate change effects, causing disruptions in ecosystems and human activities. Strategies to address these challenges include enhancing climate resilience through infrastructure improvements, promoting sustainable practices in agriculture and urban planning, and implementing policies aimed at reducing greenhouse gas emissions. International cooperation and public awareness are essential to drive collective action towards mitigating the impacts of climate change and adapting to new weather realities. *The article might have information for the previous academic years, please refer the official website of the exam.Share on FacebookShare on TwitterHow likely are you to recommend Prepp.in to a friend or a colleague?Test will end in 00:00:00Test will end in 00:00:00View MoreView MoreTest will end in 00:00:00View MoreView More Science, Tech, Math All Science, Tech, Math Humanities All Humanities Languages All Languages Resources All Resources