

## O Level Physics

### Unit 8: Temperature

#### Principles of Thermometry

- 1) Ice point: The temperature of pure melting ice at one atmospheric pressure.  
Steam point: The temperature of steam from pure boiling water at one atmospheric pressure.
- 2) A thermometer makes use of a physical property which changes evenly and continuously with temperature. The physical property of any thermometer is directly proportional to the temperature.
- 3) **Suggest a procedure for constructing a temperature scale in an unmarked thermometer. State the assumption made in your procedure.**

*Step1: Record the values of the physical property of the thermometer at the lower and upper fixed points. The ice point and steam point can be obtained by measuring the values of the physical property when placed in pure melting ice and steam from pure boiling water at standard atmospheric pressure respectively.*

*Step2: Divide the temperature range between the two fixed points into intervals to obtain a scale.*

*Assumption made: The physical property varies evenly and continuously with changing temperature.*

- 4) 
$$\theta^{\circ}\text{C} = \frac{l_{\theta} - l_0}{l_{100} - l_0} \times 100$$
 where  $l$  is the physical property of the thermometer.

Physical Property	Thermometer
Volume of fixed mass of liquid with increasing temperature	Mercury-in-glass thermometer
Electromotive force produced with increasing temperature difference	Thermocouple thermometer
Resistance of platinum wire with increasing temperature	Resistance thermometer

- 6)  $\text{Temp/K} = \text{Temp}/^{\circ}\text{C} + 273$   
 $1\text{K} = 1^{\circ}\text{C}$

7)

Property	Definition	Ways to increase efficiency
Sensitivity	Change in length of mercury thread with temp increase of 1°C	<ol style="list-style-type: none"> <li>1. Narrow the bore of the capillary tube. This allows a more noticeable expansion of mercury thread with a small temp change.</li> <li>2. Increase the volume of the liquid. This allows greater liquid expansion and hence a larger increase in thread length with a small temp change.</li> </ol>
Responsiveness	The time taken for the thermometer to register a 1°C temp change.	<ol style="list-style-type: none"> <li>1. Decrease volume of liquid in the bulb. A smaller amount of liquid has lower heat capacity and thus less time is needed to register temp changes.</li> <li>2. Choose thermometric liquids with lower specific heat capacity. Such liquids heat up faster and hence less time is needed to register temp change.</li> </ol>
Range		<ol style="list-style-type: none"> <li>1. Choosing an appropriate thermometric liquid.</li> <li>2. Increasing length of capillary tube. A longer tube allows larger expansion of liquid and allows measurements of wider temp ranges.</li> </ol>

#### Thermocouple thermometers

- 8) The thermometric property used in the thermocouple thermometer is the variation of the voltage generated with increasing temp difference between the cold and hot junctions.
- 9) The cold junction of the thermocouple is placed at ice point (in pure melting ice) while the hot junction is placed in the object to be measured. This temp difference generates an EMF and a millivoltmeter calibrated in °C is used to measure the temperature.
- 10) Main advantages of thermocouple thermometers:
1. It has a wide temp range of -200°C to 1500°C and thus can be used to measure high temps.
  2. It is very responsive to rapidly changing temperatures because of its low heat capacity. Its low heat capacity is due to small mass and because metals are good conductors of heat.

Notes: