UNIQUE STUDY POINT

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Class: VI	**Subject:** Science	**Session:** 2025-26
Chapter: 07 - Temperature and its Measurement	**Time:** 1½ Hours	**Max. Marks:** 40

General Instructions:

1. All questions are compulsory.
2. This question paper contains 20 questions divided into five sections A, B, C, D and E.
3. Section A contains 10 MCQs of 1 mark each.
4. Section B contains 4 questions of 2 marks each.
5. Section C contains 3 questions of 3 marks each.
6. Section D contains 1 question of 5 marks.
7. Section E contains 2 Case Study Based questions of 4 marks each.

SECTION A - Multiple Choice Questions (1 mark each)

1. Which of the following correctly describes temperature?
(a) A measure of total heat energy
(b) A measure of hotness or coldness
(c) A measure of pressure
(d) A measure of volume

2. The temperature of a healthy human body does not normally go below:
(a) 30 °C
(b) 32 °C
(c) 35 °C
(d) 37 °C

3. Which of the following temperature scales does NOT use the degree symbol?
(a) Celsius scale
(b) Fahrenheit scale
(c) Kelvin scale
(d) All use degree symbol

4. In a laboratory thermometer, as temperature increases, the liquid column:
(a) Falls down
(b) Rises up
(c) Remains same
(d) First rises then falls

5. The temperature at the core of the Sun is approximately:
(a) 1 thousand degrees Celsius
(b) 1 million degrees Celsius

(c) 15 million degrees Celsius
(d) 100 million degrees Celsius

6. Room thermometers are usually hung on walls to measure:
(a) Body temperature
(b) Air temperature
(c) Water temperature
(d) Food temperature

7. Which component in digital thermometers detects temperature?
(a) Mercury
(b) Alcohol
(c) Heat sensors
(d) Light bulbs

8. When water is boiling, which statement is TRUE?
(a) Temperature keeps increasing
(b) Temperature keeps decreasing
(c) Temperature remains constant
(d) Temperature fluctuates

9. What is the full form of SI in SI unit?
(a) Scientific International
(b) Système International (International System)
(c) Standard Instrument
(d) Simple Index

10. The word 'degree' in temperature units should be written in:
(a) Plural for temperatures more than one
(b) Always singular
(c) Always plural
(d) Capital letters always

SECTION B - Short Answer Questions (2 marks each)

11. Why is it important to hold a laboratory thermometer vertically while measuring temperature? What error can occur if this is not done?

12. Name the three temperature scales commonly used. Write the symbol for the unit of temperature in each scale.

13. During a science experiment, a student observed that the temperature of ice remained at 0 °C even when it was being heated. Explain why this happens.

14. A doctor recorded a patient's temperature as 102 °F. Convert this temperature to Celsius scale. (Formula: $C = 5/9 \times (F - 32)$)

SECTION C - Short Answer Questions (3 marks each)

15. Explain why air temperature is an important weather parameter. How is this data useful for weather forecasting? Give any three reasons.

16. A laboratory thermometer shows the following markings: The distance between 20 °C and 40 °C contains

20 small divisions. Calculate: (a) The value of each small division (b) The temperature if the liquid column is at the 7th division mark after 20 °C

17. Write any three differences between the way we write Celsius and Kelvin temperature values. Give examples for each difference.

SECTION D - Long Answer Question (5 marks)

18. Imagine you are a science teacher and need to teach your students how to properly measure the temperature of hot water using a laboratory thermometer. Write a detailed step-by-step procedure including all precautions. Also explain what common mistakes students might make and how to avoid them.

SECTION E - Case Study Based Questions (4 marks each)

19. Case Study 1:
A science exhibition was organized in a school where students demonstrated various aspects of temperature measurement. Three groups presented the following:

Group A: Showed that different people feel tap water as hot or cold depending on whether their hands were previously in warm water or cold water.
Group B: Measured temperature of the same tap water using three different thermometers (clinical, laboratory, and room thermometer).
Group C: Recorded how body temperature of 5 people varied throughout one day from morning to night.

Based on the above case study, answer the following questions:

(a) What principle was Group A demonstrating through their experiment? (1 mark)

(b) Which thermometer used by Group B would give the most accurate reading for tap water temperature and why? (1 mark)

(c) Why would Group B get an error if they used a clinical thermometer for measuring tap water? (1 mark)

(d) What conclusion would Group C likely reach about human body temperature based on their observations? (1 mark)

20. Case Study 2:
A meteorological department recorded the following temperatures for three cities on the same day:
City X (at sea level): Maximum 32 °C, Minimum 24 °C
City Y (hill station, 2000m altitude): Maximum 18 °C, Minimum 10 °C
City Z (desert region): Maximum 42 °C, Minimum 28 °C

The department also noted that at City Y, water was observed to boil at 93 °C instead of 100 °C.

Based on the above case study, answer the following questions:

(a) Which city had the highest temperature and which had the lowest? (1 mark)

(b) Calculate the temperature range (difference between maximum and minimum) for each city. Which city had the greatest range? (1 mark)

(c) Why does water boil at 93 °C in City Y instead of 100 °C? (1 mark)

(d) Convert City Z's maximum temperature (42 °C) to Kelvin scale. (1 mark)

DETAILED ANSWER KEY - PAPER 04

SECTION A - Answers to MCQs

1. (b) A measure of hotness or coldness

Temperature is defined as a measure of hotness or coldness of a body. It tells us how hot or cold an object is in comparison to another object.

2. (c) 35 °C

The temperature of a healthy human body does not normally go below 35 °C. The normal range is typically between 35 °C and 42 °C.

3. (c) Kelvin scale

The Kelvin scale does not use the degree symbol. We write 300 K, not 300 °K. Celsius and Fahrenheit both use the degree symbol (°C and °F).

4. (b) Rises up

In a laboratory thermometer, as temperature increases, the liquid (mercury or alcohol) expands and the liquid column rises up in the tube.

5. (c) 15 million degrees Celsius

The temperature at the core of the Sun is approximately 15 million degrees Celsius. This extremely high temperature enables nuclear fusion reactions.

6. (b) Air temperature

Room thermometers hung on walls are used to measure air temperature (room temperature) to give an approximate idea of the temperature in that space.

7. (c) Heat sensors

Digital thermometers use heat sensors (thermistors) to detect temperature. These electronic sensors convert temperature changes into electrical signals that are displayed digitally.

8. (c) Temperature remains constant

When water is boiling, the temperature remains constant at 100 °C (at sea level). The heat energy supplied is used for the phase change rather than increasing temperature.

9. (b) Système International (International System)

SI stands for Système International, which means International System in French. It is the modern form of the metric system used worldwide for scientific measurements.

10. (a) Plural for temperatures more than one

The word 'degree' should be written in plural (degrees) for temperatures more than one. For example: "25 degrees Celsius" but "1 degree Celsius".

SECTION B - Answers to Short Answer Questions

11. Importance of holding thermometer vertically:

Why it is important: It is important to hold a laboratory thermometer vertically (not tilted) while

measuring temperature because this ensures that we can read the level of the liquid column accurately against the scale markings on the thermometer.

Error that can occur if not done: If the thermometer is tilted or held at an angle, it becomes very difficult to determine the exact level where the top of the liquid column meets the scale. This creates a reading error because we cannot accurately identify which mark on the scale corresponds to the liquid level. The tilted position distorts our view of the liquid column's true height, leading to incorrect temperature measurement.

12. Three temperature scales and their symbols:

The three commonly used temperature scales are:

1. **Celsius scale** - Symbol: °C (degree Celsius)
Example: 37 °C

2. **Fahrenheit scale** - Symbol: °F (degree Fahrenheit)
Example: 98.6 °F

3. **Kelvin scale** - Symbol: K (kelvin, without degree symbol)
Example: 310 K

13. Why ice temperature remains constant while heating:

Explanation: When ice is being heated, its temperature remains constant at 0 °C until all the ice completely melts into water. This phenomenon occurs because of the following reason:

During the phase change (solid to liquid), all the heat energy being supplied is used to break the bonds between ice molecules and convert solid ice into liquid water. This energy is called latent heat of fusion. Since all the heat energy is being used for changing the state of matter (from solid to liquid) rather than increasing the temperature, the temperature remains constant at 0 °C.

Only after all the ice has melted into water does the temperature start to rise above 0 °C, because then the heat energy can be used to increase the temperature of water rather than for phase change.

14. Convert 102 °F to Celsius:

Given: Temperature = 102 °F
Formula: C = 5/9 × (F – 32)

Calculation:
C = 5/9 × (102 – 32)
C = 5/9 × 70
C = 5 × 70 ÷ 9
C = 350 ÷ 9
C = 38.89 °C

Answer: 102 °F is equal to approximately 38.89 °C (or about 39 °C).
This indicates the patient has a mild fever since normal body temperature is 37 °C.

SECTION C - Answers to Short Answer Questions

15. Importance of air temperature in weather forecasting:

Explanation: Air temperature is an important weather parameter that plays a crucial role in weather forecasting.

Three reasons why air temperature data is useful for weather forecasting:

1. Predicting weather patterns: Air temperature helps meteorologists predict various weather patterns such as formation of clouds, fog, and precipitation. Temperature differences between air masses drive weather systems. When warm and cold air masses meet, they create weather fronts that bring changes in weather conditions.

2. Understanding seasonal changes: Continuous monitoring of air temperature helps in understanding and predicting seasonal changes. Rising temperatures indicate approach of summer, while falling temperatures signal winter. This information is vital for agriculture, as farmers need to know the right time for sowing and harvesting crops based on temperature patterns.

3. Public safety and planning: Accurate air temperature data helps authorities issue warnings about extreme weather conditions like heat waves or cold waves. This allows people to take necessary precautions. Temperature forecasts also help in planning daily activities, energy consumption (heating/cooling needs), and transportation operations. For example, knowing about sub-zero temperatures helps in preparing for frost and ice on roads.

16. Calculate division value and temperature reading:

Given:
Distance between 20 °C and 40 °C contains 20 small divisions

(a) Value of each small division:
Temperature difference = 40 °C – 20 °C = 20 °C
Number of divisions = 20
Value of one division = 20 °C ÷ 20 = 1 °C

Therefore, each small division represents 1 °C.

(b) Temperature at 7th division after 20 °C:
Starting temperature = 20 °C
Number of divisions beyond 20 °C = 7
Temperature increase = 7 divisions × 1 °C per division = 7 °C
Final temperature = 20 °C + 7 °C = 27 °C

Therefore, the temperature reading is 27 °C.

17. Differences in writing Celsius and Kelvin temperatures:

Three differences between writing Celsius and Kelvin temperature values:

1. Use of degree symbol:
• Celsius uses the degree symbol (°): We write 25 °C
• Kelvin does NOT use the degree symbol: We write 298 K (not 298 °K)
Example: Room temperature is 25 °C or 298 K

2. Starting point reference:
• Celsius scale starts from 0 °C (freezing point of water). Negative values are possible: –10 °C, –273.15 °C
• Kelvin scale starts from absolute zero (0 K). There are NO negative values in Kelvin scale. The lowest possible temperature is 0 K
Example: Freezing point of water is 0 °C or 273.15 K

3. Unit name capitalization:

• In Celsius, the word "degree" starts with lowercase 'd', but "Celsius" is capitalized when writing full form: "degree Celsius" or "degrees Celsius"
• In Kelvin, the unit name starts with lowercase 'k' when written in full: "kelvin" (not "Kelvin" except when referring to Lord Kelvin himself)
Example: "The temperature is twenty-five degrees Celsius" or "The temperature is two hundred ninety-eight kelvin"

SECTION D - Answer to Long Answer Question

18. Teaching students to measure hot water temperature:

LESSON PLAN: Measuring Temperature of Hot Water Using Laboratory Thermometer

STEP-BY-STEP PROCEDURE:

Step 1 - Preparation and Safety:
"Dear students, today we will learn to measure the temperature of hot water. First, please wear safety goggles if available and be very careful as we are working with hot water which can cause burns. Keep a safe distance from the beaker and never touch hot surfaces."

Step 2 - Examine the Thermometer:
"Before starting, carefully observe your laboratory thermometer. Notice the range marked on it (usually –10 °C to 110 °C). Count the divisions between markings to understand what value each small division represents. Handle the thermometer very gently as it is made of glass and can break easily."

Step 3 - Set Up the Equipment:
"Place the beaker containing hot water on a stable, flat surface. Use a stand and clamp to hold the thermometer. This is important because it keeps the thermometer steady and at the correct position."

Step 4 - Position the Thermometer Correctly:
"Now, carefully immerse the thermometer in the hot water. Make sure:
• The bulb (bottom rounded part) is completely immersed in the water
• The bulb DOES NOT touch the bottom of the beaker
• The bulb DOES NOT touch the sides of the beaker
• The thermometer is held VERTICALLY (straight up and down), not tilted"

Step 5 - Wait for Stabilization:
"Wait for about 30 seconds to 1 minute without disturbing the setup. Watch the liquid column inside the thermometer - it will rise and then stop moving when it reaches the water's temperature."

Step 6 - Read the Temperature:
"To read the temperature correctly:
• Keep your eyes at the SAME LEVEL as the top of the liquid column
• Read the temperature while the thermometer is STILL in the water (do not take it out!)
• Note the mark where the top of the liquid column is pointing
• Record this temperature in your notebook"

Step 7 - Repeat if Necessary:
"To ensure accuracy, you may take 2-3 readings and calculate the average."

Step 8 - Careful Removal:
"After completing your measurement, carefully remove the thermometer from the water and place it safely in its holder."

COMMON MISTAKES STUDENTS MAKE AND HOW TO AVOID THEM:

Mistake 1 - Bulb touching bottom or sides:
Problem: The bottom and sides of beaker are directly heated and are much hotter than the water itself.
Solution: Always ensure there is space between the bulb and the container. Use a stand and clamp to maintain proper position.
Why it matters: This will give you the temperature of the beaker material, not the water.

Mistake 2 - Taking thermometer out before reading:
Problem: Many students take the thermometer out of water and then try to read it.
Solution: Teach students to read while the thermometer is still immersed.
Why it matters: The liquid column starts falling immediately when removed from hot water, giving a lower (incorrect) reading.

Mistake 3 - Tilting the thermometer:
Problem: Students sometimes hold the thermometer at an angle.
Solution: Always hold it perfectly vertical using a stand and clamp.
Why it matters: Tilting makes it very difficult to read the exact level of liquid column against the scale.

Mistake 4 - Wrong eye position while reading:
Problem: Students read from above or below the liquid level.
Solution: Teach them to position their eyes exactly at the level of the liquid column top.
Why it matters: This causes parallax error, giving incorrect readings.

Mistake 5 - Not waiting for stabilization:
Problem: Students try to read immediately after inserting the thermometer.
Solution: Wait until the liquid column stops rising.
Why it matters: The thermometer needs time to reach thermal equilibrium with the water.

Mistake 6 - Rough handling:
Problem: Students may handle the thermometer carelessly.
Solution: Always remind students that thermometers are fragile. Hold them gently and place them safely when not in use.
Why it matters: Thermometers can break easily, and broken thermometers may spill mercury (if it's a mercury thermometer) which is toxic.

FINAL TIPS FOR STUDENTS:
• Practice makes perfect - the more you practice proper technique, the better your measurements will be
• Always record your observations immediately in your notebook
• If you get an unusual reading, repeat the measurement
• Never hesitate to ask your teacher if you're unsure about any step
• Safety first - always be careful around hot water and glass equipment

SECTION E - Answers to Case Study Based Questions

19. Case Study 1 - Answers:

(a) Principle demonstrated by Group A:
Group A was demonstrating the principle that our sense of touch is not reliable for judging temperature accurately. They showed that the same water can feel hot or cold to different hands depending on the previous temperature conditions those hands were exposed to. This proves that we need a thermometer (not just our sense of touch) to measure temperature objectively and reliably. (1 mark)

(b) Most accurate thermometer for tap water:

The laboratory thermometer would give the most accurate reading for tap water temperature. This is because:
• Laboratory thermometers have a wide range (–10 °C to 110 °C) that includes typical tap water temperature (usually 20-30 °C)
• Clinical thermometers have too narrow a range (35-42 °C) and might not even register tap water temperature
• Room thermometers are less precise and designed for air temperature, not for immersion in water
The laboratory thermometer is specifically designed for measuring liquid temperatures in such situations. (1 mark)

(c) Error from using clinical thermometer for tap water:
Group B would get an error if they used a clinical thermometer for measuring tap water because:
• Tap water temperature is typically around 20-30 °C (at room temperature) or even lower if it's cold water
• Clinical thermometers have a range starting from 35 °C
• Since tap water temperature is below 35 °C (outside the range of clinical thermometer), the thermometer would not show any reading at all, or might show the lowest mark (35 °C) even though the actual temperature is lower
• Clinical thermometers are simply not designed to measure temperatures below body temperature range. (1 mark)

(d) Conclusion about body temperature variation:
Based on their observations, Group C would likely conclude that human body temperature is NOT constant throughout the day - it varies naturally based on time of day and activity level. They would observe that body temperature is typically:
• Lower in early morning (after rest)
• Gradually increases during the day
• May be slightly higher after physical activity or meals
• Decreases in evening and night
These variations (typically 0.5-1 °C) are normal and do not indicate illness. This is why we call 37.0 °C the "average" normal temperature. (1 mark)

20. Case Study 2 - Answers:

Given data:
City X: Max 32 °C, Min 24 °C
City Y: Max 18 °C, Min 10 °C
City Z: Max 42 °C, Min 28 °C

(a) Highest and lowest temperatures:
City Z had the highest temperature at 42 °C (maximum temperature).
City Y had the lowest temperature at 10 °C (minimum temperature).
Note: City Z (desert) has very high temperatures while City Y (hill station at high altitude) has much lower temperatures. (1 mark)

(b) Temperature range for each city and greatest range:
Temperature range = Maximum temperature – Minimum temperature

City X: Range = 32 – 24 = 8 °C
City Y: Range = 18 – 10 = 8 °C
City Z: Range = 42 – 28 = 14 °C

City Z (desert region) had the greatest temperature range of 14 °C.

This makes sense because deserts typically experience large temperature fluctuations between day and night - very hot during the day (due to direct sunlight and low humidity) and relatively cooler at night (due

to rapid heat loss). (1 mark)

(c) Why water boils at 93 °C in City Y:
Water boils at 93 °C in City Y (instead of 100 °C) because City Y is at a high altitude (2000m). At higher altitudes:
• Atmospheric pressure is lower than at sea level
• Water molecules need less energy to escape from the liquid surface
• Therefore, water boils at a lower temperature

The boiling point of water depends on atmospheric pressure. At sea level, atmospheric pressure is higher, so water boils at 100 °C. As we go higher (like in hill stations), pressure decreases and boiling point decreases. This is why places like Shillong also recorded water boiling at 97-98 °C instead of 100 °C. (1 mark)

(d) Convert 42 °C to Kelvin scale:
Formula: Temperature in K = Temperature in °C + 273.15

Temperature in K = 42 + 273.15
Temperature in K = 315.15 K

Therefore, City Z's maximum temperature of 42 °C is equal to 315.15 K. (1 mark)
