UNIQUE STUDY POINT BY SUMEET SAHU

Temperature and its Measurement

Class 6 — Science — Chapter 7

NCERT Comprehensive Notes 2025-26

Section 01

Overview — Temperature and its Measurement

This chapter introduces the concept of temperature as a reliable measure of hotness or coldness of a body. It explains why our sense of touch cannot always be trusted to judge temperature accurately and establishes the need for a device called a thermometer. Students learn about two main types of thermometers — clinical thermometers and laboratory thermometers — along with the correct methods for using each. The chapter also covers three important temperature scales (Celsius, Fahrenheit, and Kelvin), the concept of normal human body temperature (37.0 °C or 98.6 °F), and how air temperature is measured and used in weather forecasting. The chapter opens with a story of Lambok and Phiban from Shillong, where Phiban uses a digital clinical thermometer to check if Lambok has a fever, and includes the inspiring quote by Indian scientist Anna Mani: "Wrong measurements are worse than no measurements at all."

USP Key Points

- Normal human body temperature is 37.0 °C (98.6 °F) — an average of many healthy individuals.
- Human body temperature does not normally go below 35 °C or above 42 °C.
- A laboratory thermometer typically has a range of −10 °C to 110 °C.
- Temperature measured in the armpit is about 0.5 °C to 1 °C lower than the actual body temperature.
- The SI unit of temperature is kelvin (K); conversion: K = °C + 273.15.
- Boiling water temperature in Shillong was recorded between 97.8 °C and 98.1 °C (lower due to altitude).
- Absolute zero is the lowest possible temperature: −273.15 °C (0 K).

Section 02

Hot or Cold? — Can We Trust Our Touch?

We know from everyday experience that some bodies are hotter than others. For example, during summers, the tap water may feel hotter than the cold water from a matka (earthen pot) or a refrigerator. We can sense this difference by merely touching the two samples. But the question is — can we always rely upon our sense of touch to judge temperature correctly?

Activity 7.1 — Let Us Investigate

In this activity, three containers labelled A, B, and C are used. Container A holds warm water, container B holds tap water, and container C holds ice-cold water. The steps of the activity are as follows:

First, the right hand is dipped in container A (warm water) and the left hand is dipped in container C (ice-cold water). Both hands are kept there for 1–2 minutes. Then, both hands are taken out and placed simultaneously in container B (tap water). The surprising result is that the right hand (which was previously in warm water) feels the water in B as cool, while the left hand (which was previously in cold water) feels the same water in B as warm.

Key Learning: The same water in container B feels different to each hand. This proves that our sense of touch is not a reliable way to judge the temperature of a body. The sensation of hot or cold depends on the previous condition of our hand, not on the actual temperature of the water.

Inference from Activity 7.1

We cannot always rely upon our sense of touch to decide correctly whether a body is hot or cold. We need a more reliable method — a device that can give an objective, numerical measure of hotness or coldness. This device is called a **thermometer**.

Section 03

Understanding Temperature

A reliable measure of the hotness or coldness of a body is its temperature. A hotter body has a higher temperature than a colder body. The difference in temperature between two bodies tells us how hot one body is in comparison to another body. A device that measures temperature is called a thermometer.

Temperature

Temperature is a measure of the degree of hotness or coldness of a body. It is a physical quantity that can be measured accurately using a thermometer.

Thermometer

A thermometer is a device used to measure the temperature of a body. Different types of thermometers are used for different purposes.

Types of Thermometers

There are two main kinds of thermometers that we commonly come across:

FEATURE	CLINICAL THERMOMETER	LABORATORY THERMOMETER
Purpose	Measures human body temperature	Measures temperature of liquids, objects, and experiments
Range	35 °C to 42 °C (approx.)	−10 °C to 110 °C (typical)
Usage	Placed under the tongue or in the armpit	Immersed in the substance being measured
Reading	Can be read after removing from body	Must be read while immersed in the substance
Type	Digital (modern) or Mercury (older)	Liquid-in-glass (alcohol or mercury)

Important Note: A clinical thermometer cannot be used to measure the temperature of boiling water or ice because these temperatures are outside its range. Similarly, a laboratory thermometer should not be used to measure body temperature because it is not designed for that purpose and needs to be read while immersed.

Section 04

Clinical Thermometer — Measuring Body Temperature

Digital Clinical Thermometer

A clinical thermometer is used for measuring our body temperature. Modern clinical thermometers display temperatures digitally and are known as digital clinical thermometers. They run on batteries and use heat sensors to determine the temperature when placed in contact with a person's body. The temperature is displayed on a small digital screen, making it easy to read.

Why Digital Thermometers Replaced Mercury Thermometers: Earlier, mercury thermometers were used for measuring body temperature. However, mercury is an extremely toxic substance and is difficult to dispose of if the thermometer breaks accidentally. Digital thermometers pose no such risk and their numbers are easier to read. Therefore, mercury thermometers are being replaced by digital thermometers worldwide.

Celsius Scale

For measuring temperature, clinical thermometers generally use a scale called the Celsius scale. On this scale, the unit of temperature is degree Celsius and is denoted by °C.

Infrared (Non-Contact) Thermometers

During the COVID-19 pandemic, special thermometers were used that could measure the temperature of a person from a distance. These are called non-contact thermometers or infrared thermometers. They can measure temperature without touching a person's body, thus reducing the risk of spreading disease.

Activity 7.2 — Let Us Measure

In this activity, students use a digital clinical thermometer to measure body temperature. The correct procedure involves: washing hands and the thermometer tip with soap and water, pressing the reset button, placing the thermometer under the tongue, closing the mouth, waiting for the beeping sound or flashing light, reading the temperature on the digital display, and then cleaning the thermometer again.

☆ Precautions While Using a Digital Clinical Thermometer

- ☆ Read the instruction manual of the thermometer before use.
- ☆ Wash the tip with soap and water before and after each use.

- While washing, keep the digital display portion out of water.
- Do not hold the thermometer by the tip.
- Wait for the beep sound before reading the temperature.

Normal Body Temperature

The normal temperature of a healthy human body is taken to be 37.0 °C (or 98.6 °F). However, not every person has exactly this temperature. The "normal temperature" is actually the average body temperature of a large number of healthy people. A perfectly healthy person may have a normal temperature slightly different from 37.0 °C. Body temperature is influenced by several factors, such as age, time of the day, and activity level.

Did You Know? Small children generally have slightly higher body temperatures compared to adults, while old people, even when healthy, may have lower body temperatures than young adults. The temperature of human beings does not normally go below 35 °C or above 42 °C.

Armpit Measurement

For small children or old people, the digital thermometer can also be placed in the armpit. The temperature measured this way is about 0.5 °C to 1 °C lower than the actual body temperature.

Fever Detection Before Thermometers

Before thermometers were developed, fever was detected by checking the pulse rate of a person. This method was known even in ancient India. However, apart from fever, some other situations also affect the pulse rate. Hence, pulse rate alone is not a reliable indicator of fever.

Section 05

Laboratory Thermometer — Measuring Beyond Body Temperature

Structure of a Laboratory Thermometer

A laboratory thermometer consists of a long, narrow, uniform glass tube which is sealed. At one end of the tube is a bulb that contains a liquid. Outside the bulb, in the tube, a narrow column of liquid can be seen. There is a Celsius scale marked along the tube. The liquid column rises or falls with a change in temperature. The mark of the Celsius scale with which the top level of the liquid column coincides gives the temperature reading.

Liquid Used: The liquid used in the laboratory thermometer is generally alcohol (coloured red to make it easily visible) or mercury.

Activity 7.3 — Finding the Range

To find the range of a laboratory thermometer, students observe the lowest temperature it can measure and the highest temperature it can measure. For the thermometer shown in the textbook, the range is from –10 °C to 110

°C.

Activity 7.4 — Finding the Smallest Division

To find the smallest value that a laboratory thermometer can read, students look at the temperature difference between two bigger marks and count the number of smaller divisions between them. For example, if the temperature difference between 0 °C and 10 °C is 10 °C and there are 10 divisions between them, then one small division reads 10 ÷ 10 = 1 °C. The smallest value that thermometer can read is 1 °C.

Least Count of a Thermometer

The smallest temperature value that a thermometer can read is called its least count. It is calculated by dividing the temperature difference between two bigger marks by the number of smaller divisions between them. Different thermometers may have different least counts.

Correct Way of Using a Laboratory Thermometer

★ Rules for Correct Measurement

- ★ The bulb of the thermometer should not touch the bottom or sides of the beaker when immersed in water.
- ★ The thermometer should be held vertically (straight up) — it should not be tilted.
- ★ The temperature must be read while the thermometer is still immersed in the liquid.
- ★ While reading, your eye should be directly in line with the level of the liquid column (to avoid parallax error).
- ★ Handle the thermometer with care — if it hits a hard object, it can break.
- ★ Do not hold the thermometer by the bulb.

Activity 7.5 — Measuring Temperature of Warm Water

In this activity, students take some warm water in a beaker, dip the laboratory thermometer so that its bulb is immersed, observe the rise of the liquid column until it stops rising, and note the temperature reading. An important observation is that as soon as the thermometer is taken out of the water, the liquid column begins to fall. This confirms that the temperature must be read while the thermometer is immersed.

Activity 7.6 — Boiling Water Temperatures in Shillong

In a school in Shillong, students measured the temperature of boiling water. Their readings were between 97.8 °C and 98.1 °C — not exactly 100 °C. This is because water boils at a lower temperature at higher altitudes (Shillong is at a high elevation). Slight differences in readings among students may also be due to not following the correct method of reading the thermometer.

STUDENT NAME	TEMPERATURE OF BOILING WATER (°C)
Phiban	97.8
Shemphang	98.0
Onestar	97.9
Kloi	98.0
Bandarisha	98.1

Key Observation: The temperature of water remains constant while it is boiling. Similarly, the temperature of ice remains constant while it is melting. These are important properties of phase changes.

Section 06

Air Temperature and Weather

Room Thermometers

You might have seen thermometers hung on walls of school laboratories, doctors' clinics, and hospitals. These are called room thermometers and they give an approximate idea of the room temperature.

Weather Reports

Weather reports in newspapers, TV news, and the internet mention the maximum and minimum air temperature of the day. These temperatures usually vary every day because weather depends on several factors. Generally, as we approach the summer season, the temperature rises, and during the winter season, it falls.

Activity 7.7 — Let Us Analyse

In this activity, students read or listen to weather reports for a place for 10 successive days, record the maximum and minimum air temperatures for each day, and analyse the data. This helps students understand how air temperature changes over time and how weather patterns work.

Air Temperature Monitoring: There are many techniques for measuring air temperature. Air temperature is an important weather parameter and is monitored at weather stations all over the world. The data gathered on air temperature along with various other parameters are used for making weather forecasts.

Know a Scientist — Anna Mani (1918–2001)

Anna Mani was an Indian scientist, also known as the "Weather Woman of India." She invented and built a large number of weather measurement instruments, which reduced India's reliance on other nations for such instruments. She also explored the possibilities of using wind and solar energy in India. Her work helped India become one of the global leaders in renewable energy. The chapter opens with her famous quote: "Wrong measurements are worse than no measurements at all."

Section 07

Temperature Scales and Conversions

Three Major Temperature Scales

There are three most-used scales of temperature, each named after the scientist who developed it. Understanding these scales and their relationships is essential for scientific studies.

SCALE	UNIT	SYMBOL	NORMAL BODY TEMP.	FREEZING POINT OF WATER	BOILING POINT OF WATER
Celsius	degree Celsius	°C	37.0 °C	0 °C	100 °C
Fahrenheit	degree Fahrenheit	°F	98.6 °F	32 °F	212 °F
Kelvin	kelvin	K	310.15 K	273.15 K	373.15 K

Conversion Formula

Celsius to Kelvin: Temperature in Kelvin = Temperature in Celsius + 273.15

Example: 37.0 °C = 37.0 + 273.15 = 310.15 K

Note: The SI unit of temperature is kelvin (K). The degree sign (°) is not used with K.

Rules for Writing Temperature Units

★ Important Writing Conventions

- ★ The names of temperature scales (Celsius, Fahrenheit, Kelvin) start with a capital letter.
- ★ For degree Celsius and degree Fahrenheit, the word "degree" starts with a lowercase letter, while Celsius and Fahrenheit start with a capital letter.
- ★ The unit "kelvin" starts with a lowercase letter.
- ★ The symbols of all units (°C, °F, K) use capital letters.
- ★ The degree sign (°) is not written with K.
- ★ A full stop is not written after the symbol, except at the end of a sentence.
- ★ A space is left between the number and the unit (e.g., 37.0 °C, not 37.0°C).
- ★ For temperatures more than one degree, use "degrees" (plural) when writing the full form.

Extreme Temperatures

Sun's Core Temperature: The temperature at the core of the Sun reaches as high as 15 million degrees Celsius. There is no upper limit on the highest temperature that can exist.

Absolute Zero: However, there is a limit to the lowest temperature that can be achieved. It is close to –273.15 °C (0 kelvin) and is called absolute zero. No object can be cooled below this temperature.

Section 08

Glossary of Key Terms

Temperature
A measure of the degree of hotness or coldness of a body, measured using a thermometer.

Thermometer
A device used to measure the temperature of a body accurately.

Clinical Thermometer
A thermometer specifically designed to measure the body temperature of humans, typically ranging from 35 °C to 42 °C.

Laboratory Thermometer
A thermometer used in scientific experiments, typically with a range of –10 °C to 110 °C, using alcohol or mercury.

Celsius Scale
A temperature scale where 0 °C is the freezing point of water and 100 °C is the boiling point. Unit: degree Celsius (°C).

Fahrenheit Scale
A temperature scale where 32 °F is the freezing point of water and 212 °F is the boiling point. Unit: degree Fahrenheit (°F).

Kelvin Scale
The SI temperature scale. 0 K is absolute zero (–273.15 °C). Conversion: K = °C + 273.15. Unit: kelvin (K).

Infrared Thermometer
A non-contact thermometer that measures temperature from a distance using infrared radiation, widely used during COVID-19.

Absolute Zero
The lowest possible temperature: –273.15 °C or 0 K. No object can be cooled below this temperature.

Air Temperature
The temperature of the surrounding air, an important weather parameter measured at weather stations worldwide.

Range of a Thermometer
The span between the lowest and highest temperatures a thermometer can measure (e.g., –10 °C to 110 °C for a lab thermometer).

Least Count
The smallest temperature value that a thermometer can read, determined by the smallest division on the scale.

Section 09

Q&A, MCQs and Case Studies

NCERT Exercise Questions with Answers

Q1. The normal temperature of a healthy human being is close to ___.

Answer: (ii) 37.0 °C
The normal temperature of a healthy human adult is taken to be 37.0 °C, which is equivalent to 98.6 °F on the Fahrenheit scale. This is an average value and individual healthy persons may have slightly different temperatures depending on factors like age, time of day, and activity level.

Q2. 37 °C is the same temperature as ___.

Answer: (iv) 98.6 °F
The normal human body temperature of 37.0 °C on the Celsius scale is equivalent to 98.6 °F on the Fahrenheit scale. This relationship between the two scales is a fundamental fact to remember.

Q3. Fill in the blanks: (i) The hotness or coldness of a system is determined by its ___. (ii) The temperature of ice-cold water cannot be measured by a ___ thermometer. (iii) The unit of temperature is degree ___.

Answers:
(i) The hotness or coldness of a system is determined by its **temperature**.
(ii) The temperature of ice-cold water cannot be measured by a **clinical** thermometer. (Clinical thermometers have a range of about 35 °C to 42 °C, so they cannot measure the temperature of ice-cold water which is around 0 °C.)
(iii) The unit of temperature is degree **Celsius** (on the Celsius scale). Other units include degree Fahrenheit and kelvin.

Q4. The range of a laboratory thermometer is usually ___.

Answer: (ii) –10 °C to 110 °C
A laboratory thermometer typically has a range from –10 °C to 110 °C. This wide range allows it to measure the temperatures of many substances, including ice (around 0 °C) and boiling water (around 100 °C). This is much wider than a clinical thermometer's range of 35 °C to 42 °C.

Q5. Four students used a laboratory thermometer to measure the temperature of water. Who followed the correct way?

Answer: (iii) Student 3
Student 3 followed the correct method because: (a) The thermometer is held vertically (upright), not tilted. (b) The bulb is immersed in water without touching the bottom or sides of the container. (c) The eye is directly in line with the level of the liquid column. (d) The reading is taken while the thermometer is still immersed in the water. The other students made errors — some tilted the thermometer, some held it by the bulb, or read it at an incorrect angle.

Q6. Colour to show the red column on the drawings of thermometers as per the temperatures: 14 °C, 17 °C, 7.5 °C.

Answer: For a thermometer with 1 °C divisions, the red column should be drawn up to: (a) 14 °C — the column reaches the 14th mark above 0. (b) 17 °C — the column reaches the 17th mark above 0. (c) 7.5 °C — the column reaches exactly halfway between the 7th and 8th marks above 0. Students need to carefully count the divisions and fill the red column to the correct level.

Q7. Observe the part of thermometer shown in Fig. 7.8 and answer: (i) What type of thermometer is it? (ii) What is the reading? (iii) What is the smallest value it can measure?

Answers:
(i) It is a **laboratory thermometer**. The visible scale with range extending from –10 to well beyond body temperature range indicates it is a laboratory thermometer, not a clinical one.
(ii) The reading of the thermometer is **21 °C** (based on the position of the liquid column on the scale shown in Fig. 7.8).
(iii) The smallest value this thermometer can measure is **1 °C**. This is calculated by looking at the number of smaller divisions between two bigger marks. If there are 10 divisions between 10 °C marks, each division = 10 ÷ 10 = 1 °C.

Q8. A laboratory thermometer is not used to measure our body temperature. Give a reason.

Answer: A laboratory thermometer is not used to measure our body temperature for the following reasons: (1) The laboratory thermometer must be read while it is immersed in the substance — the reading drops as soon as it is removed. This makes it impractical for body temperature measurement. (2) It is made of glass and is fragile, making it unsafe to place in the mouth. (3) Its range (–10 °C to 110 °C) is much wider than needed for body temperature, making the readings less precise for the narrow range of human body temperature. (4) It is not designed for hygienic contact with the human body. Clinical thermometers are specifically designed for this purpose.

Q9. Vaishnavi's body temperature record: (i) Highest temperature? (ii) Day and time of highest? (iii) Day temperature returned to normal?

Answers:
(i) Vaishnavi's highest recorded temperature was **40.0 °C**.
(ii) The highest temperature of 40.0 °C was recorded on **Day One at 7 pm**.
(iii) Vaishnavi's temperature returned to normal on **Day Three**. On Day Three, her temperature started at 37.6 °C at 7 am and gradually decreased to 36.6 °C by 10 pm. Temperatures around 37.0 °C and below are considered normal, so by the afternoon of Day Three, her temperature had come close to normal (37.2 °C at 1 pm, 37.0 °C at 4 pm).

Q10. To measure 22.5 °C, which of the three thermometers (a), (b), or (c) will you use? Explain.

Answer: To measure 22.5 °C, we should use thermometer **(b)**. This is because thermometer (b) has smaller divisions (each division represents 0.5 °C), which allows us to read 22.5 °C accurately. Thermometers (a) and (c) have larger divisions (each division represents 1 °C or more) where the mark for 22.5 °C would fall between two divisions and would have to be estimated, leading to a less accurate reading. Always choose a thermometer whose least count allows you to read the required temperature directly.

Q11. The temperature shown by the thermometer in Fig. 7.10 is ___.

Answer: (iii) 26.5 °C
By carefully observing the thermometer in Fig. 7.10, the liquid column is at the halfway mark between 26 °C and 27 °C. Since each small division represents 0.5 °C (if there are 2 divisions between each degree), the reading is 26.5 °C.

Q12. A laboratory thermometer has 50 divisions between 0 °C and 100 °C. What does each division measure?

Answer: Each division of this thermometer measures = (100 – 0) ÷ 50 = 100 ÷ 50 = **2 °C**. This means the smallest temperature change that this thermometer can read (its least count) is 2 °C. Each small mark on the scale represents a jump of 2 degrees Celsius.

Q13. Draw the scale of a thermometer where the smallest division reads 0.5 °C. Draw only the portion between 10 °C and 20 °C.

Answer: Between 10 °C and 20 °C, if each smallest division is 0.5 °C, there will be 20 small divisions (since 10 ÷ 0.5 = 20). The scale will show major marks at 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20 °C, with one small mark between each consecutive pair of major marks representing the half-degree (0.5 °C) point. For example, between 10 and 11, there would be a small mark at 10.5 °C.

Q14. Komal tells you that she has a fever of 101 degrees. Does she mean it on the Celsius scale or Fahrenheit scale?

Answer: Komal means it on the **Fahrenheit scale**. The maximum body temperature for a human being is about 42 °C. A fever of 101 °C is impossible because it would be far above the boiling point of water (100 °C). However, 101 °F is a common fever temperature. On the Fahrenheit scale, normal body temperature is 98.6 °F, so 101 °F represents a mild to moderate fever, which is realistic and commonly observed in patients.

Additional Short Answer Questions

Q15. Why can we not rely on our sense of touch to judge the temperature of a body?

Answer: Our sense of touch is not a reliable way to judge temperature because the sensation of hot or cold depends on what our hands were previously in contact with. As demonstrated in Activity 7.1, when one hand is first placed in warm water and the other in cold water, and then both are placed in the same container of tap water, the hand that was in warm water feels the tap water as cold, while the other hand feels the same water as warm. This shows that our perception of temperature is relative and subjective. We need a thermometer for accurate and objective measurement of temperature.

Q16. What are infrared thermometers? Why were they widely used during the COVID-19 pandemic?

Answer: Infrared thermometers are non-contact thermometers that can measure the temperature of a person from a distance without physically touching the body. They work by detecting the infrared radiation (heat energy) emitted by the body. They were widely used during the COVID-19 pandemic because: (1) They allow temperature screening without physical contact, reducing the risk of spreading the virus between people. (2) They give instant readings, making it efficient to screen large numbers of people quickly. (3) They are safe, hygienic, and easy to use in public places like airports, hospitals, offices, and schools.

Q17. What is absolute zero? Why is it significant?

Answer: Absolute zero is the lowest possible temperature that can theoretically be achieved. It is –273.15 °C or 0 kelvin (K). At absolute zero, particles of matter have the minimum possible energy. No object in the universe can be cooled below this temperature. It is significant because: (1) It is the starting point of the Kelvin scale. (2) It sets a fundamental limit in nature — there is no limit to the highest temperature, but there is a definite lower limit. (3) It is important in scientific research, as studying matter near absolute zero reveals unusual properties like superconductivity.

Q18. Explain why the temperature of boiling water measured in Shillong was less than 100 °C.

Answer: The temperature of boiling water in Shillong was measured between 97.8 °C and 98.1 °C, which is less than 100 °C. This is because Shillong is located at a high altitude (approximately 1,496 metres above sea level). At higher altitudes, atmospheric pressure is lower than at sea level. Water boils when its vapour pressure equals the atmospheric pressure. Since the atmospheric pressure is lower at higher altitudes, water boils at a temperature lower than 100 °C. The boiling point of water decreases by approximately 1 °C for every 300 metres of altitude gained.

Q19. What is the difference between the range and the least count of a thermometer?

Answer: The range of a thermometer is the span between the lowest and highest temperatures it can measure. For example, a laboratory thermometer has a range of –10 °C to 110 °C. The least count of a thermometer is the smallest temperature change that it can read, determined by the smallest division on the scale. For example, if there are 10 divisions between 0 °C and 10 °C, the least count is 1 °C. The range tells us what temperatures the thermometer can handle, while the least count tells us how precisely it can measure.

Multiple Choice Questions (MCQs)

MCQ 1. Which of the following is the SI unit of temperature?

(a) degree Celsius

(b) degree Fahrenheit

(c) kelvin

(d) joule

✅ Answer: (c) kelvin

MCQ 2. The temperature of a healthy human body does not normally go below:

(a) 30 °C

(b) 35 °C

(c) 37 °C

(d) 40 °C

✅ Answer: (b) 35 °C

MCQ 3. Which thermometer uses heat sensors to measure temperature?

(a) Mercury thermometer

(b) Alcohol thermometer

(c) Digital clinical thermometer

(d) Laboratory thermometer

✅ **Answer: (c) Digital clinical thermometer**

MCQ 4. The temperature measured in the armpit is about ___ lower than the actual body temperature.

(a) 0.1 °C to 0.2 °C

(b) 0.5 °C to 1 °C

(c) 2 °C to 3 °C

(d) 5 °C to 6 °C

✅ **Answer: (b) 0.5 °C to 1 °C**

MCQ 5. Anna Mani is known as the:

(a) Missile Woman of India

(b) Weather Woman of India

(c) Science Teacher of India

(d) Mother of Thermometers

✅ **Answer: (b) Weather Woman of India**

MCQ 6. What is the value of absolute zero?

(a) 0 °C

(b) –100 °C

(c) –273.15 °C

(d) –373.15 °C

✅ **Answer: (c) –273.15 °C**

MCQ 7. While reading a laboratory thermometer, your eye should be:

(a) Above the level of the liquid column

(b) Below the level of the liquid column

(c) Directly in line with the level of the liquid column

(d) At any angle to the liquid column

✅ **Answer: (c) Directly in line with the level of the liquid column**

MCQ 8. The liquid used in a laboratory thermometer is usually:

(a) Water

(b) Milk

(c) Alcohol (coloured red) or mercury

(d) Oil

✅ Answer: (c) Alcohol (coloured red) or mercury

MCQ 9. Convert 25 °C to Kelvin scale:

(a) 248.15 K

(b) 273.15 K

(c) 298.15 K

(d) 325.15 K

✅ Answer: (c) 298.15 K (25 + 273.15 = 298.15)

MCQ 10. A clinical thermometer should NOT be used to measure:

(a) Body temperature of a child

(b) Temperature of boiling water

(c) Body temperature under the tongue

(d) Body temperature in the armpit

✅ Answer: (b) Temperature of boiling water

MCQ 11. Temperature remains constant during:

(a) Heating of water

(b) Boiling of water

(c) Cooling of water

(d) Stirring of water

✅ Answer: (b) Boiling of water

MCQ 12. The degree sign (°) is NOT used with which unit of temperature?

(a) Celsius

(b) Fahrenheit

(c) Kelvin

(d) Both Celsius and Fahrenheit

✅ Answer: (c) Kelvin

Case-Based Questions

Case Study 1: The Three-Container Experiment

Ravi conducted an experiment in his school laboratory. He took three containers A, B, and C. He filled container A with warm water, container B with tap water at room temperature, and container C with ice-cold water. He first placed his right hand in A and left hand in C for 2 minutes. Then he placed both hands in

container B at the same time. He was surprised to find that his right hand felt the water in B as cold, while his left hand felt the same water as warm.

1. **(a) Why did Ravi's right hand feel the water in B as cold?**
2. **(b) Why did his left hand feel the same water as warm?**
3. **(c) What conclusion can be drawn from this experiment?**
4. **(d) What device should Ravi use to find the actual temperature of water in B?**

Answers:

(a) Ravi's right hand was previously in warm water (container A). When it was placed in the tap water (container B), the tap water felt comparatively colder because his hand was adapted to a higher temperature.

(b) His left hand was previously in ice-cold water (container C). When placed in container B, the tap water felt warmer because his hand was adapted to a much lower temperature.

(c) The conclusion is that our sense of touch is not a reliable method for judging the actual temperature of a body. The same water felt both hot and cold to different hands depending on prior exposure.

(d) Ravi should use a laboratory thermometer to find the actual temperature of water in container B, as a thermometer gives an accurate and objective measurement.

Case Study 2: Fever at Home

During the monsoon season, 10-year-old Meera felt unwell. Her mother touched her forehead and thought she might have fever. She used a digital clinical thermometer to check Meera's temperature. She washed the tip with soap and water, placed it under Meera's tongue, waited for the beep, and read the display which showed 39.2 °C. The next morning, the reading was 37.4 °C. Meera's grandmother suggested using an old mercury thermometer instead, but Meera's mother preferred the digital one.

1. **(a) Was Meera running a fever when the thermometer showed 39.2 °C? How can you tell?**
2. **(b) Had Meera's temperature returned to normal the next morning?**
3. **(c) Why did Meera's mother prefer the digital thermometer over the mercury one?**
4. **(d) What precautions did Meera's mother follow while using the thermometer?**

Answers:

(a) Yes, Meera was running a fever. The normal body temperature of a healthy person is about 37.0 °C. Her temperature of 39.2 °C was 2.2 °C above normal, which indicates a significant fever.

(b) The next morning, her reading was 37.4 °C. This is very close to the normal temperature of 37.0 °C but still slightly above normal. Her temperature was almost back to normal, showing she was recovering.

(c) Meera's mother preferred the digital thermometer because: (i) Mercury is a toxic substance and is dangerous if the thermometer breaks. (ii) Digital thermometers are easier to read with a clear display. (iii) They are safer and more accurate for home use.

(d) Meera's mother followed these precautions: she washed the tip with soap and water before use, placed it correctly under the tongue, waited for the beep sound before reading, and used the digital thermometer as per instructions.

Case Study 3: Science Lab Activity

During a science practical class, the teacher asked four students to measure the temperature of hot water in a beaker using a laboratory thermometer. Student A held the thermometer tilted at an angle. Student B removed the thermometer from the water before reading. Student C placed the thermometer vertically with the bulb touching the bottom of the beaker. Student D held the thermometer vertically with the bulb immersed but not touching the bottom, and read the temperature while the thermometer was still in the water with eyes at the level of the liquid column. The teacher's reading was 68 °C.

1. **(a) Which student followed the correct method? Explain why.**
2. **(b) What error did Student A make?**
3. **(c) Why was Student B's method incorrect?**
4. **(d) What was wrong with Student C's technique?**

Answers:

(a) **Student D** followed the correct method. The thermometer was held vertically, the bulb was immersed in water without touching the bottom, the temperature was read while immersed, and the eyes were at the correct level (in line with the liquid column) to avoid parallax error.

(b) Student A made the error of tilting the thermometer. A laboratory thermometer should always be held vertically (straight up) for an accurate reading. A tilted thermometer can give a wrong reading.

(c) Student B's method was incorrect because the temperature must be read while the thermometer is still immersed in the water. As soon as a laboratory thermometer is removed from the substance, the liquid column starts to fall and the reading changes, giving an inaccurate measurement.

(d) Student C's error was placing the bulb touching the bottom of the beaker. The bulb should not touch the bottom or the sides of the container, because the bottom may be hotter or colder than the water itself (due to direct contact with the heat source), leading to an inaccurate reading of the water's temperature.

🎯 Exam Tips — Score Full Marks!

- 🎯 Remember the three temperature scales and their units: Celsius (°C), Fahrenheit (°F), and Kelvin (K). The SI unit is kelvin.
- 🎯 Memorise: Normal body temperature = 37.0 °C = 98.6 °F. Human body temperature range: 35 °C to 42 °C.
- 🎯 Know the Kelvin conversion formula: K = °C + 273.15. Practise numerical problems using this formula.
- 🎯 Learn the differences between clinical and laboratory thermometers — their range, use, and how to read them. This is a frequently asked comparison question.
- 🎯 Remember all precautions for using both digital clinical and laboratory thermometers — examiners love asking these.
- 🎯 Laboratory thermometer range: −10 °C to 110 °C. A clinical thermometer cannot measure boiling water or ice temperature.
- 🎯 Understand why our sense of touch is unreliable (Activity 7.1) — this is a common short-answer question.
- 🎯 Anna Mani is the "Weather Woman of India" — remember her contributions and the opening quote of the chapter.
- 🎯 Absolute zero = −273.15 °C = 0 K. There is no upper limit on temperature, but there is a lower limit.
- 🎯 For diagram-based questions, practise reading thermometer scales and identifying the least count. Always calculate: Least Count = Value between two big marks ÷ Number of small divisions.

UNIQUE STUDY POINT

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