

Thermal Properties of Matter — CBSE Pattern Test 1

Class 11 Physics · 90 minutes · 40 marks · Sections A–D with answer key · Narayan Gurukul Academy

Test 1 — CBSE Pattern (90 minutes, 40 marks)

Class 11 Physics · Thermal Properties of Matter · Narayan Gurukul Academy (ClassApna)

General Instructions: (1) This paper has four sections — Section A (1×10), Section B (2×4), Section C (3×4) and Section D (5×2) — total 40 marks. Time allowed: 90 minutes.

(2) All questions are compulsory. No overall choice is given; internal choice, where allowed, is clearly marked.

(3) For MCQ questions choose the single correct option; for VSA answers write a single line.

(4) Take $g = 10 \text{ m/s}^2$. All symbols carry their usual meaning. Use of a calculator is not permitted.

Section A — MCQ & VSA ($10 \times 1 = 10$ marks)

- The boiling point of water in the Fahrenheit scale is
 - 212 °F
 - 100 °F
 - 180 °F
 - 320 °F
- Absolute zero is approximately
 - −273.15 °C
 - 0 °C
 - 273.15 °C
 - −100 °C
- A change of 1 kelvin is equal to a change of
 - 1 °C
 - 1 °F
 - 1.8 °C
 - $9/5$ °C
- Heat always flows from
 - a body at higher temperature to one at lower temperature
 - a body of larger mass to one of smaller mass
 - a solid to a liquid
 - a body at higher pressure to lower pressure
- For a solid, the relation between the volume (γ) and linear (α) expansion coefficients is
 - $\gamma = 3\alpha$
 - $\gamma = 2\alpha$
 - $\gamma = \alpha$
 - $\gamma = \alpha/3$
- The coefficient of superficial expansion β is related to α by
 - $\beta = 2\alpha$
 - $\beta = 3\alpha$
 - $\beta = \alpha$
 - $\beta = \alpha/2$
- Water has its maximum density at
 - 4 °C

- (B) 0 °C
- (C) 100 °C
- (D) 37 °C

8. A bimetallic strip bends on heating because
- (A) its two metals have different expansion coefficients
 - (B) one metal is magnetic
 - (C) the strip is thin
 - (D) its two metals have the same expansion coefficient
9. Define specific heat capacity and give its SI unit.
10. State Newton's law of cooling.

Section B — Short Answer I (4 × 2 = 8 marks)

11. How much heat is required to raise the temperature of 500 g of water from 20 °C to 40 °C? ($c = 4200 \text{ J kg}^{-1} \text{ K}^{-1}$)
12. Convert 98.6 °F (normal body temperature) to the Celsius scale.
13. A steel rod of length 1 m and coefficient of linear expansion $1.1 \times 10^{-5} \text{ K}^{-1}$ is heated from 20 °C to 120 °C. Find its increase in length.
14. A metal rod of length 0.5 m and cross-section 10^{-4} m^2 has a temperature difference of 100 °C across its ends. If $k = 200 \text{ W m}^{-1} \text{ K}^{-1}$, find the rate of heat flow.

Section C — Short Answer II (4 × 3 = 12 marks)

15. At what temperature do the Celsius and Fahrenheit scales read the same numerical value? Derive your answer.
16. A copper plate has a hole of diameter 1 cm at 20 °C. Find the new diameter of the hole when the plate is heated to 220 °C. ($\alpha = 1.7 \times 10^{-5} \text{ K}^{-1}$)
17. A piece of metal of mass 100 g at 100 °C is placed in 200 g of water at 20 °C in a calorimeter of negligible heat capacity. If the final temperature is 25 °C, find the specific heat of the metal. ($c_{\text{water}} = 4200 \text{ J kg}^{-1} \text{ K}^{-1}$)
18. A body of surface area 0.1 m^2 at 500 K radiates as a black body. Find the power radiated. ($\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$)

Section D — Long Answers (2 × 5 = 10 marks)

19. Find the heat required to convert 200 g of ice at -10 °C to steam at 100 °C . ($c_{\text{ice}} = 2100$, $c_{\text{water}} = 4200$, $L_f = 3.34 \times 10^5$, $L_v = 2.26 \times 10^6 \text{ J kg}^{-1}$)
20. Explain heat transfer by conduction, convection and radiation with examples, describe the greenhouse effect, and state Stefan's law and Wien's displacement law.

Answer Key (Marking Scheme)

- Q1 — (A) 212 °F. Q2 — (A) -273.15 °C . Q3 — (A) 1 °C. Q4 — (A) higher to lower temperature.
- Q5 — (A) $\gamma = 3\alpha$. Q6 — (A) $\beta = 2\alpha$. Q7 — (A) 4 °C. Q8 — (A) different expansion coefficients.
- Q9 — Specific heat capacity: heat needed to raise the temperature of unit mass by 1 K; SI unit $\text{J kg}^{-1} \text{ K}^{-1}$.
- Q10 — The rate of cooling of a body is proportional to the temperature excess over the surroundings.
- Q11 — $Q = mc\Delta T = 0.5 \times 4200 \times 20 = 4.2 \times 10^4 \text{ J}$.
- Q12 — $T = (98.6 - 32) \times 5/9 = 37 \text{ °C}$.
- Q13 — $\Delta l = \alpha l \Delta T = 1.1 \times 10^{-5} \times 1 \times 100 = 1.1 \text{ mm}$.

Q14 — $H = kA\Delta T/l = 200 \times 10^{-4} \times 100 / 0.5 = 4 \text{ W}$.

Q15 — $x = 5/9(x - 32)$ $\Rightarrow x = -40$. At -40° both scales read the same.

Q16 — $\Delta d = \alpha d \Delta T = 1.7 \times 10^{-5} \times 1 \times 200 = 3.4 \times 10^{-3} \text{ cm}$; new diameter $\approx 1.0034 \text{ cm}$.

Q17 — $0.1 \text{ c } (100 - 25) = 0.2 \times 4200 \times 5 \Rightarrow = 560 \text{ J kg}^{-1} \text{ K}^{-1}$.

Q18 — $P = \sigma AT^4 = 5.67 \times 10^{-8} \times 0.1 \times (500)^4 \approx 354 \text{ W}$.

Q19 — $4200 + 66800 + 84000 + 452000 = 6.07 \times 10^5 \text{ J}$.

Q20 — Conduction: adjacent molecules transfer energy ($kA\Delta T/l$); convection: bulk motion of a fluid (sea breezes); radiation: electromagnetic waves needing no medium (heat from the Sun). Greenhouse gas layers trap outgoing IR; Stefan: $E \propto T^4$; Wien: $\lambda_{\text{max}} T = \text{constant}$.