Chapter 3 - Heat- Textbook Exercise -(Solved)

Exercises

State similarities and differences between the laboratory thermometer and the clinical thermometer.

Answer Similarities-

- Both laboratory and clinical thermometers are used to measure temperature.
- They both use the Celsius (°C) scale for temperature measurement.

Differences-

- Clinical thermometers are designed for measuring human body temperature, while laboratory thermometers are used for various scientific and industrial purposes.
- Clinical thermometers have a limited temperature range typically around 35°C to 42°C, whereas laboratory thermometers have a broader range, typically from -10°C to 110°C.
- Clinical thermometers often have a shorter and thicker design with a kink to prevent mercury from falling back, while laboratory thermometers are longer and narrower.
- Clinical thermometers are generally more delicate and have to be shaken down before each use, while laboratory thermometers are sturdier and do not require shaking.

Also Check - Class 7 science -Chapter 4 – Heat -Complete Notes

Give two examples each of conductors and insulators of heat.

Conductors of Heat-

- Example 1- Copper
- Example 2- Aluminium

Insulators of Heat-

- Example 1- Wood
- Example 2- Plastic

Also Check - Class 7 science -Chapter 4 – Heat – Definition and Explanation of Important Keywords

Fill in the blanks-

(a) The hotness of an object is determined by its **temperature**.

(b) Temperature of boiling water cannot be measured by a **clinica**l thermometer.

(c) Temperature is measured in degrees **Celsius**.

(d) No medium is required for transfer of heat by the process of **radiation**.

(e) A cold steel spoon is dipped in a cup of hot milk. Heat is transferred to its other end by the process of **conduction**.

(f) Clothes of **dark colours** absorb more heat better than clothes of light colours.

Match the Following-

(i) Land breeze blows during -**(c) day**

(ii) Sea breeze blows during- **(d) night**

(iii) Dark coloured clothes are preferred during- **(b) winter**

(iv) Light coloured clothes are preferred during -**(a) summer**

Also Check - Sea Breezes and Land Breezes – Class 7 Science explained

Discuss why wearing more layers of clothing during winter keeps us warmer than wearing just one thick piece of clothing.

Answer - Wearing more layers of clothing during winter keeps us warmer than wearing just one thick piece of clothing due to the following reasons-

- **Insulation-** Multiple layers of clothing create pockets of air between them. Air is a poor conductor of heat, and these air pockets act as insulation, preventing the loss of body heat to the cold environment.
- **Adjustable Comfort-** Layering allows for flexibility and control over your comfort level. You can add or remove layers depending on the temperature, ensuring you stay comfortable throughout the day.
- **Moisture Control-** Layering allows for better moisture management. The inner layer (usually a moisture-wicking material) helps absorb sweat and keeps your skin dry, while the outer layers protect against the cold and wind.
- **Trap Heat-** Each layer traps a bit of body heat, and this cumulative effect helps to keep you warm. It's like having multiple barriers against the cold.
- **Ventilation-** Layering also provides opportunities for ventilation. If you start feeling too warm, you can unzip or remove a layer to release excess heat and maintain comfort.

Look at Fig. 3.13. Mark where the heat is being transferred by conduction, by convection, and by radiation.

Answer-

- Heat transfer by conduction occurs from the flame to the bottom of the container where the flame touches the metal surface.

- Heat transfer by convection happens as the warmer water near the bottom rises, and cooler water near the top sinks, creating a circulating motion.
- Heat transfer by radiation occurs from the flame to the sides and top of the container as the heat is emitted in the form of electromagnetic waves.

[Also Check - Conduction, Convection, and Radiation- Class 7 Science Explained]

In places of hot climate, it is advised that the outer walls of houses be painted white. Explain.

Answer-

Painting the outer walls of houses white in places with hot climates is advised because white or light-coloured surfaces reflect most of the sunlight (radiation) that falls on them. This reflection prevents the walls from absorbing and trapping heat. Here's why it's effective-

- **Reflective Properties-** White surfaces have high reflectivity, meaning they bounce back a significant portion of the incoming sunlight. This prevents the walls from heating up excessively.
- **Heat Absorption-** Dark-coloured surfaces, on the other hand, absorb a substantial amount of solar radiation, causing them to become very hot. When the walls of a house absorb heat, it can make the interior of the house uncomfortably warm.
- **Cooler Interiors-** By painting the walls white, less heat is absorbed, and the interior of the house remains cooler. This helps in reducing the need for air conditioning and lowers energy consumption, making the house more energy-efficient and comfortable during hot weather.

One litre of water at 30°C is mixed with one litre of water at 50°C. The temperature of the mixture will be - (a) 80°C (b) more than 50°C but less than 80°C (c) 20°C (d) between 30°C and 50°C

Answer -(b) more than 50°C but less than 80°C

Explanation-

When two equal volumes of water at different temperatures are mixed together, the final temperature of the mixture will be between the initial temperatures of the two volumes of water. In this case, the water at 30°C and 50°C are mixed-

- The final temperature will be somewhere between 30°C and 50°C because it's a blend of the two temperatures.
- It will be more than 50°C (the temperature of one of the water samples) but less than 80°C (the sum of both temperatures).

So, the correct answer is (b) more than 50°C but less than 80°C.

An iron ball at 40°C is dropped in a mug containing water at 40°C. The heat will- (a) flow from iron ball to water. (b) not flow from iron ball to

water or from water to iron ball. (c) flow from water to iron ball. (d) increase the temperature of both.

Answer - (b) not flow from the iron ball to water or from water to the iron ball.

Explanation-

When the iron ball and water are at the same temperature (both at 40°C), there will be no net heat flow between them. Heat will not flow from the iron ball to the water or from the water to the iron ball because they are already at thermal equilibrium (the same temperature). There is no temperature difference to drive the heat transfer.

A wooden spoon is dipped in a cup of ice cream. Its other end- (a) becomes cold by the process of conduction. (b) becomes cold by the process of convection. (c) becomes cold by the process of radiation. (d) does not become cold.

Answer- (d) does not become cold.

Explanation-

Wood is a poor conductor of heat. When the wooden spoon is dipped in ice cream, its other end does not become cold because wood does not efficiently transfer heat. Therefore, the temperature of the wooden spoon remains relatively stable, and it does not become cold as quickly as materials with better heat conductivity.

Stainless steel pans are usually provided with copper bottoms. The reason for this could be that - (a) copper bottom makes the pan more durable. (b) such pans appear colourful. (c) copper is a better conductor of heat than stainless steel. (d) copper is easier to clean than stainless steel.

Answer - (c) copper is a better conductor of heat than stainless steel.

Explanation-

Copper is a better conductor of heat compared to stainless steel. Stainless steel alone is not as efficient at conducting heat. By providing stainless steel pans with copper bottoms, heat is distributed more evenly across the cooking surface. This ensures that the entire pan heats up uniformly and helps in cooking food evenly. Additionally, copper also offers good heat responsiveness, allowing for quick adjustments to temperature changes while cooking.

Extended Learning - Activities and Projects-

Activity 1- Observing a Doctor Taking Temperature-

(a) Why does the doctor dip the thermometer in a liquid before use?

Answer- The doctor dips the thermometer in a liquid, often an antiseptic solution, before use to ensure that it is clean and free from any potential germs or contaminants. This helps maintain hygiene and prevents the spread of infections between patients.

(b) Why is the thermometer kept under the tongue?

Answer- The thermometer is placed under the tongue because the mouth provides a convenient and accurate location for measuring body temperature. The temperature under the tongue closely reflects the core body temperature, which is essential for accurate medical diagnosis.

(c) Can the body temperature be measured by keeping the thermometer at some place other than the mouth?

Answer- Yes, body temperature can be measured at various locations other than the mouth, depending on the medical need. Common alternative locations include the armpit (axillary measurement), ear (tympanic measurement), and forehead (temporal measurement). Different methods may be used based on the patient's condition and the type of thermometer being used.

(d) Is the temperature of different parts of the body the same or different?

Answer- The temperature of different parts of the body can vary slightly. The core body temperature, typically measured orally, is relatively consistent and reflects the overall body temperature. However, the extremities (like hands and feet) may have slightly lower temperatures compared to the core. Additionally, the forehead and armpit measurements may show slight variations from the oral measurement, but they are generally in the same range. Different parts of the body can have varying temperatures due to factors like blood circulation and exposure to external conditions.

Question- Go to a veterinary doctor (a doctor who treats animals). Discuss and find out the normal temperature of domestic animals and birds.

Answer- Domestic animals and birds have different normal body temperatures. Here are the approximate normal body temperatures for some common domestic animals and birds-

- **Dogs-** The normal body temperature for dogs ranges from 99.5°F to 102.5°F (37.5°C to 39.2°C).
- **Cats-** Cats have a normal body temperature similar to dogs, ranging from 100.5°F to 102.5°F (38.1°C to 39.2°C).
- **Cattle-** The normal body temperature for cattle is around 101.5°F to 103.5°F (38.6°C to 39.7°C).
- **Horses-** Horses typically have a normal body temperature ranging from 99°F to 101°F (37.2°C to 38.3°C).
- **Birds-** The normal body temperature for birds can vary depending on the species. On average, it's around 105°F (40.6°C) for most birds.

Please note that these temperatures can vary slightly among individual animals and may change in response to various factors, including age, activity level, and health.

Question- Wrap a thin paper strip tightly around an iron rod. Try to burn the paper with a candle while rotating the iron rod continuously. Does it burn? Explain your observation.

Answer- No, the paper does not burn when wrapped tightly around an iron rod and rotated continuously. This phenomenon can be explained by the process of convection and the fact that air is a poor conductor of heat.

When the paper is wrapped around the iron rod and rotated, the heat from the candle flame is quickly conducted away by the iron rod. This prevents the paper from reaching its ignition temperature (the temperature at which it can catch fire). Additionally, as the air around the paper heats up, it rises due to convection, further cooling the paper and preventing it from burning.

In summary, the continuous rotation of the iron rod helps dissipate the heat, making it difficult for the paper to reach the temperature required for combustion. This experiment demonstrates how heat can be efficiently conducted away from an object, preventing it from catching fire.

Question- Take a sheet of paper. Draw a spiral on it as shown in Fig. 3.14. Cut out the paper along the line. Suspend the paper as shown in Fig. 3.14 above a lighted candle. Observe what happens. Think of an explanation.

Answer--When you suspend the paper spiral above a lighted candle, you will observe that the paper spiral begins to rotate slowly. This rotation occurs because of the principle of convection, which is driven by the movement of hot air.

Explanation-

- **Heating of Air-** The candle flame produces heat, causing the air around it to become hot. Hot air is lighter and less dense than cold air, so it rises.
- **Upward Air Current-** As the hot air rises, it creates an upward current. This current of hot air moves upward, carrying the paper spiral with it.
- **Rotation of the Spiral-** The paper spiral is suspended in the rising current of hot air. As the hot air flows upwards along the spiral's surface, it creates a difference in air pressure. The lower pressure on one side of the spiral compared to the other side results in a rotating motion.
- **Convection Current-** The continuous rising of hot air and the resulting rotation of the spiral create a convection current. This current causes the spiral to spin or rotate above the candle flame.

In summary, the rotation of the paper spiral is a visual demonstration of convection currents. As hot air rises, it carries the paper upward and creates a spinning motion due to differences

in air pressure, resulting in the observed rotation. This experiment showcases how heat can drive the movement of air, leading to fascinating effects like the rotating paper spiral.

Question- Take two similar transparent glass bottles having wide mouths. Put a few crystals of potassium permanganate or pour a few drops of ink in one bottle. Fill this bottle with hot water. Fill the other bottle with cold water. Cover the cold water bottle with a thick piece of paper such as a postcard. Press the postcard firmly with one hand and hold the bottle with the other hand. Invert the bottle and place it on top of the hot water bottle. Hold both the bottles firmly. Ask some other person to pull the postcard. Observe what happens. Explain.

Answer-

When you perform this experiment, you will observe an interesting phenomenon known as a "liquid transfer" or "liquid exchange" due to the principles of convection and temperature differences.

Explanation-

- **Temperature Difference**- Initially, one bottle contains hot water, while the other contains cold water. The hot water bottle contains water at a higher temperature, while the cold water bottle has water at a lower temperature.
- **Convection Currents-** Hot water is less dense and rises, while cold water is denser and sinks. This creates convection currents within each bottle. In the hot water bottle, hot water rises and mixes with the water containing potassium permanganate or ink. In the cold water bottle, cold water sinks.
- **Pressure Difference-** As the hot water rises in the hot water bottle, it displaces the air above it, creating lower pressure. In contrast, the cold water bottle has air trapped above the cold water, creating higher pressure.
- **Postcard Seal-** The thick piece of paper (postcard) seals the mouth of the cold water bottle, preventing air from escaping or entering the bottle. This effectively traps the higher-pressure air inside the cold water bottle.
- **Inversion and Pulling-** When you invert the cold water bottle and place it on top of the hot water bottle and someone else pulls the postcard, the pressure difference becomes significant. The higher-pressure air inside the cold water bottle pushes against the lower-pressure air in the hot water bottle.
- **Liquid Transfer-** Due to this pressure difference, the higher-pressure air forces its way into the hot water bottle, displacing some of the hot water. Simultaneously, the lower-pressure air from the hot water bottle enters the cold water bottle. This exchange of air results in liquid (coloured water) transferring from the cold water bottle to the hot water bottle, creating a colourful display.

In summary, the experiment demonstrates the principles of convection and pressure differences. The temperature disparity between the hot and cold water bottles drives convection currents, and the pressure difference caused by sealing one bottle with a postcard leads to the transfer of liquid from one bottle to another when the seal is broken.